

Canadian Transportation Research Forum

Le Groupe de Recherches sur les Transports au Canada

GOING THE DISTANCE
Franchir le fil d'arrivée

PROCEEDINGS of the 29th Annual Meeting

ACTES de la 29ième Conférence annuelle

Victoria
B. C. / C.-B.
May 15-18,
15 au 18 mai,
1994

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President's Message
Welcome to CTRF's 29th Annual Conference

These Proceedings include the papers presented to CTRF's 29th Annual Conference in Victoria, British Columbia, May 15 to May 18, 1994. In keeping with CTRF's goal of value added benefits to our members, the best papers from our student paper competition are also included. A summary of the plenary and panel discussions will be made available at a later date.

This year's conference organizers, Jonathan Seymour and George Clark have lived up to the conference theme of "Going the Distance". They have left no stone unturned in developing an exciting and valuable conference. On behalf of the CTRF membership I would like to thank Jonathan and George as well as the many other enthusiastic and willing participants that are necessary to make an undertaking of this nature a success.

Bill Raney
President

◂ ▸

Message du Président
Bienvenue à la 29ième Conférence annuelle

Ce livre renferme une copie de tous les textes présentés à la 29ième Conférence annuelle du GRTC tenue á Victoria en Colombie-britannique du 15 au 18 mai 1994. Afin de s'en tenir á l'objectif du GRTC de toujours en donner plus à ses membres, une copie des meilleurs textes de notre concours pour étudiants(es) y a aussi été incorporée. Un sommaire des discussions lors de la séance plénière et des séances avec panel sera disponible à une date ultérieure.

Cette année, Jonathan Seymour et George Clark, qui ont vu à l'organisation de la conférence, ont multiplié les efforts pour "Franchir le fil d'arrivée" et ainsi réaliser le thème de la conférence. Ils ont franchi tous les obstacles et ils nous ont organisé une conférence excitante et informative. Au nom de tous les membres du GRTC, je tiens à remercier Jonathan et George ainsi que toutes les personnes enthousiastes qui ont participé et qui ont été nécessaires au succès de cette conférence.

Bill Raney
Président

CTRF is . . .
a broadly based network of transportation professionals with an interest in research and commentary on public policy issues. Membership is open to anyone interested in any aspect of transportation.

CTRF's objectives are . . .
* to encourage transportation research in those disciplines which address themselves to the economic, managerial, technical, political, and social aspects of transportation.
* to provide a common meeting ground to exchange ideas and research results.
* to provide a forum for presenting and discussing transportation issues.
* to bring together persons involved with Canada's transportation systems.

CTRF's program consists of . . .
* a national conference with research papers, panel discussions, and invited speakers held annually in a different Canadian location.
* published proceedings of the national conference.
* a one-day semi-annual conference on a topic of national interest.
* regional seminars promoted and co-sponsored with other organizations.
* an annual CTRF student paper competition
* the CTRF Scholarship Fund
* a newsletter published five times a year.

Le GRTC est . . .
un groupe de professionnels(les) en transport intéressés(ées) à la recherche et aux questions de politiques publiques. Être membre du GRTC convient à quiconque s'intéresse aux transports.

Les objectifs du GRTC sont . . .
* d'encourager la recherche dans les domaines suivants liés aux transports: économie, gestion, technologie, politique et aspect social.
* de fournir un lieu de rencontre pour échanger idées et résultats de recherche.
* de créer un forum pour présenter et discuter de questions de transport.
* de réunir les personnes intéressées au système canadien de transport.

Au programme du GRTC . . .
* une conférence nationale annuelle avec site variable au Canada, qui consiste en une présentation de textes, tables rondes, conférenciers invités.
* la publication des textes présentés à la conférence nationale.
* une conférence semi-annuelle d'une journée sur un sujet d'intérêt national.
* la promotion et le parrainage de colloques régionaux avec d'autres organismes.
* un concours annuel de textes d'étudiants(es)
* un fonds permettant de décerner des bourses
* un bulletin de nouvelles publié cinq fois l'an.

CANADIAN TRANSPORTATION RESEARCH FORUM
LE GROUPE DE RECHERCHES SUR LES TRANSPORTS AU CANADA

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Enhancing the Value Added: Terminals and Logistics in Canada

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Introduction

While all sectors and segments of the freight transportation industry have sought to improve efficiency and reduce costs over the last twenty years, nowhere has this been more evident than in the terminals. Transfer costs have diminished, and throughputs have been speeded up considerably. The gains in productivity, however, have occurred at the expense of added value. Ports, for example, once prided themselves on the jobs they generated and the ancillary functions they engendered. Today, they find themselves as but one of the many links in global logistical chains. Cargoes never stay long enough to generate added value, and so port economic impacts have declined considerably. Thus, while the Canadian economy as a whole may have benefitted from more efficient transfers, locally the effects may have been negative.

This paper begins by discussing the causes and consequences of the declining economic impacts of transportation terminals, with particular emphasis on water and rail facilities. This review provides a backdrop for an analysis of whether or not the increased efficiency of terminals necessarily precludes an enhancement of local benefits. Here, the link is established between the form of terminal development and the nature of transport policy. In Canada, the absence of any transport policy has led individual operators to adopt strategies regarding their terminals based on purely commercial considerations. In Europe, where some member states of the Community are developing more integrated transport policies, terminals are evolving in differently. Enhancing the added value has become a policy objective, and terminals are being used as instruments in regional planning.

Because the basic geography of Europe, and its political and public policy culture are so different, realistic comparisons with Canada are difficult to make. Nevertheless, it is important to evaluate policy developments occurring in Europe since there may be elements that are relevant, and we may learn from their

mistakes. The paper concludes by discussing the applicability of some of the approaches to Canadian conditions.

Terminal Developments in Canada

Historically, freight transport terminals have been bottlenecks. The transfer of goods between modes required large amounts of labour, and, because only small amounts of cargo could be transferred each shift, rail cars and ships would spend a long time at rest. Because ships carried more cargo per trip than most other modes, water transport terminals were particularly afflicted by these diseconomies. Up until the 1960s most vessels spent up to 50 per cent of their lives tied up in port (Hilling and Hoyle 1984, p. 9). As Chilcote (1988, p. 127) has pointed out, this was pure overhead to the ship owner, since no revenues were being earned.

Yet, the combination of high costs and lengthy turnarounds generated significant local benefits. Neighbouring communities obtained direct employment from the terminals, and distinct railroad and port working class neighbourhoods emerged in major transportation centres such as Edmonton (Smith 1993) and Halifax (McCalla 1983). In addition, the services required to support the ships and their crews during their lengthy stays in port, gave rise to many shore-based enterprises, such as chandlers, bars, hostels and brothels, which tended to congregate in highly visible and notorious districts that were found in many port cities: the docklands or sailor towns (Hilling 1987), such as Gastown. Even more significant economic benefits were generated by businesses that took advantage of the delays in transfers. Warehousing and freight consolidation grew in association with transport terminals. Manufacturing too, exploiting 'break of bulk' economies, frequently sought out terminal locations. In these ways major Canadian rail centres, such as Winnipeg, and seaports, such as Montreal, established significant warehousing, consolidation and manufacturing activities in areas adjacent to their freight transport terminals.

The transport industry as a whole has made remarkable gains in efficiency and productivity over the last twenty five years. Nowhere has this been more apparent than in the terminals. Because ports and railroad yards were the most obvious bottlenecks in freight transport systems, they have been primary targets for improvement. The progress would not have been possible without the unitization of cargoes. Pallets, piggyback, and containers have transformed freight distribution systems (Mahoney 1985), principally because they facilitate non-manual handling. From the ubiquitous forklift, through piggypackers, to giant post-panamax gantry cranes, rail, road, sea and air terminals have mechanised their operations progressively through the last twenty years. The result has been that productivity and throughput in ports, rail yards, truck stations and airports

have increased significantly. Terminal costs have declined as a component of over all transport costs, and efficiency has improved greatly.

In order to achieve these economies, terminal operators, public and private, have slashed their labour force. While unions have prevented management achieving the size of cuts that are potentially attainable, it is significant that labour inputs are now well below former levels. For example, the number of longshoremen employed in the port of Montreal was cut in half between 1973 and 1978.

Maximising throughput and minimising costs have become the operational imperatives of transportation terminals in Canada. The public and private corporations involved have been driven by these purely commercial considerations. They have renovated old facilities, such as CN's Canport in Montreal and Halterm in the port of Halifax, and others have been built on greenfield sites, such as CP's Vaughan yard in Toronto and the TASK terminal in the port of Montreal. The success of these facilities is evident, because in terms of throughput they compare favourably with comparable terminals anywhere else (Canada Ports Corporation 1991).

Added value - the lost component?

Although Canadian transport terminals are more efficient than ever before, their local economic impacts have diminished. The loss of jobs in the yards is has impacted negatively on many adjacent communities. Manufacturing activity adjacent to transportation terminals has largely disappeared, as former break of bulk advantages have evaporated. Indeed, formerly vital and active areas adjacent to the terminals, and the terminals themselves, have become redundant, objects of urban renewal and revitalisation in non-transportation uses (Desfor 1993). It is difficult to obtain precise measures of these declines, because of the problems with economic impact methodology, but the available evidence points in this direction. For example, in the United States it has been demonstrated that the employment impact of the port of Hampton Roads fell between 1979 and 1984 from 14,623 to 12,738 jobs, despite an increase in cargo traffic (Yochum and Agarwal, 1988). Increased throughput has been achieved in part, therefore, at the expense of added value.

This raises the following questions: are efficiency and maintenance of the added value incompatible in transportation terminals? are local communities that were the beneficiaries of the added value contributed by transportation doomed? Certainly, the trend in Canada would suggest that this so. However, there is practical evidence that efficiency and added value can co-exist. In the port of Rotterdam efforts are being made to enhance the added value without restricting

the operational efficiency of the terminal function. This provides an interesting test case.

The port of Rotterdam Authority is in the process of establishing a number of 'Trade Distribution Centres'(TDCs) and 'Distriparks'. The former are combination offices-warehouses, showrooms and conference rooms. Relatively small (the average centre measures 2,200 square metres), they are intended to accommodate 20 - 30 small companies mainly from the Newly Industrialising Countries (NICs) that otherwise would have difficulty, because of their size, in securing a base in Europe. Individual firms can thus obtain a toehold in Europe for an estimated cost of $50,000 (van Horssen 1990). These 'shares' can be sold if the company wishes to move out. At present eleven TDCs are either planned or in operation, including Taiwan, Korea, Singapore, Thailand, Indonesia, China and Hong Kong, and Malaysia. These serve as incubators of firms that will hopefully grow and establish a presence on their own.

The Distriparks are more substantial. Essentially they are parks for logistics firms. Established on sites adjacent to the port, the container terminals in particular, they provide excellent road and rail access. Three sites are being developed by the port authority: Eemhaven (35Ha), Botlek (55Ha), and Maasvlatke (80Ha). In these parks firms are being established that involve themselves in modern logistics. Although traditional warehousing is a primary activity, the businesses are deeply involved in distribution and supply. They act as supply sources for clients across Europe. They maintain storage facilities within the Distripark, and provide products to clients on a virtual 'just-in-time' basis. In addition, several of the companies perform component assembly and packaging for products destined for the multi-lingual European markets. Sophisticated distribution systems require advanced communication technology. Companies share Rotterdam's 'Teleport' facilities for voice, data, and text transmission (van Horssen, 1989), and are linked to the Customs electronic system, Sagitta.

The distribution companies relieve the foreign manufacturers of dealing directly with markets themselves, which would add considerably to the costs of doing business. Instead, a firm such as Vitesse, which is established in the Eemhaven Distripark, stores and distributes goods for foreign suppliers, as well as providing stock administration, invoicing, modification (re-packaging), and quality control. While many of the firms specialise in import distribution, others, such as Datema, in the Botlek Distripark, handle products for export markets as well.

The TDCs and Distriparks are partial outcomes of deliberate policy initiatives undertaken to address the question of added value by the Rotterdam

authorities. By the late 1980s the Port Authority had recognised that the traditional measures of port performance, including traffic tonnages and TEUs, were inadequate. It chose added value as a function to be maximised in its long term planning. It found that the added value due to port activity had declined from 10.5 billion guilders in 1985 to 9.9 billion guilders in 1989 (Port of Rotterdam, nd). The long term strategic plan calls for the port's added value to grow from 9.9 billion guiders in 1989 to 14.9 billion guilders in 2010. The plan also predicts an increase in employment (from 69,200 in 1989, to 82,700 in 2010 (Port of Rotterdam, nd). Fostering distribution and logistics activity, is a major component of the plan.

Few would deny that the port of Rotterdam has an enviable reputation for efficiency. Yet its recent initiatives demonstrate that port productivity and throughput need not be at variance with objectives of enhancing added value. Indeed, the strategies developed to promote its distribution function actually enhance traffic volumes. The companies established in the Distriparks use the port of Rotterdam in their logistics operations, and the small enterprises in the TDCs that eventually expand are likely to exploit the facilities available in the port. The jobs created in the distribution centres provide direct and indirect benefits for the community. It is a win-win situation for the port of Rotterdam and for the city.

Certainly, no port in Canada is comparable with Rotterdam as a load centre or 'mainport'. However, the issue is not a function of scale. There is no reason to believe that a comparable outcome, on a smaller scale, could not be engendered in Canada. It is more a matter of objectives and policies. The difference with the Canadian situation is that Rotterdam (in common with Hamburg and Antwerp) has adopted a ports policy that is not just concerned with throughput. A broader-based mission has been defined, in which raising added value has been chosen as a primary objective.

One may conclude, therefore, that there is no intrinsic reason for sacrificing added value before the altar of competition. Throughput and economic impact can coexist and complement each other. The difference is one of policy. Through policy interventions, outcomes dissimilar to those experienced in Canada have arisen in Rotterdam. This suggests a role for policy (or the absence thereof) in shaping terminal developments of all kinds. In order to pursue further this link, the paper goes on to review other initiatives and strategies being initiated in other jurisdictions, as a prelude to a discussion of their appropriateness to the transportation industry in Canada.

Terminals as elements in regional and urban planning

There is a long tradition of state intervention in the transportation industry in Europe. This tradition is being carried into the present day at many levels (Whitelegg, 1988). Some of the greatest challenges are being provided by the evolving multimodal, or to use the European term combined, networks.

The most comprehensive planning of an entire system is taking place in Italy. The government has been pursuing a policy of developing an integrated multimodal transport network, in which the establishment of a number of terminals forms a central part. Nine Interporti, or intermodal load centres, have been established. They are strategically located to serve the most important markets. Lombardy (Lachiarella-Segrate), Piedmonte (Rivalta Scrivia and Orbasso), Venezia (Verona and Padua), Tuscany (Livorno-Guasticce), Emilia-Romana (Bologna and Parma), and Campagna (Marchianise-Nola). One of the first was Rivalta Scrivia, which like most of the others, was built on a greenfield site (see Fig. 1). It extends over 203ha, and provides road and rail access, transfer equipment, storage facilities, bonded warehouses, office space, overnight accommodation for truckers, a data processing centre, repair and maintenance facilities. In 1991, it handled 81,200 Teus, and had a throughput of 1.5 million tons of freight of all kinds (Charlier and Ridolfi, 1994). It performs traditional warehousing functions as well as labelling, weighing, and re-packing.

Besides providing the elements of an integrated intermodal system, Italian policy contains a number of other objectives. The terminals are seen as focal points of regional economic development. In southern Italy, they serve as potential growth poles in a traditionally economically depressed region. In the North, they are frequently established to divert growth from chronically congested cities. This was the case with Rivalta Scrivia, which is designed to accommodate intermodal traffic for Genoa, a city lacking any extensive development sites, and with a heavily clogged arteries.

Concerns over congestion are at the heart of an evolving policy towards intermodal terminals elsewhere in Europe. The rise in truck traffic has raised alarms in France, Germany and the EC. Steps are being introduced to tax road freight movements much more heavily, in step with policies designed to boost combined transport. The promotion of 'Freight Traffic Centres' (FTCs), is an important evolving policy in Britain, France and Germany. In the latter, FTCs are being established that emulate the prototype already in operation in Bremen (Holtgen, 1992). The Bremen Guterverkehrszentrum was established in order to centralise the location of firms involved in distribution and logistics in the region. Instead of firms seeking individual premises all over the city, they have been combined in one complex, to reduce traffic flows.

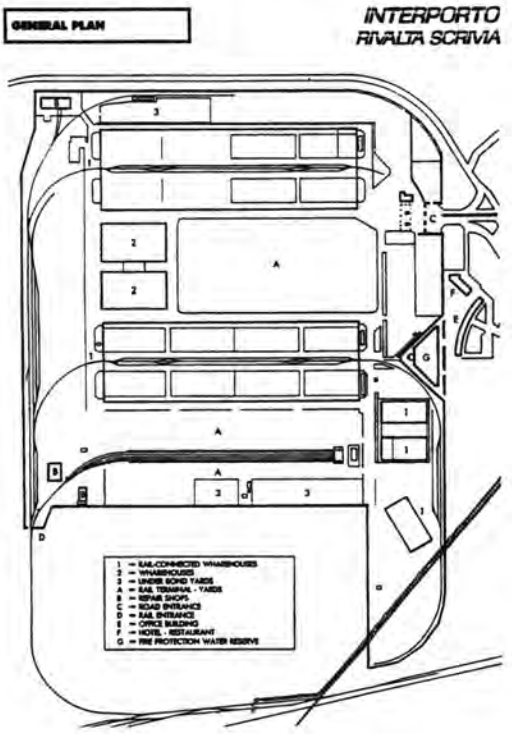


Fig. 1 Site Plan of Rivalta Scrivia, Italy

Both vertical and horizonal cooperation is considered important in policy formulation. Vertical cooperation is where one firm, a freight forwarder for example, buys in the service of a neighbour, a cold storage depot for example, and later when the products are distributed to retail outlets by a local for-hire trucker. Horizontal cooperation is what is referred to in Germany as 'freight exchange' (Holtgen, 1992). Here, consignments from different companies in the centre are pooled, with the help of data interchange, and given to carriers according to availability. In this way small firms are able to offer a wider range of services to more destinations more competitively. At the same time it has contributed to a reduction of urban truck traffic.

Several other benefits have been recorded for the Bremen facility. It accounts for an employment of 2,000 on a site of 200ha, and its 30 firms generate 48 million DM to the city authority in business taxes. The communal use of on-site facilities, such as truck wash, container repair, security, and restaurants are regarded by the businesses on site an advantage that would not be available elsewhere (Holtgen, 1994).

In common with the Distriparks in the port Rotterdam, the Interporti, the Guterverkehrszentren (and their equivalent Plate-formes intermodales in France and Freight villages in Britain) are generating value added, as well as providing efficient transfer facilities. They are providing an appropriate setting for firms to exploit the opportunities offered by logistics. Synergies between firms are made possible, and for small firms in particular, this has been shown to be an attraction. The businesses located there may augment traffic volumes through the terminal, yet the local community may obtain relief in traffic congestion. We may conclude that transport policy is having an effect on the form, function and local impacts of intermodal terminals in Europe in ways that differ greatly from the Canadian experience.

The Canadian and European situation compared

International comparisons are notoriously difficult. It is evident, however, that Canadian intermodal facilities differ greatly from the European examples reviewed above. The container-handling facilities developed in Canadian ports and the intermodal rail yards operated by CN and CP are transfer facilities only. Their overriding purpose is to effect transfers and remove the cargo units as quickly as possible from the sites. As such, they are highly efficient, but they do not provide the range of value adding logistical services found in many European terminals.

Of course, many businesses do obtain advantages from Canadian intermodal terminals. There are forwarders, truckers, and logistics firms that facilitate, and in turn benefit from, intermodal transportation. There is no certainty, however, that these services will benefit the community in which the terminal is located, and even if these businesses are located in the same city, they may not be able to benefit from agglomeration economies, the vertical and horizontal cooperation achieved by the Europeans. This is revealed very clearly in Fig 2, which plots the transportation service industry of Toronto. The open circles represent the locations and numbers of firms in the service industry in general (shipping lines, trucking companies, warehouses, forwarders). The dark shading indicates the proportions of firms involved in rail intermodal (TOFC and COFC) business. While there are several concentrations - the airport and downtown - a basically dispersed pattern is evident. What synergies between

firms are possible here? How much extra traffic on the roads is produced? Is Toronto obtaining all the potential added value from the intermodal activity taking place there?

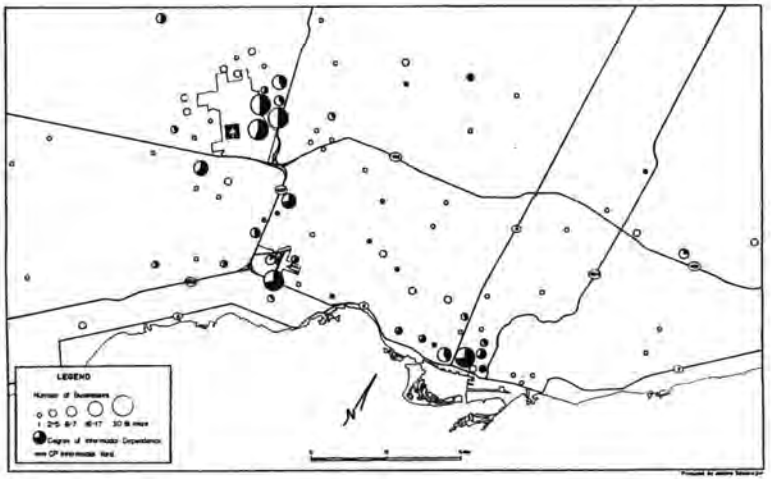


Fig. 2 Location of Transportation Service Companies in Toronto

Although the market conditions, operating environments and basic geography of Europe differ greatly from Canada, the main reason for the differences identified in this paper is the absence of policy in Canada. Here, in an increasingly deregulated environment, governments have retreated from interventions, and as a result market forces have largely shaped conditions. In addition, the public and private operators of terminals have lacked the financial ability to invest in functions not directly related to transfer operations.

It is unrealistic to assume that policies that seek to develop or impose a national system of transportation terminals, such as in Italy, have any relevance in Canada. The political and economic culture would not support this. However, there is a need to carefully consider public policy approaches at a more local level. Although the terminals may have national implications and may be owned by national institutions, many of the benefits and most of the problems they engender are local. There is a need for city and provincial administrations in Canada to consider the ramifications of intermodal activity to a far greater degree than they have so far. Traffic calming, and the promotion of new economic

opportunities that create jobs and increase revenues would appear to be sufficient grounds for greater public involvement at the local/regional level.

Public authorities have a role to play in planning logistics centres. Given the fragmented nature of the transportation industry (although global logistics companies are important), logistics centres, especially those that would involve smaller companies, are unlikely to develop spontaneously. Local or regional governments, acting in conjunction with the business community, can be useful in providing the necessary leadership and coordination. This aspect has particular relevance in Canada, where the competition from larger U.S. or international firms is frequently cited as a problem for domestic companies. One of the prime benefits cited for the German traffic centres is that they give smaller local companies greater opportunities to compete in the enlarged European Community market. There, the cooperation between potential developers, the railways, truckers, intermodal companies, made possible by local/regional authorities, has been shown to be vital. Assessments of regional demand, and site assessments are necessary preludes to actual development, and here the governments can play a vital technical role.

The actual construction and operation of the logistics centres need not involve public capital. Several of the 'freight villages' being developed in Britain are privately financed (Holtgen, 1994). In Germany, the freight transport centres were originally conceived as public corporations, but quickly it became obvious that the private users preferred a development company that was more independent. Thus, mixed ownership corporations are in place. These make investments, manage the facilities, and coordinate outside representation. On the other hand, a more direct role is played by the Rotterdam port authority. Its Distriparks are on port-owned land, and the port has built the access roads and provided the infrastructure such as sewerage. These divergencies in the extent of public investments indicate that public policy may result a wide range of commitments by government. A policy towards intermodal transportation at the local/regional level need not necessarily imply large financial obligations.
What is needed is a vision and a commitment to carry out policies that stand to benefit the transportation industry and the communities.

Conclusion

Without a transformation in public policy, it is unlikely that there will be changes to the status quo in Canada. The intermodal terminals will continue to become more efficient, and shed even more jobs. In the meantime, local communities will face painful readjustments through declines in added value, they will almost certainly experience heavier traffic flows on city streets, and terminals themselves surely will not realise their full traffic potential. These are grounds

enough for undertaking a public review of the needs of the transportation industry and the community. Public policy has an important role to play in defining objectives and in coordinating developments. In this respect Canada has much to learn from recent European transport policy initiatives.

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PROGRÈS TECHNOLOGIQUES EN MATIÈRE DE CONTENEURISATION

Les progrès de la conteneurisation de cargaisons de plus en plus nombreuses et variées ont stimulé considérablement les efforts d'adaptation des infrastructures et des réseaux d'une part et d'amélioration et de développements d'équipements et technologies performants d'autre part.

Cette recherche constante de l'efficience et de meilleurs niveaux de services intégrés est bâtie sur la combinaison de nombreux facteurs, notamment techniques.

L'on tentera, dans les pages qui suivent, de donner un bref aperçu - inévitablement partiel et partial - de progrès technologiques touchant la conteneurisation. En aucun cas, cet exposé ne se veut exhaustif; il comporte même le risque de voir certains passages dépassés par rapport à l'évolution technique en cours tellement celle-ci est rapide, diversifiée, considérable, en un mot, difficile à cerner dans sa totalité.

Après quelques brèves informations sur la dernière génération de navires porte-conteneurs, l'on s'attachera à présenter l'introduction de certaines technologies nouvelles dont bénéficient les terminaux et ce, avant d'aborder plusieurs types de conteneurs et de conclure sur le traitement des données.

1. Les porte-conteneurs

1.1 Augmentation de la capacité des navires

L'ère des "overpanamax" est bel et bien arrivée compte tenu de commandes de navires de 4 800 EVP des compagnies M.O.L., N.Y.K. et A.P.L. Les premières unités de cette taille seront opérationnelles avant la fin de la présente année. Celles de N.Y.K., de 4 812 EVP de capacité, seront alors les plus grands porte-conteneurs en opération dans le monde.

Par ailleurs, le géant et numéro 1 mondial Evergreen est en train de renouveler sa flotte en passant commande ferme, à court terme, de dix «panamax» de 4 300 EVP tandis que l'armateur allemand Hapag Lloyd prend livraison des deux derniers navires d'une série de huit de 4 422 EVP[1].

1.2 Surcapacité et accès aux ports

Ces exemples soulèvent de sérieuses questions en raison des risques de surcapacité et de la faiblesse quasi-chronique des taux de fret. De plus, cette tendance au gigantisme éliminera de nombreux ports du marché du fait que les plus gros navires ne pourront y accoster, se contentant de moins en moins d'escales, notamment dans le cadre de services autour du monde.

1.3 Développement axé sur les marchés d'Asie

Enfin, il est intéressant de signaler que cette vague de renouvellement de la flotte et cette tendance à l'augmentation de la capacité se concentrent sur les marchés trans-Pacifique et Europe – Asie. Elles ne touchent guère le trafic de l'Atlantique Nord. La croissance des échanges générés par les économies asiatiques explique une telle concentration.

2. Les ports et autres terminaux

Dans les ports à conteneurs, s'achemine-t-on vraiment vers des «déserts mécaniques robotisés» ? Si l'expression est excessive, certains signes existent déjà pour confirmer partiellement cette prédiction. Quelques exemples de R. & D. appliqués à des situations réelles méritent d'être cités.

2.1 Véhicules guidés automatisés (A.G.V. : Automated Guided Vehicules)

Opérés à partir d'un poste informatisé central, des équipements de manutention et des portiques sans opérateurs humains commencent à être disponibles. Des grues de quai devraient être opérationnelles sous peu également.

Déjà au terminal Delta de Rotterdam (Pays-Bas), des engins de manutention de conteneurs sont à l'oeuvre. Mis au point par la firme allemande Mannesmann Demag Gottwald, ces véritables véhicules intelligents, tel le modèle CT 40, possèdent une conduite bidirectionnelle, utilisent la radio digitale, des senseurs et autres matériels informatiques pour se positionner, se diriger, opérer et même contrôler leur propre programme d'entretien.

De plus, ce matériel de haute performance fonctionne dans les pires conditions, sans interruption, entre -20 °C et 40 °C, par vents de force 9, dans le blizzard ou d'intenses poussières, c'est-à-dire là où l'opérateur humain aurait beaucoup de difficultés à poursuivre son travail[2].

2.2

Le projet FRAIT (Free-Ranging Automated Industrial Transport) actuellement à l'essai en Angleterre, fait appel à la technologie des missiles terre-air et tout son attirail de laser, de radar, etc.[3]

2.3 Planification et contrôle

Le S.P.A.R.C.S. (Synchronous Planning And Real-Time Control System) de Navis Corp. d'Oakland, Californie, en service dans plus de 30 terminaux à travers le monde, constitue une illustration remarquable du progrès technologique. Utilisant un simple ordinateur MacIntosh de Apple, ce système peut faire visualiser à l'écran les plans de chargement du navire, d'entreposage à quai, d'opération, etc. Il sert d'outil de planification et de gestion des opérations de chargement, de déchargement, d'utilisation de l'espace à bord et à terre, de calcul de la stabilité du navire, de regroupement des conteneurs en fonction de divers critères ou exigences techniques et commerciales, etc. Il va sans dire que les gains de productivité au terminal sont considérables[4].

Le SCUSY, (système informatisé de simulation de manutention de conteneurs), est un puissant outil d'analyse de la productivité portuaire. Il peut comparer l'efficience de plusieurs scénarios d'utilisation d'équipement identiques ou différents, de gerbage, etc. Il s'agit d'un modèle permettant la visualisation des séquences de mouvements au terminal, l'analyse de la capacité d'utilisation des différents espaces, de l'acheminement des flux d'import-export destinés au rail ou à la route, des opérations et du temps requis pour chacune d'elles, entre autres possibilités[5].

2.4 Productivité des grues

L'exemple du T.A.S. (Terminal Automative System) de la compagnie américaine Sea-Land permet d'accroître la productivité des grues de deux ou trois mouvements à l'heure, ce qui n'est pas négligeable quand on sait que la moyenne est de vingt à vingt-cinq mouvements à l'heure. Utilisant la micro-informatique, ce système couvre plusieurs modules spécifiques à chaque fonction (entrée; opérations à terre; opérations à bord; contrôle du trafic...). Tous les terminaux de Sea-Land à travers le monde en sont munis et sont reliés à une unité centrale au siège de l'entreprise qui s'attend à ce que les gains réalisés soient bientôt de beaucoup supérieurs aux deux ou trois mouvements supplémentaires à l'heure déjà obtenus[6].

2.5 Productivité de la main-d'oeuvre

Le métier de grutier nécessite désormais des habiletés tellement poussées que l'opération des grues, portiques et autres équipements de manutention est entrée dans l'ère des simulateurs, celle qui est surtout jusqu'ici connue dans l'industrie aéronautique. Les D.S.S. (Digitran Simulation Systems), mis au point aux États-Unis, mettent la personne en formation dans un contexte réel d'opération, grâce notamment à une combinaison du son et des images avec les mouvements et même l'effet du vent. La recherche se poursuit pour améliorer davantage les possibilités de tels simulateurs et leur application[7].

2.6 Transfert de conteneurs d'un mode terrestre à l'autre

La question de la rupture de charge entre wagon et camion préoccupe la plupart des intervenants de la chaîne intermodale du fait des coûts et du temps du transfert d'un mode à l'autre.

De nombreux systèmes efficaces existent déjà, mais peu d'entre eux sont réellement innovateurs et simples. Pour sa part, l'A.C.T.S. (Abroll Container Transport System) utilisé en Europe, semble prometteur car, pour une fois, aucun équipement de levage n'est requis. De plus, un seul opérateur peut faire fonctionner ce système qui ne nécessite que ces trois éléments peu coûteux : des miniconteneurs, des plateformes de rotation pour les wagons et, pour les camions, un mécanisme à chaîne ou un crochet. Plus de 2 000 conteneurs compatibles ACTS sont actuellement en circulation en Europe où l'avenir de cette technique paraît prometteur pour certains trafics spécifiques[8].

Il faut espérer un développement de ce système adapté aux conteneurs de 20' et de 40'.

3. Les conteneurs

Les besoins grandissants en conteneurs spécialisés et la recherche de l'optimisation des espaces de chargements donnent lieu à la fois à des nouveautés et à des débats de normalisation.

3.1 Nouveaux types de conteneurs

- La compagnie japonaise MOL (Mitsui OSK Lines) fait figure de leader dans le développement de conteneurs spécialisés réfrigérés[9].

  Le Solar J. Box, utilisant l'énergie renouvelable, (froid et soleil) consiste en un ou deux conteneurs couplés (bien isolés contre la chaleur) dont l'un sert de chambre froide capable de maintenir la

température entre 0 et 5 °C à 90 % d'humidité. Le froid est stocké grâce à l'air ambiant de l'hiver de certaines régions, pour obtenir la glace nécessaire. Quant à la ventilation, elle est mue par l'électricité produite par la cellule solaire fixée au toit du conteneur.

Le Fishtec, conçu spécialement pour le transport de poissons vivants est incorporé à même un conteneur de 20'. Il permet le contrôle de la température, la purification de l'eau, la fourniture d'oxygène, la stérilisation utilisant l'ozone etc... pour transporter une tonne de poissons vivants dans de bonnes conditions.

Le Coolter, pour sa part, conserve des denrées hautement périssables comme certains fruits et légumes transportées à une température variant de -1 °C à 3 °C, avec contrôle de l'humidité et absorption de gaz pour en conserver toute la fraîcheur.

Toujours dans le domaine du transport de produits très périssables, il faut signaler l'apparition des conteneurs à atmosphère totalement contrôlée par microprocesseur. Un tel contrôle de la température, de l'humidité et des gaz s'ajuste automatiquement en fonction des conditions, ce qui permet le transport de produits qui ont muri naturellement jusqu'à leur cueillette, de même que leur mise en marché avec une fraîcheur remarquable. La compagnie Freshtainer Worldwide Ltd a mis en service des conteneurs de type INTAC (In-Transit Atmosphere Control) qui, au lieu de l'injection initiale de gaz, utilisent des «tamis» moléculaires[10].

Dans le même ordre d'idées et conformément au Protocole de Montréal sur la réduction des CFC (chlorofluorocarbones) du 16 septembre 1987, des efforts pour l'utilisation de subtances de remplacement moins polluantes sont menés activement. Aussi, la firme Sabroe Reefer Cool As a développé l'utilisation des HFC-134 (hydrofluorocarbones) pour les conteneurs réfrigérés de type TNE 508 dont l'isolation ne contient pas non plus de CFC[11].

- Au chapitre des conteneurs démontables, le Magnatek's Pack Flat Container (M.P.F.C.) retient l'attention. En effet, outre le gain d'espace pour le stockage et le repositionnement des unités vides, ce type de conteneurs est très solide, pouvant accepter une charge de 26 tonnes (pour des 48') et être empilés, pleins, à neuf niveaux. De plus, il est très simple à monter et à démonter auquel cas il n'occupe qu'un tiers de sa hauteur normale. Quand on connait le coût astronomique du transport des conteneurs vides à travers le monde (près de 10 milliards de dollars américains en 1992), l'avenir des boîtes démontables semble assuré[12].

3.2 Normalisation

Les années '80 ont été marquées par l'apparition de conteneurs aux dimensions différentes de celles de la série 1 de l'ISO, ayant par exemple une longueur de 45', 48' ou 53'. Les pressions de chargeurs et de certains transporteurs terrestres, surtout aux États-Unis, font que l'étude d'une seconde série de l'ISO semble inévitable pour ne pas permettre la prolifération quelque peu anarchique des conteneurs hors normes.

Par exemple, le chargement de cargaisons sur palettes de 1 x 1,2 m ou 0,8 x 1,2 m (standardisées en Europe) pose des problèmes de perte d'espace dans un conteneur de la série 1-ISO. Les chargeurs européens veulent une largeur intérieure de 2,44 m de façon à charger deux palettes de front.

Par ailleurs, s'il y a une tendance générale à vouloir obtenir plus d'espace de chargement que ce qu'offre la première série ISO, il n'est pas sûr que la seconde série ISO soit en mesure d'offrir bien plus de capacité. Ainsi, le futur 49' ne devrait guère offrir un poids brut supérieur à celui d'un 40'; bien plus, sa tare serait plus élevée d'une tonne ! Seul le trafic L.C.L. (Less-than-Container-Load) devrait bénéficier de la mise en service des 49'. En effet, plus le conteneur est grand, plus sa capacité de chargement en poids par rapport au volume diminue comme le montrent ces quatre exemples[13] :

20' ISO :	670 kg/ m^3
40' ISO :	411 kg/ m^3
49' et 8'6" de hauteur :	312 kg/ m^3
49' et 9'6" de hauteur :	276 kg/ m^3

Il ne s'agit là que d'un aperçu des difficultés qui se posent surtout aux transporteurs maritimes soumis à des pressions pour opter pour des conteneurs plus longs et plus larges et confrontés à des choix cruciaux en matière d'investissements dont personne ne peut prévoir la rentabilité pour l'instant.

- Identification et «pistage» automatiques (tagging & tracking) :

Des expériences prometteuses sont en cours, utilisant les possibilités de l'identification automatique de l'équipement (A.E.I. : Automatic Equipment Identification). Les plaques électroniques indiquant le code alphanumérique dont sont munis les conteneurs sont lues, grâce à des ondes radios, par des lecteurs à chaque étape du processus de transport et les données recueillies sont transmises à une base de données centrale : nom du navire, numéro du voyage, localisation des conteneurs,

numéro de chassis des véhicules utilisés, codes d'identification de chaque conteneur...

En mars 1993, A.P.L. a décidé d'«étiqueter» ainsi toute sa flotte intermodale (conteneurs, chassis, tracteurs et wagons) et d'installer des lecteurs dans 130 sites à travers le monde[14].

La standardisation de l'A.E.I. permettra une quasi généralisation de ce phénomène.

3.3 Sécurité

Marchandises de contrebande, drogues, explosifs et armes de toutes sortes se sont mis à l'heure de la conteneurisation. L'impossibilité d'une inspection systématique de tous les conteneurs a ouvert la voie à des recherches poussées, notamment dans le domaine des rayons X[15]. C'est ainsi qu'est apparu le système HI-CO-SCAN de la compagnie allemande Heimann Systems GmbH qui permet de voir à travers les parois des véhicules ou des conteneurs pendant que le manifeste est examiné simultanément, offrant ainsi une comparaison valable entre les données de ce dernier et celles de l'inspection. L'avantage réside dans le fait que seuls certains conteneurs qui auront été clairement identifiés comme suspects seront soumis à l'inspection manuelle.

Il s'agit d'un système sophistiqué faisant appel à l'électronique et à l'informatique, donnant une image à angles multiples et limitant l'intensité des radiations à un niveau très bas pour ne pas contaminer la cargaison, notamment les aliments, les médicaments, les films, etc.

Ce système vient s'ajouter à celui de la firme Schlumberger Industries, le SYCOSCAN (System for the Control of freight and vehicules by Scanning).

4. Traitement des données et communications

La popularité des micro-ordinateurs, leur prix abordable et leur puissance en croissance constante en font des outils fort utiles aux transporteurs. Certains systèmes offrent l'avantage de communications directes dans des réseaux reliant plusieurs centaines d'ordinateurs individuels entre eux et avec des postes centraux.

4.1 Logiciels

Le développement quantitatif et qualitatif de progiciels maritimes applicables aux domaines techniques et de gestion commerciale masque mal une lacune en matière de logiciels spécifiques au transport multimodal. Ainsi, il n'existait pas de progiciel standard particulier aux

études d'itinéraires de lignes maritimes régulières offrant l'acheminement intérieur de cargaisons conteneurisés. Face à cette pénurie, la CNUCED a chargé l'Institut maritime de Gdansk, en Pologne, d'entamer des travaux, lesquels ont abouti aux programmes MULTISHIP qui existent désormais sous quatre modèles, dont le second connaît un certain succès. Ce dernier, dont une nouvelle version a dû sortir, a une capacité de traitement de 999 mouvements de marchandises entre 20 ports comportant chacun trois terminaux intérieurs.

De plus, la CNUCED a ajouté un module «transport» au progiciel SYDONIA (Système douanier automatisé) qui permet d'extraire les statistiques de transport au-delà de la zone portuaire. Si l'extension de SYDONIA continue, on pourrait en arriver à une normalisation des statistiques de transport à travers le monde.

Enfin, en parallèle avec SYDONIA, la CNUCED a développé un système logistique d'information rapide sur les marchandises (ACIS) fonctionnant grâce à l'E.D.I. L'ACIS a le triple avantage de fournir :

- L'information rapide sur les mouvements de marchandises, ce qui permet une meilleure planification des réseaux, équipements et installations terrestres et donc une fluidité accrue du transit;

- Les services d'une base de données aux intervenants avec accès immédiat à des informations précises sur les expéditions et leur dernière position;

- Des données chronologiques servant de base à des statistiques régulières sur les transports, des indicateurs de performance de rendement par module et des volumes de trafic, ce qui est capital pour la prise de décisions par les pouvoirs publics et les entreprises en matière d'investissement.

4.2 E.D.I.

L'échange de données informatisées est souvent défini comme étant «le transfert d'ordinateur à ordinateur de données commerciales et administratives constituant une transaction et qui sont structurées selon une norme agréée»[16]. Il convient de rappeler les grandes lignes des avantages tirés de l'E.D.I. :

- Réduction des coûts administratifs (on a évalué à 15 00 $ américains par expédition l'économie réalisée grâce à l'E.D.I. pour la préparation de la documentation[17]); transmission entre ordinateurs des données propres à une transaction rapidement et sans risque d'erreur;

- Amélioration de la gestion de l'information et de l'échange des données au sein de l'entreprise et dans les rapports de celle-ci avec ses partenaires et autres intervenants; facilité d'adaptation aux contraintes du «juste à temps»;

- Rapidité du traitement de la facturation permettant d'accélérer le paiement;

- Accélération des formalités douanières et autres de contrôle aux frontières;

- Collecte de meilleures informations commerciales par les pouvoirs publics (surtout pour la balance commerciale).

4.3 Communications

Le marché E.D.I. est tellement florissant que pas moins de sept réseaux sont en concurrence : Reso Worldinx, GE Information Services, IBM, Ordenet, Immedia, AT & T et TDNI, ce dernier se spécialisant dans le transport.

La tendance, au-delà de la liaison par modem entre partenaires, est l'accès à un vaste réseau à valeur ajoutée regroupant de nombreux abonnés. Un tel réseau garantit la confidentialité grâce à la boîte aux lettres électronique protégée, particulière à chaque abonné.

Actuellement, la norme la plus utilisée en E.D.I. dans les rapports entre les transporteurs et leurs partenaires est ANSI-X12.

Cependant, la norme EDIFACT, plus répandue en Europe, serait appelée à s'implanter sérieusement en Amérique du Nord. Il s'agit d'une série de règles développées en Europe pour l'administration, le commerce et le transport et qui est reconnue par des institutions des Nations-Unies, telle la CNUCED, en vue de sa généralisation.

«L'EDIFACT/ ONU est un ensemble de principes visant à faciliter l'échange électronique de données commerciales entre fabricants, exportateurs, grossistes, distributeurs, détaillants, courtiers, transitaires, chargeurs, consignataires, transporteurs, banquiers, assureurs, autorités portuaires, services douaniers, etc. Les documents imprimés traditionnels sont remplacés par des fichiers électroniques composés de messages établis de manière uniforme conformément aux normes internationales»[18].

En matière de douanes au Canada, l'initiative CADEX (Custom Automated Data Exchange) datant de 1988, regroupe plus de 150 importateurs et courtiers qui utilisent ce système pour transmettre 68 %

du volume des déclarations d'entrées commerciales[19]. En plus d'opérations diverses, CADEX permet la mainlevée des marchandises (MDM : mainlevée sur documentation minimale).

Plus spécifiquement en matière de conteneurs, la création, sur le plan international, du CEDIC (Container EDI Council) vise surtout à «favoriser un consensus entre les utilisateurs de l'EDI dans les diverses tranches de l'industrie des conteneurs sur des questions telles que la conception des messages et le codage des données et déterminer les messages nouveaux à mettre au point»[20].

Au terme d'un tel inventaire, certes incomplet, il est tout de même permis de constater que cette véritable course technologique constitue un des gages essentiels de succès pour les compagnies de transport, les opérateurs de terminaux et l'ensemble de leurs partenaires, tout particulièrement dans la chaîne de transport multimodale au sein de laquelle l'efficience et la qualité du service sont primordiaux.

Les conséquences sur le plan de la rationalisation des activités en sont indubitables dans un contexte hautement concurrentiel où seules les entreprises ayant fait de l'adaptation technologique un élément primordial de leur planification stratégique pourraient assurer leur survie et leur part de marché.

Néanmoins, si les progrès technologiques du transport par conteneurs sont évidents, constants et pleins de promesses, qu'en est-il sur le plan juridique ? A-t-on reconnu la spécificité du transport intermodal ? Rien n'est moins sûr sur le plan international alors que la Convention sur le transport multimodal de 1980 n'arrive pas à attirer un nombre suffisant de ratifications pour entrer en vigueur. Les documents de transport multimodal ne sont pas encore standardisés et les tentatives comme celles de la Chambre de commerce internationale ne font pas l'unanimité... Décidément, les mentalités commerciales et les instruments juridiques sur lesquels elles s'appuient n'arrivent pas à suivre le rythme effréné du développement technologique.

1. Rapport spécial conteneurisation : «Porte-conteneurs : une nouvelle vague sur le marché à l'horizon 1994/1995». Journal de la marine marchande, 26 nov. 1993, p. 2 880.

2. W.F.T. '93 (World Freight Technology '93) : "A.G.V. for Rotterdam" (Mannesman Demag Gottwald GmbH), p. 89-90.

3. W.F.T. '93 : 'rojet FRAIT" (David Avery), P. 73-76.

4. W.F.T. '93 : 'SPARCS : a revolution in terminal operations" (Erik Tiemroth), p. 185-188.

5. W.F.T. '93 : 'SCUSY - Simulation of container handling systems" (Carsten Boll), p. 171-173.

6. W.F.T. '93 : 'Information technology to improve crane productivity" (Michael T. Bohlman), p. 177-179.

7. W.F.T. '93 : 'Port crane simulation training comes to age" (Mike Compton), p. 175-176.

8. W.F.T. '93 : "ACTS : container transfer without lifting equipment", p. 163-166.

9. W.F.T. '93 : 'Marine container technologies for storage and transport" (M.O.L. Ltd), p. 25-28.

10. W.F.T. '93 : " Total atmosphere control : keeping fresh produce perfect" (Andrew Lavey), p. 33-35.

11. W.F.T. '93 : 'TNE 508 'green" reefer unit" (Seabroe Reefer Cod AS), p. 38.

12. W.F.T. '93 : 'Magnatek's Pack Flat Collapsible container" (Maurice Jarman), p. 39-41.

13. W.F.T. '93 : "A new container age ?" (Christoph Seildelmann), p. 19-21.

14. "Tagged" Containers Setting an Example for compatibility, Doug Harper, the Journal of Commerce, July 19, 1993.

15. W.F.T. '93 : "X-ray inspection of large-size objects" (Cornelius Koch), p. 223-225.

16. Publication de la CNUCED n° TD/B/C. 4/328 du 90-01-30, chapitre I, p. 2.

17. Publication de la CNUCED n° TD/B/C. 4/328 du 90-01-30, chapitre I, p. 3.

18. Publication de la CNUCED n° TD/B/C. 4/328 du 90-01-30, chapitre I, p. 4.

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19. E.D.I. et les douanes, par M. Gilles Desjardins, l'Expéditeur, juillet/ août 1993, p. 15.

20. The Open Container, Ocean Voice, London, Vol. 9. n° 4, p. 14.

TRENDS IN LOGISTICS: IMPLICATIONS FOR CARRIERS, RESEARCHERS AND POLICYMAKERS[1]

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Introduction

In modern organizations, increasing competitive pressures have augmented the importance of managing transportation within the context of a larger logistics system (Chow, in press). *Logistics*, as defined by the Council of Logistics Management, is "the process of planning, implementing and controlling the efficient, cost-effective flow and storage of raw materials, in-process inventory, finished goods and related information from point-of-origin to point-of consumption for the purpose of conforming to customer requirements" (Lambert & Stock, 1993). In addition to transportation, logistics includes inventory control, warehousing, storage, materials handling and order processing activities. By managing these activities as an integrated group rather than piecemeal, the performance of the firm is likely to improve.

The 1990s find logistics management practices in transition. New applications of well-understood strategies such as integrated logistics management and new developments such as supply chain management, outsourcing, strategic alliances and partnerships are changing the nature of the relationship between carriers and shippers. The purpose of this paper is to explore some characteristics of these developments and their attendant implications for carriers, researchers and policymakers.

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Approaches to managing the supply chain

Outsourcing, strategic alliances, partnerships, and traditional transactions-based management are approaches to structuring relationships with suppliers. Therefore, all are ways of managing relationships that are a part of the supply chain. The utility of the supply-chain management concept is that it highlights the need to manage the various relationships - within and outside the organization - as part of an integrated system. Adopting an integrated approach can influence logistics performance. The dimension of logistics performance that is of key importance in this context is optimized inventory management.

Three of the dimensions of what Aldrich (1979) calls "interorganizational relationships" are helpful in providing a theoretical framework in which to articulate the supply chain relationship. Formalization connotes "the extent to which transactions between the organizations are given official recognition and legislatively or administratively sanctioned" (Aldrich, 1979:273). In other words, formalization describes a state in which the norms governing transactions between the organizations are made explicit (e.g. Scott, 1981:60).

Intensity "indicates the amount of investment that an organization has in its relations with other organizations". This is reflected by the amount of resources involved and the frequency of interaction (Aldrich, 1979: 275). Finally, reciprocity refers to "the degree of symmetry in relations between the organizations" (pp. 276). Reciprocity has two sub-dimensions. One, "resource reciprocity" is "the extent to which resources in a transaction or a relationship flow to both parties equally or benefit one unilaterally (pp. 276). The other sub-dimension is more procedural in nature: "definitional reciprocity" is "the extent to which the terms of a transaction are mutually agreed upon, with equal contributions from all organizations involved" (pp. 276).

The concepts of formalization, reciprocity and intensity can be applied to several logistics management practices. For example, the decision to outsource or create a strategic alliance will normally increase the degree of formalization, as negotiations between supplier and customer identify the terms of the relationship. Intensity increases as the organizations allocate risks and resources in different ways, as do the degrees of reciprocity. In general, the management of the relationships in supply chains have been changing in these ways.

Outsourcing

Outsourcing - that is, a commitment by a business to utilize an external supplier for certain products or services - has become a common strategy during

the last part of this century (Bettis, Bradley & Hamel, 1992:9). Some manufacturers and retailers have elected to outsource logistics-related activities, often out of a conviction that a firm should focus its resources upon specific bases of competitive advantage - and purchase "non-core" products or services elsewhere. For example, some years ago, Alcan Corporation chose to outsource its shipping business to oceangoing shipping companies. More recently, Vancouver's Pacific Press, publisher of the city's two major daily newspapers, chose to outsource delivery services (much to the consternation of unionized drivers who lost their jobs). Arguments commonly cited as rationales for outsourcing non-core activities focus upon the need for improved asset and human resource productivity.

Anecdotal accounts of outsourcing and benefits associated with it are not difficult to find in logistics (e.g. Anderson, Lynch & McCabe, 1991; Bowersox, Daugherty, Dröge, Germain & Rogers, 1992). But the discussion of Bettis and his colleagues (1992) suggests that it is important to view sourcing (or outsourcing) "in strategic and offensive terms instead of merely as a defensive technique for trying to fix problems" (pp. 18). In particular, the authors emphasize the need for a firm to have an in-depth understanding of its core competencies and to focus its outsourcing activities in a manner that is complementary to them. For, as their subsequent discussion implies, if the firm abandons complex activities on which its competitive advantage depends, the firm's performance and competitiveness may eventually deteriorate. In particular, if a firm's competitive advantage depends on customer service, the overall merits of outsourcing those activities critical to the delivery of that output may be uncertain, particularly in the long run.

Strategic Alliances/Partnerships

Strategic alliances and partnerships represent a departure from traditional, transactions-based relationships between buyers and sellers. Both may be formally defined as cooperative relationships characterized by the sharing of risks and gains, long-term commitment, and by a co-mingling of operations and information (Chow & Heaver, 1993:108). The incidence of strategic alliances and partnerships is reported to be increasing in both North America and Europe (Bowersox et al., 1992; Chow & Heaver, 1993; Eggleton, 1992; Gadde & Håkansson, 1993:3).

The Burroughs Corporation is a helpful example of this trend. The company developed a partnership with Skyways Freight Systems, which took over the management of inbound transportation. Skyways became responsible for selecting the type of transportation to be used, and now acts on Burroughs' behalf

in receiving and processing freight. The information systems of the two companies are linked together, which facilitates an effective just-in-time manufacturing program at Burroughs. The results of the new arrangement have included sharply reduced transit times and freight costs, and sharp increases to inventory turnover.

Another effort with impressive results has occurred at Motorola, Inc. Through partnerships with a small group of transportation suppliers, the company has been able to stimulate considerable improvements in carrier performance. This goal was achieved through extensive supplier education programs. A supplier advisory board works to improve two-way communication, and care is taken to involve the suppliers in new product development activities. The improved carrier performance has been instrumental to Motorola's own improved performance (Gadde & Håkansson, 1993:114-5).

Not all strategic alliances and partnerships have yielded stellar results. In fact, estimates of mortality rates have been as high as 70 percent (Parkhe, 1993: 794). In any discussion of trends such as these, the "file-drawer problem" is a necessary caveat. Quite simply, stories of unsuccessful applications are less likely to be presented at trade association meetings or discussed in journal articles. They are more likely to be left in file drawers. While the examples of failed partnerships in the article by Bettis and his colleagues (1993) are not logistics-related, they do point to the need for critical thinking (see also Gadde and Håkansson, 1993:57). Perhaps management writer Tom Peters sums it up best:

> There is a rhetoric of partnership in the business world today - and then there is the reality. According to the rhetoric, we are moving toward a seamless global economy, in which "borderless" companies work with an every-shifting array of partners to take advantage of new opportunities and to achieve mutually beneficial goals. . . But we have many miles to go in translating slogans like "strategic alliances" and "borderless company" into competitive reality (Peters, 1991:97).

Supply-chain management and integrated logistics management

Supply-chain management can be defined as "integrating operations from supplier to customer to optimize information and material flows through the supply chain" (LeMaistre & Plosker, 1993). The careful reader will observe that this is closely related to the definition of logistics presented at the beginning of the paper. It is also closely related to integrated logistics management, although it emphasizes relationships outside the firm.

The notion that logistics activities ought to be managed as an integrated entity rather than piecemeal has been known for some time (Ballou, 1973). By the end of introductory logistics or "physical distribution management" courses, most students of the 1970s emerged with some familiarity of the "classical" trade-offs between logistics cost components. For example, transportation cost savings achieved through the use of lower quality services needed to be balanced against the subsequent increases in inventory holding costs. Similarly, increased production run lengths would lower unit production costs but increase inventory holding costs. In sum, students learned that with a pre-determined customer service standard, management's objective was one of minimizing total costs.

Subsequent efforts of firms to integrate logistics activities have been associated with increased formalization and intensity of external relations, as evidenced by alliances and partnerships. Strengthening these arrangements has been facilitated greatly by improved information and communications technologies. These enable the combination of various logistics components into more efficient and, in many cases, more complex systems (Chow & Heaver, 1993: 108-9; see also deRoulet & Kallock, 1992: 489). By the end of this decade, it is expected that for the first time, business outlays for logistics management information systems will exceed inventory-related costs (Anderson & House, 1991).

The Dow Chemical Company is a large multinational corporation which operates in both Canada and the United States. Distribution requirements planning (DRP) systems are used to translate demand forecasts into realistic shipping quantities and schedules, and then consolidate that demand at each shipping point in the distribution network. Master Production Scheduling (MPS) systems are used to translate schedules of DRP demand into feasible master schedules of when finished goods will be produced. Purchasing and transportation systems supported by electronic data interchange (EDI) manage the flow of material from vendors (Coyle, 1993:7). This example demonstrates not only the importance of information technology in achieving integrated logistics management, but also the important role of logistics in strategic corporate decision-making. It is this dual characteristic that distinguishes the core concepts in integrated logistics management from the externally-oriented supply-chain management concept.

Implications of these logistics trends

The increasing levels of formalization is leading to a greater degree of integration and interdependence among all participants in logistics processes. The changes have consequences for the private sector (including carriers and other

logistics suppliers), for policymakers, whose decisions affect logistics services, and for researchers.

Implications for Carriers

Carriers are facing a rapidly changing environment. Successful carriers will develop effective environmental scanning practices in order to find out what customers and end-users (e.g. "the customer's customer") want. They will not only design their services in a way that delivers the benefits most valued by shippers and customers, but also correctly anticipate future changes in these preferences. The latter is especially important, for the requirements of time-based competition differ from competition based on quality or cost: different markets may call for different core competences (Corbett & Van Wassenhove, 1993). In any case, transportation providers wishing to be considered as candidates for outsourcing or partnership ventures may well find it necessary to offer related logistics services such as warehousing, brokerage, or intermodal movements in order to remain competitive.

Successful transportation providers will continue to be on the leading edge of available communications and computer technology. Where supply chains cross several organizations, the computer will become an increasingly important way of linking the participants. It will create increased opportunities for intermodal cooperation and coordination.

Increasing formalization is associated with greater accountability in supply-chain relationships. For example, in successful strategic alliances or partnerships, accountability relationships are clearly spelled out. In the "transportation partnership" arrangements now used in many automobile manufacturing settings, there is an very clear linkage of specific carrier behaviours and rewards or penalties (see Raia, 1988). Similarly, outsourcing logistics activities implies a specific delegation of decision-making authority, but also a very clear assignment of responsibility. For carriers, this suggests a clear need to ensure that operating controls provide swift, accurate and customer-relevant performance feedback. It also suggests that management needs to ensure that every employee is motivated to perform well whenever a "moment of truth" (e.g. Carlzon, 1987) occurs.

Implications for Policymakers

Policymakers affect logistics performance directly and indirectly. The direct effects are through public agencies that are involved in logistics processes.

The indirect effects are from government regulations that affect the design and functioning of logistics services.

An example of the former is the emphasis now being given by Canada Customs to trade facilitation. This is part of the general effort to enhance national competitiveness (Heaver, 1992). It will be achieved by relying on corporate computer records and the use of EDI to avoid paperwork. Canada Customs is expected to release information on its plans during the spring of 1994. Canada Customs will become more involved in the development of appropriate information systems in partnership with exporters, importers and their representatives. Port and airport authorities will be affected by the challenges and opportunities presented by enhanced trade facilitation.

The development of strategic alliances and partnerships has implications for competition policy. Shippers need access to competitive suppliers with whom they may enter into exclusive logistics service arrangements. This points to the need for alternative competitive railway services. It also suggests that confidential contracts should be available with individual shipping lines. These are not now allowed by conferences and not required by the *Shipping Conferences Exemption Act*.

It is possible that strategic alliances and partnerships might have an anticompetitive effect. This is unlikely when competitive modes of transport are involved but could be a concern in specialized situations. As strategic alliances and partnerships become more prevalent and more successful, policymakers may need to investigate whether current legislative safeguards against anticompetitive practices remain adequate. Many of these safeguards focus on mergers. If strategic alliances and partnerships become substitutes for mergers, it may be necessary to refine existing legislation in order to discourage the use of these arrangements for anticompetitive purposes.

Implications for Researchers

There is an unmistakable need for research on logistics organization issues. The topic emerges frequently as a concern in the annual Survey of Career Patterns in Logistics (see, for example, LaLonde & Masters, 1993). Although there has been some pioneering work in this area (e.g. Bowersox, Daugherty, Dröge, Rogers & Wardlow, 1989), much more remains to be done so that the properties of organizational structure that are conducive to effective logistics management can be identified.

Second, researchers must scratch below the surface and provide a more coherent theoretical base for studying the trends in supply-chain relationships. The increasing attention that has been given to concepts such as outsourcing and strategic alliances has certainly given managers several new and useful ideas. Unfortunately, as the editors of Business Week (1984) pointed out many years ago, people have a fatal attraction for turning useful ideas into formula responses (p. 144). Research which identifies the underlying characteristics of new trends and demonstrates how they relate to firm (or alliance) performance will help overcome gaps between "rhetoric and reality" (e.g. Parkhe, 1993). An added benefit would be a more rigorous and coherent curriculum for students of transportation and logistics.

In particular, the discussion of the supply chain presented here suggests that formalization and intensity may be useful in modelling supplier-customer relationships more concisely. While trends such as outsourcing and strategic alliances are interesting, a significant contribution will be made by researchers who are able to identify how successful applications differ from unsuccessful ones. In pursuit of this end, researchers should consider the broad array of tools that are available, particularly the case study. Mail surveys also have considerable potential, but all of us are challenged to design data-collection instruments carefully and report findings in a more scholarly fashion than has sometimes occurred in the past.

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GOVERNMENT'S ROLE IN A POST-DEREGULATED ENVIRONMENT: THE CASE OF INTERNATIONAL AVIATION

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Introduction

The benefits of economic regulation have been dealt with extensively. One problem with past research in this area is it tends to discuss regulatory environments in their extremes; either in terms of rigid regulation or complete economic liberalization, as these are the environment most readily observed. Study of international aviation provides a new area for the study of market liberalization in that a wide range of degrees of regulatory environments are observable. This paper will first discuss previous findings with respect to aviation market regulation, and then discusses a current study which compares the efficiency levels of international air carriers from areas of differing stages of economic regulation.

Regulation Theories

Regulation theory suggests two reasons supporting a regulatory framework in an industry. The first is that regulation is in the public's best interest by preventing a monopolist, or potential monopolists, from taking unfair advantage of consumers. Regulation, according to this view, is the result of public need (Kahn 1970; Frantz 1988), and may be justified in cases of natural monopoly.

The second related theory in support of regulation is that natural monopolies exist in some industries. In this case inter-firm competition necessitates spreading fixed costs over fewer units of output than are economically optimal. Regulation in a natural monopoly may be necessary, first to allow the monopoly to exist (legally), and second, in order to prevent the natural monopoly from obtaining economic profits. It might be argued that this theory of regulation applies in the aviation industry because economies of scale and scope do exist. It has been shown though, that in the aviation industry, such economies only exist up to a certain level of service or airline size after which gains from increased density or size level out (Gillen, Oum, and Tretheway 1985). The natural monopoly theory would only hold

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in the aviation industry if the market served by an airline were relatively small and self-contained. This is not the case in the international airline industry.

Proponents believe regulation is clearly justified when the industry is a natural monopoly. Opponents contend that regulation ordinarily results in higher than necessary costs (Posner, 1975; Frantz, 1988). That is to say, the primary argument against regulation holds that the costs outweigh the benefits because regulation invariably leads to market inefficiencies which take several forms and have a number of causes. In a discussion of the theory of regulated industries, the Economists Advisory Group (EAG (1987)) cites four sources of inefficiency which might be found in a regulated industry such as the aviation industry. These types of inefficiency are not mutually exclusive.

Technical Inefficiency

The first is technical inefficiency ensuing from the protection of inefficiently sized firms. A technically inefficient firm is one which does not operate at the most efficient combination of inputs given a certain output (Averch and Johnson 1962). Rate of return regulation, such as is found in some areas of international aviation, has the effect of moving the firms to higher cost functions. Technical inefficiency is supported by regulation in that the regulators are likely to increase rates to cover the inefficient firms and inefficient combinations of inputs and outputs (EAG, 1987).

X-inefficiency

X-inefficiency, results from the absence of competitive pressures on the firm inducing personnel to pursue goals other than cost minimization or production maximization. Leibenstein (1969) indicates that this type of inefficiency results because the gain to be achieved from a change is not sufficient to cover the costs of making such a change. Bergman (1974) refers to the costs associated with X-inefficiency as avoidable higher costs of regulation that the firm could avoid, but chooses not to do so. X-inefficiency in the aviation industry is the result of protected markets. According to X-inefficiency theory, protection from potential and real competition tends to eliminate the motivation to minimize costs (Leibenstein 1966; and Frantz 1988), leading to higher expenditures on such items as unnecessary staff, unjustified bonuses, higher spending on office decor, and the absence of basic service offerings.

Allocative Inefficiency

Allocative inefficiency results when regulation permits price structures to be out of line with costs. It permits costs to differ from what they should be and is the symptom of non-optimal market prices. Allocative inefficiency may be the result of X-inefficiency, but differs from X-inefficiency in that it relates to market activities rather than intra-firm (EAG 1987).

As the industry is protected, it incurs what Bergman (1974) refers to as unavoidable higher costs; regulation protects the regulated industry from lower cost competitors. The firm thus produces the product at a higher cost than would be achieved without industry protection. Resources are inefficiently allocated to the protected industry. The problem of allocative inefficiency is intensified in international aviation in that only the domestic carrier may transport domestically; lower cost foreign carriers are not permitted to enter the domestic market.

Innovative Inefficiency

A fourth area of inefficiency identified by the EAG (1987) is innovative inefficiency resulting from the lack of need to improve upon operations. Accompanying X-inefficiency, the firm lacks not only incentive to minimize costs but also lacks incentive to innovate. First, innovative change is risky as it involves the unknown. Second, the basic incentive to innovate is increased profits. If the firm knows that profits are regulated, or even guaranteed, there is no incentive to change the status quo with a relatively risky innovation. In addition, changes are often made by firms outside of the regulated industry. If entry is made difficult or impossible by regulation, the potential for innovation is limited (EAG 1987; Frantz 1988).

Industry Liberalization

As indicated above, forces supporting and promoting liberalization are being felt world wide. Liberalization occurs at both the domestic and international levels. Domestic liberalization includes but is not limited to: 1.) reduced restrictions of rates, routes, market entry/exit, and 2.) in instances outside the U.S., reductions in or elimination of government airline ownership.

The U.S. formally liberalized its domestic market in 1978, and informally through actions of the Civil Aeronautics Board (CAB), as early as 1976 (Caves et al. 1987; Taneja 1988). This liberalization is generally agreed to have positively influenced airline efficiency as airlines were permitted to adjust operations to better suit their needs through actions such as adding profitable routes, dropping unprofitable routes, adapting services to customer's needs, and adopting the more operationally efficient hub-and-spoke route systems (Morrison and Winston 1986; Caves, Christensen, and Tretheway 1983; Caves et al. 1987). Deregulation in Canada has been studied and similar improvements in efficiency as those found in the U.S. have been noted (Gillen, Stanbury, and Tretheway 1987).

The tendency following domestic liberalization is to promote international aviation liberalization, or to achieve open skies (Taneja 1988; Sampson 1984). The philosophy of opening the airways is spreading to other parts of the world, and efforts are being made to liberalize international airways.

This international liberalization is taking four basic forms: (i.) governmental economic liberalization; (ii.) airline privatization; (iii.) the development of strategic alliances between airlines from different countries; (iv.) and the reduction of restrictions in bilateral agreements. Governmental deregulation involves reducing the level of involvement the government has in economic regulation of the airline industry, as was experienced in the U.S. in the late 1970's, or Canada in 1984.

Increased liberalization is likely to result in an increase in the occurrence of strategic alliances. Strategic alliances involve two carriers combining forces to offer "coordinated price promotions, code-sharing, and sharing of airport terminal space." (Pustay 1992) Examples include those between British Airways and United Airlines, Air France and Lufthansa, as well as KLM and Northwest Airlines.

Liberalization in the EC

Removal of barriers in the aviation industry in the EC takes several forms: a) legal action by the European Council, b) gradual privatization of some of the state airlines, and c) liberalization of bilateral agreements. Restrictions in bilateral agreements between EC states are being eliminated as part of unification efforts, however, delayed compliance with liberalizing measures is allowed in the EC by its less developed members. Further, countries such as Great Britain and the Netherlands have and are reducing restrictions in bilateral agreements between their respective countries and those outside the EC.

Privatization aids in this process in that it helps to remove the airline from complete control of the states. Of the airlines which are being privatized (e.g. Alitalia, SAS, Lufthansa) partial but often controlling ownership is maintained by the government. While the airline may pursue a more 'liberal' course, it still has the state to support it.

British Airways became a wholly private business in January, 1987. KLM has approximately sixty percent private ownership with a goal of an even greater percentage. The goal of SABENA is to have only twenty seven percent nationally owned. With the prospect of liberalization of EC air regulation, other countries in the EC have begun or are likely to begin to privatize their airlines.

Legal action has and is being taken to liberalize the European market as well. The air and sea transport industries, as of 1986, were the only ones for which specific regulations regarding competition did not exist. EC extremists desired that liberalization extend worldwide. The Commission of the European Communities as well as the European Council have taken a more realistic view.

Civil Memorandum No. 2 allows for the maintenance of the bilateral structure within the EC but provides for the introduction of measures to make the market more flexible and competitive. It allows the protection of national airlines, while making

the market more liberal. Memorandum No. 2 was followed by several directives in 1987 referred to as the 'first aviation package'. One of these directives allowed the Commission to "apply rules relating to competition directly to aviation." (Button 1991). A second provided EC airlines with greater pricing freedom. These directives also provided for gradual liberalization by the year 1993.

In 1990, a second aviation package was adopted which bound the EC member countries to full liberalization within the EC with implementation planned, but not fully carried out, by June 1993. This package provided for increased competition on routes and such airline freedom rights as full pricing freedom; freedom to pick up and deliver passengers in a second country as well as the freedom to carry passengers between two countries other than the country of origin (Stasinopoulos 1992).

Liberalization and privatization are not without their problems. A major difficulty is passing the regulations to liberalize the market through the Council. Foremost among the problems of implementing liberalizing policies is that they are viewed to infringe upon the sovereignty of the states. Some states do not want to give up control of an industry which has been under their complete control, particularly since this might mean the end of that airline.

Liberalization in Australia

The Australian airline industry is unique in its isolation from other markets. Because of the country's isolation, domestic service, which tends to be rather short haul service, is significantly different from international service, which tends to be extremely long haul. This distinction in services is a major factor contributing to the separation of domestic and international aviation. Qantas has been the international carrier for the last few decades with Ansett and Australian Airlines splitting the domestic market.

All economic aspects of the Australian market, on both a domestic and international basis, were strictly regulated until the beginning of the 1980's when the government began the liberalization process. Liberalization culminated in an official policy change for the domestic market in 1987 when the Minister for Transport and Communications announced domestic market economic deregulation. An interesting provision of liberalization of Australia's market is that carriers from other countries will be able to enter the domestic Australian market on a purely domestic basis. They cannot provide service for domestic legs of international service, but can operate in the market on a domestic basis (Button 1991).

Qantas, the major Australian international airline servicing Australia, is for the most part not affected by deregulation of the domestic market. Until 1987 Qantas flew no domestic flights in Australia except those supplying its international routes. It still does not participate in strictly domestic routes. As of 1987, however, it was

allowed to service domestic customers linking to another international carrier (Button 1991). In the early 1990's discussion began to allow Qantas to compete to a minor extent on a domestic basis as well as to allow the domestic carriers to pick up certain international routes.

The international Australian air market is controlled by the Australian government, but the government appears to be moderately liberal in its approach to international aviation agreements. This is primarily an effort to promote its flag carrier, Qantas (Findlay 1982, and Button 1991).

Liberalization in Canada

Prior to the late 1970's Canada's air industry was heavily regulated like that of the U.S.. Deregulation of the U.S. market prompted limited liberalization of Canadian air regulations as a result of consumer pressure. Due to the closeness of U.S. airports to Canadian customers, these consumers were able to take advantage of lower U.S. fares following liberalization of the U.S. market.

Fare restrictions were partially liberalized in 1979. At the same time, capacity restrictions limiting CP Air's share of transcontinental traffic and thereby its ability to compete with Air Canada were gradually removed. The advent of deep discount fares occurred in 1982 with the reduction in fare regulation. The New Canadian Air Policy of 1984 cancelled the regulations that limited "competitors to twenty-five percent of Air Canada's route mileage" (Taneja 1988). It also removed entry barriers and fare restrictions on the southern Canadian routes (Taneja 1988; Button 1991).

Regulations were gradually eroded in Canada until January 1988 when the National Transportation Act of 1987 was put into effect. This Act maintained the North and South division of the Canadian air industry. Moderate regulation was retained in the Northern area while the Southern area was almost completely deregulated. In addition, this act proposed that the government seek more liberalized bilateral agreements.

Liberalization in Other Markets

The majority of the other international aviation markets are relatively heavily regulated. However, there are a few countries other than those discussed above which have taken a liberal stance with respect to international aviation regulation. Of note are Singapore, Chile, Ecuador, and Panama which adopted more liberal stances during the 1980's.

Liberalization efforts are continuing in the 1990's. For example, Brazil, Pakistan, and South Africa are making efforts to privatize their carriers. These

countries are also discussing liberalization of their markets. No country has yet reversed its 'liberalization efforts'.

Government Liberalization in the Aviation Industry

Outside of the United States most major airlines have strong ties to their respective governments, experiencing varying levels of control by said governments (Sampson 1984). Hence a major course for market government liberalization involves airline privatization. As discussed above, reductions in government ownership are seen in many countries.

Privatizing an airline has several beneficial effects. National airlines tend to be a major financial burden on a country's budget. One beneficial result of privatization is the reduction of the cash drain on the government that might have been taking place due to direct or indirect subsidization (OECD 1988; Barrett 1987). Moreover, selling stock in the airline has the added benefit of raising money for the state. If the country wishes to maintain some control of the airline, it may maintain a stock interest in the company.

Secondly, privatization is likely to increase airline efficiency as the airline becomes subject to market pressures (OECD 1988; Barrett 1987; Caves et al. 1987). As a government owned entity, with heavy subsidization, there is little incentive for the carrier to control costs. With rates and routes controlled, there is no true incentive to control either rates or costs. In addition, as a government owned entity, goals other than maximizing profits are more important to the carrier. As complete or partially private entities, profit will become more important to the carrier resulting in an increased emphasis on efficiency.

A second course liberalization takes is government reduction of the restrictiveness of bilateral agreements. Such reductions are made in order to increase market competition, or rather to allow the forces of free trade to take over. Barrett (1987) indicates that from an economic point of view the elimination or reduction of restrictions in bilateral agreements will allow allocation of resources to areas which will provide the greatest return. He further states that increased competition arising from liberalization will result in improved efficiency and improved consumer benefit through increased travel options and reduced rates. There appears to be general agreement that more liberal bilateral agreements will improve airline efficiency as well as improve consumer welfare and efficiency of the economy as a whole (Barrett 1987; OECD 1988; Dresner and Windle 1989; Economists Advisory Group [EAG] 1987).

In its Civil Aviation Memorandum No. 2, the European Commission expresses a purpose of maintaining the bilateral structure while introducing restrictions which make the market more flexible and competitive. One rationale for such restrictions is that in the currently existing network of aviation routes in the EC

competitive route advantages tend to be negotiated away by bilateral agreements, promoting inefficiency. In addition, the commission hopes that by reducing restriction it will foster carrier efficiency.

Liberalization is also viewed as one means to promote the unification of the EC. In order to foster unification of the EC countries improved transportation is looked to as a means of reducing barriers between the various nations. Liberalization of the air market is a step in this direction. In addition, a more cohesive aviation industry will aid the EC in dealing with international organizations and in international transport agreements. It will add more clout to their dealings.

Methodology

Time and Airline Sample

Airlines' relative inefficiency levels were determined for the years 1982, 1985, 1988, and 1990. The base year selected was 1982 since most airline liberalization had not yet begun. Of those in the sample, the United States was the only market which had experienced significant liberalization. The year 1985 encompasses liberalization of the Canadian market as well as the beginning of liberalization efforts in the EC. The last year for which relevant data were available when this study was conducted was 1990. In addition, 1990 is an appropriate year to conclude because liberalizing efforts such as reductions of restrictions on bilateral agreements and major reductions in government ownership had taken place in the EC, U.S., Canada and several other countries. While liberalization of markets is not complete, these changes would be expected to influence relative airline inefficiency. The year 1988 provides a mid-point year for analysis.

The relative inefficiency measures were determined first for all airlines for which the necessary input and output data are available. It would be ideal to include every operating airline in the study; however, some airlines either do not allow publication of the necessary data by ICAO or they do not report such data. It was decided not to include these carriers in the study.

The airlines which do not report are primarily from what were formerly communist bloc countries. It is highly likely that the non-reporting airlines are among the more inefficient carriers. A complete list of the airlines included in this study -- grouped along geo-political lines -- may be found in Appendix I.

Two primary criteria controlled the inclusion or exclusion of a carrier. First, for inclusion the carrier must be an international air carrier. It was beyond the scope of this study to control for the numerous variations in local carrier regulation.

The second criteria was that the carrier have a significant involvement in scheduled passenger carriage. The carrier must have a majority of its ton-miles come

from scheduled passenger traffic; and/or it must be the flagship carrier of a country. Carriers whose primary business is cargo or charter service are excluded as they face a different environment than those whose major business is scheduled passenger traffic.

Efficiency Frontier Estimation

A cross-sectional efficiency frontier model was estimated for each of the four years using a Cobb-Douglas total cost function. The advantage of the efficiency frontier over other methods, as discussed in the previous chapter, is that it separates the error term into random and firm specific components. Relative inefficiency measures are estimated for individual airlines, which in turn are used to determine whether airline relative inefficiency varies over time according to market liberalness.

A Cobb-Douglas total cost function was used for estimation of the efficiency frontier (Meeusen and Broeck 1977; and Bruning 1991). The total cost function is specified as:

$$lnTC_i = \alpha_0 + \sum \alpha_1 lnQ_i + \sum \alpha_2 lnLP_i + \sum \alpha_3 lnF_i + \sum \alpha_4 lnK_i + v_i + u_i \quad (1)$$

where Q_i = passenger output, measured in RTK, for airline i:
RTK = passenger weight * the number of paying passengers * distance travelled;
LP_i = Labor price for airline i;
F_i = Fuel price for airline i;
K_i = capital services for airline i;
v_i = random, uncontrollable error for airline i;
u_i = firm specific error for airline i;
i = airline 1 through I.
a_0 through a_4 are the parameters for the cost function; and all summations are over 'i'.

Market Group Analyses of Inefficiency Measures

Using analysis of variance (hereafter ANOVA) the carrier inefficiency measures were compared within and across years. Ideally, the country would be the unit of delineation rather than geo-political area. The problem with this unit of measurement is in the resultant sample size. Since a great majority of countries have only one international carrier, an analysis studying the differences in efficiency measures between countries would not be very meaningful.

Carrier Grouping

The carrier grouping used for this study was (1) U.S.; (2) Pacific Rim; (3) North European; and (4) all others. It would be expected that the Pacific Rim carriers would enjoy low levels of inefficiency because of cost advantages (Windle 1991; Boberg and Collison 1989). It would also be expected that the U.S. carriers should possess lower levels of inefficiency in at least the first year because of the liberalized U.S. market. It would be further expected that as the EC becomes increasingly liberalized the mean inefficiency level of that group would begin to approach that of at least the U.S. group by 1990. The group does not include Southern European carriers as they are believed not to be as progressive in liberalization efforts.

The 'other' group includes carriers from Canada, Australia, Southern Europe, South America, Africa, and the Middle East. These are primarily from highly regulated areas. While it would be interesting to establish groupings from each of these areas there are not enough carriers from each area to do so.

This grouping is based on those developed and used in similar research by Windle (1991). Even though Windle did not have a large cross section of carriers, he used more groups in his analysis by breaking out Canada and all of Europe. Because of the small sample size of the Canadian group, the Canadian carriers are incorporated in the 'all other' group in this study. The European carriers used in this study are divided into North and South due to the variability in the liberalness of their governments.

It is postulated that as the environment of the international market became more liberal, means of carrier groups over time would converge. It was expected that the U.S. and Pacific Rim carrier groups would exhibit the lowest levels of inefficiency in 1982 due to a liberalized U.S. market and lower costs for the Pacific Rim group.

Results

The mean values for the carrier groups in each of the years are shown in the table below. The ANOVA results are indicated in the superscripts. There exist significant differences at the .05 level in 1982, 1985 and 1990. In each of the four years the Pacific Rim carrier group is least inefficient, with the U.S. being second least inefficient, and the Northern European is most inefficient.

MEAN INEFFICIENCY VALUES FOR GROUPING II
U.S., PACIFIC RIM, NORTHERN EUROPE, OTHER

	1982	1985	1988	1990
United States	.1282[B] (.0466)	.1421[B] (.0424)	.1601[A] (.0645)	.1387[B] (.0651)
Pacific Rim	.1014[B] (.0404)	.1119[B] (.0473)	.1122[A] (.0546)	.1336[B] (.0593)
Northern Europe	.2417[A] (.1212)	.2833[A] (.1490)	.2316[A] (.1242)	.3110[A] (.1343)
Other	.1364[B] (.0415)	.1535[B] (.0785)	.2070[A] (.1311)	.1948[A] (.1031)

Note: Superscripts denote cell groupings. Cells with the like superscripts are insignificantly different, i.e. in 1982 carrier groups representing the U.S., Pacific Rim and Other have mean variation which is insignificantly different. Cells with dissimilar superscripts are significantly different, i.e. in 1982 Northern Europe represents a significantly different group. Value in parentheses is the standard deviation of mean.

One possibility this indicates is that in order to be least inefficient, carriers must come from areas which meet one of two conditions. Either they must have low cost structures as is the case of the Pacific Rim carriers; or they must have a highly competitive market in which firms have a great deal of managerial autonomy as is the case in the U.S. market. In 1982, 1985 and 1988 the U.S. and Pacific Rim carriers have considerably lower costs per RTK than do the Northern European carriers. The lower cost structure of the Pacific Rim carriers is due in part to lower labor costs. In 1990 the Northern European carriers appear to have controlled costs, but improved inefficiency measures may be lagging the improvement. The same comments apply to the Liberal group because it is composed primarily of Northern European carriers.

The differences between carrier groups were not as expected. Regulatory theory cited above proposes that carriers from more liberal markets, such as the U.S., would have the lowest levels of inefficiency. This was not the case. Clearly factors other than regulatory liberalness play a role in determination of carrier inefficiency. Possible factors might include labor and facility costs, route structures, as well as the level of government subsidies provided carriers.

Concluding Statements

The results of our research suggest that governmental actions to liberalize or deregulate aviation markets represent only one critical element in the overall effort to successfully create a solvent, effective, and sustainable industry. To date, deregulation appears to have met with mixed results--prices have dropped in many world markets, however, industry concentration and incipient price wars have become the norm since the mid-to-late s. Privatization has marginally improved the plight of several carriers, yet it is clear that shifts from a protected to a dynamically competitive existence is frought with problems that will require considerable time for full adjustment to occur. Governments in many nations have determined that the cost of maintaining "national pride" carries a high price, perhaps too high of one. But, the important question is whether market mechanisms and institutions will bring about the stability and efficiency which are both necessary conditions for a viable industry.

In proposing the role for public policy, one always ventures into dangerous territory. Nonetheless, listed below are several thoughts regarding the contribution national and supra-national entities may follow to nurture a strong world-wide aviation industry.

1. Work against the notion to intervene in commercial matters which are best handled by the private sector. Pricing, traffic and freight allocation, scheduling, service, etc. are best handled by firms closest to the demand who can respond to market changes. Governments move too slowly, and rules that are developed for one problem often are non-effective over time.

2. Governments should work to harmonize competition laws regarding market dominance and destructive competition. While competitive rivalry increases the ability of firms to perform efficiently and with a clear focus on market needs, it can also become a negative factor for the industry as a whole. Thus, an oversight function is required by an interested third party in competitive relations to ensure both efficiency and industry stability.

3. Recognize that subsidies exist and create difficulties for both governments as well as private sector organizations in negotiating competitive relations. Subsidies distort economic calculations that are necessary to establish level playing fields for all participants. Governments should strive to eliminate direct subsidies in the industry wherever possible. Indirect subsidies are more difficult to address, although efforts should be directed to minimizing their influence on market decisions.

4. Related to the third point, governments should assure adequate facilities are in place to meet market demands presently and in the future. Particularly with respect to airport facilities where gates are scarce and tend to be dominated by the larger firms. Every effort should be made to encourage entry of new participants who meet minimal going concern and safety standards. Providing competitive gates in major and second-level hubs establish the opportunity for smaller and newer entrants to establish foot-holds in markets.

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Seasonality and Economic Efficiency in the Canadian Airline Industry: Performance in Air Fares Since Deregulation.

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Abstract:

Seasonal price swings represent a real cost to the economy, because of the inefficiency it represents. In the airline industry, it represents excess demand in the third quarter and unused capacity in the first and fourth quarters of each year.

In an ideal economy, price changes provide incentives to shift capacity and demand, thus eliminating seasonal pricing. One of the goals of deregulation was to give the airlines the ability to be more competitive by changing capacity on a route, or by using price incentives to affect demand. This paper will look at one aspect of economic efficiency, seasonal price factors, to see if deregulation has succeeded in improving this aspect of economic efficiency and, therefore, the performance and competitiveness of Canadian airlines.

The conclusion reached is that deregulation has produced precisely the results that theory predicts. Seasonal variation in prices has been decreasing since 1988, and is substantially less now than when deregulation was introduced.

The efficiency of Canada's airline industry has long been studied in terms of technical and allocative efficiency, using annual data for inputs and factors of production.[1] Less common has been an examination of the seasonal efficiency of the industry, using the published sub-annual data.

The concept of seasonal efficiency is most commonly encountered in the literature concerning public utilities, where problems of peak demand and rate-setting must be addressed by regulatory authorities. Simply put, the existence of seasonality in any industry is an undesirable inefficiency that results in real costs to the economy, because of excess demand at one point in time and under-used capacity

at some other point in time.[2] It has always been maintained in the literature dealing with seasonal efficiency that a free market with allocative pricing would act to level out seasonal excesses of demand and capacity over the course of the year. Since prices are the signals used in a free market to shift supply and demand from one time or place to another, one would expect to eventually see no seasonality in prices in a free market.[3]

Before the beginning of domestic deregulation in 1984, airlines were restricted in their ability to change capacity on a route, or to use price incentives to shift demand. One of the goals of deregulation was to give airlines this flexibility, and to increase efficiency of the industry.[4] The goal of this paper, therefore, is to examine the published quarterly air fare data[5] for evidence of evolving seasonal efficiency since deregulation.

This paper will analyze average domestic and international discount air fares, and their respective indexes, using the seasonal adjustment tools developed at Statistics Canada. As well as studying seasonal efficiency, some of the many advantages of using seasonally adjusted data for analysis will be discussed. Discount air fares are used because they respond to seasonal market forces, unlike full economy fares, (see Figure 1). They also account for no less than two thirds of domestic scheduled passengers and three quarters of international passengers.[6]

Figure 1



Source: Aviation Statistics Centre, STC

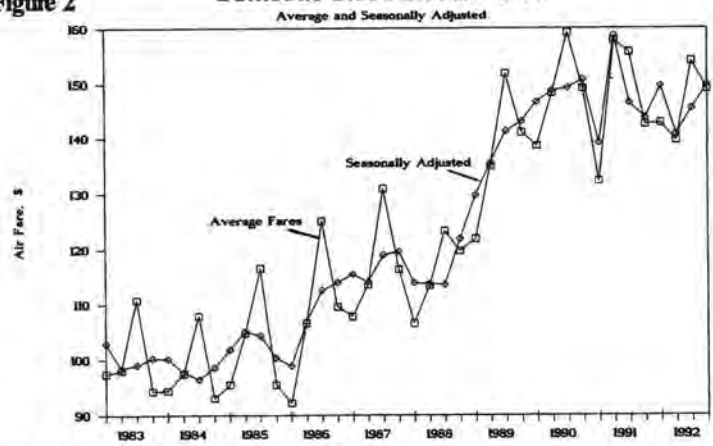
The Fare Analysis Unit, Aviation Statistics Centre, Statistics Canada, produces quarterly data for average air fares and air fare indexes from the Fare Basis Survey. The average air fares are simply the air carriers'[7] total scheduled revenue

divided by the total number of scheduled passengers, as measured by coupon origin and destination in the survey. These are tabulated by sector and fare type. A change in an average fare could be for two reasons: either the price of the same ticket has changed, or passengers have shifted their buying patterns towards either cheaper or more expensive flights.

In order to decide which event has occurred, the Fare Analysis Unit developed and publishes air fare indexes. The index weights the air fares according to a "basket" of fares bought in the base year, in this case 1983. (All indexes currently published are converted to a 1986=100 time base). The index thus produces a measurement of true change in the price of air travel, which is not confounded with changes in passenger travel patterns.

To analyze the seasonal data, they were seasonally adjusted using Statistics Canada's X-11-ARIMA software[8]. In essence, the X-11-ARIMA programme takes the original time series and breaks it down into three components[9]: the trend-cycle, the seasonal component, and the irregular component. The final seasonally adjusted series is the sum of the trend-cycle and the irregular component. Any of the three components may be analyzed individually for their information content.

Figure 2 **Domestic Discount Air Fares**



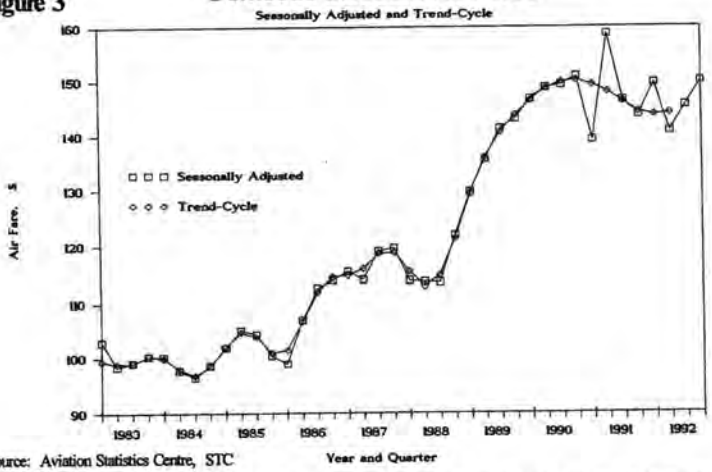
Source: Aviation Statistics Centre, STC

The main purpose of seasonal adjustment is to allow comparisons to be made between any consecutive data points. For example, consider Figure 2. This shows the average domestic discount air fares alongside the seasonally adjusted data. The strong seasonal peak in the third quarter is obvious. This means that the average air fares cannot be meaningfully compared from one quarter to the next[10]. The

normal procedure, then, is to make comparisons only to the same quarter in a previous year. Seasonally adjusted data, however, can be legitimately compared between any two quarters. This can yield a different analytical result than the more usual year-over-year analysis.

For example, a year-over-year analysis of the raw data in Figure 2 would note (correctly) that the average discount air fare in the third quarter of 1992 had declined by 1.0% from the same period in 1991. However, this analysis does not make full use of all of the information which the time series contains. The seasonally adjusted series shows that the third quarter of 1992 increased by 3.3% over the second quarter, indicating the start of a recovery in domestic discount air fares, which continued into the fourth quarter.

Figure 3



Source: Aviation Statistics Centre, STC

The trend-cycle reveals the most fundamental trends in the data, with all irregular effects removed. (Since the trend-cycle is generated by a moving-average process, the final two data points are normally suppressed to avoid signalling false turning points). The irregular component (which contains all random effects, such as strikes, wars, et cetera), can be studied by a comparison of the seasonally adjusted data with the trend-cycle. In Figure 3, the trend-cycle for domestic discount air fares is superimposed on the seasonally adjusted series. It is thus possible to show that the Gulf War in the first quarter of 1991 coincided with a drop in seasonally adjusted domestic discount air fares of 6.8% below the trend level. This was followed in the second quarter by a rebound of 7.2% above the trend.

To see whether this effect is due to price changes or changes in consumer travel

patterns during this period, the domestic discount fare index can also be seasonally adjusted and plotted in a similar manner in Figure 4. The decline in the price index in the first quarter is less marked, but the rebound above trend in the second quarter is just as noticeable. Thus, one may conclude that a drop in travel by consumers caused the sharp drop in the first quarter average fares, while the rebound in the second quarter was the result of rising prices, due to a combination of demand postponed by the war, and attempts by the industry to recoup some of their first quarter losses and fuel costs.

Figure 4

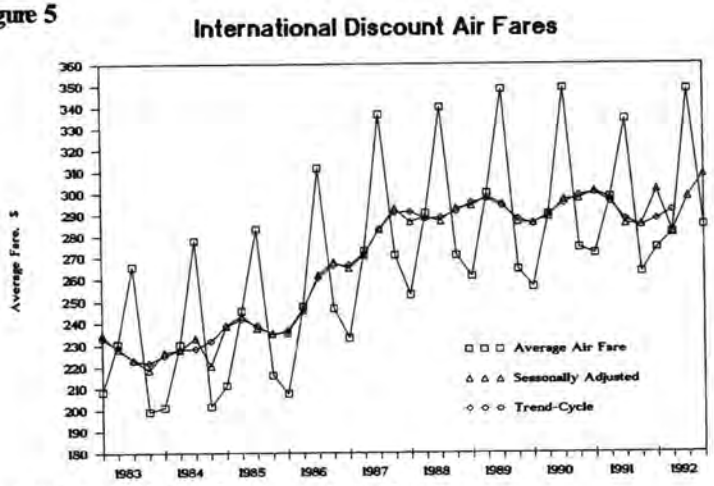


Source: Aviation Statistics Centre, STC

The international discount air fares (which include both United States and other international destinations) are shown in Figure 5. The extreme seasonality, and the lack of any noticeable effect from the Gulf War is striking. A similar result was obtained for the international discount index (Figure 6). The lack of response to outside forces in the still largely regulated international sector leads us back to the original question posed at the beginning of this paper: has deregulation made the domestic market more efficient? More interestingly, how does this compare with the efficiency of the regulated international market?

To analyze this, we must turn to the third component of seasonally adjusted model, which is the seasonal component itself. This is the part of the time series removed by the X-11-ARIMA programme. When examined on its own, it shows in percentage terms how much,on average, the air fares in each quarter differ from the annual average air fare.

Figure 5



Source: Aviation Statistics Centre, STC

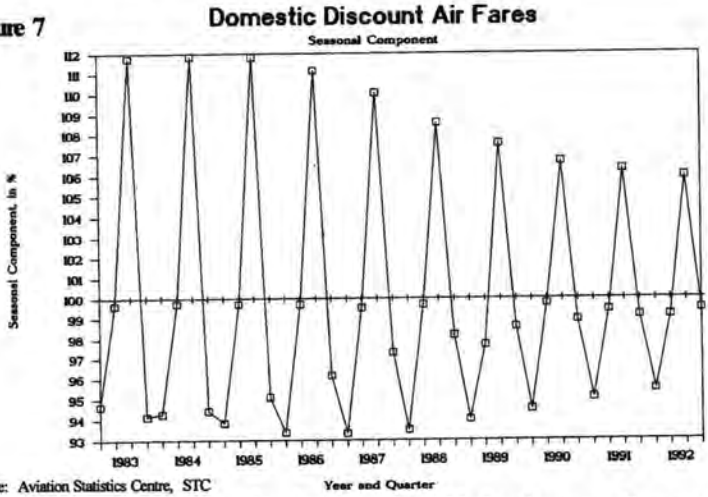
Figure 6



Source: Aviation Statistics Centre, STC

The seasonal component of the domestic discount air fares is plotted in Figure 7. The pattern is striking. From 1983 to 1985, third quarter fares commanded an average 11.6% premium over the annual average. Since 1986, this premium has declined every year. By 1992, the third quarter premium was only 5.9%, about half the value before deregulation.

Figure 7



Source: Aviation Statistics Centre, STC

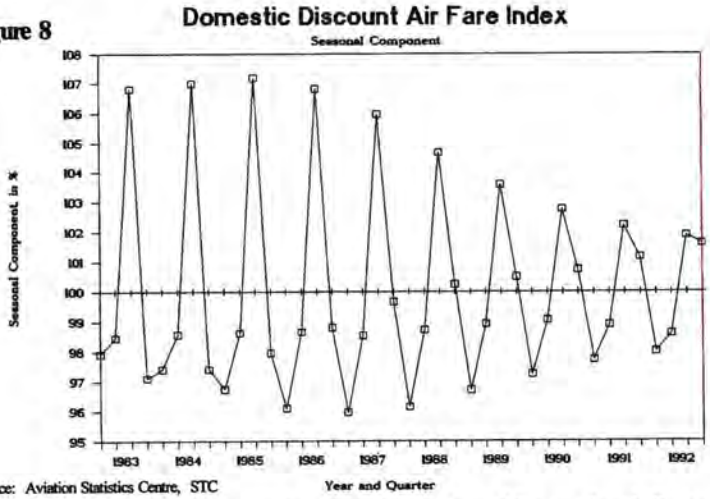
This trend is mirrored by the fourth quarter. In 1983, fourth quarter discount fares had an average markdown of 5.9% below the annual average discount fare. This has since narrowed to the point of vanishing, the seasonal factor in 1992 being less than half of a percent below the annual average discount fare.

To test whether this was caused purely by changing travel habits, the seasonal factors of the domestic discount index are plotted in Figure 8. The trend here is even more pronounced than for the domestic discount fares. By 1992, the seasonal factors for the price index were less than 2% above or below the annual average. Indeed, for the domestic discount price index seasonality has all but disappeared.

It could be argued that overcapacity and fare wars were the cause of the decline of peak fares, but that would not explain the relative rise of off-peak fares.

It could also be argued that the introduction of better consumer information through computer reservation systems has caused the rationalization of capacity and demand, and that this effect could have taken place independently of deregulation.

Figure 8



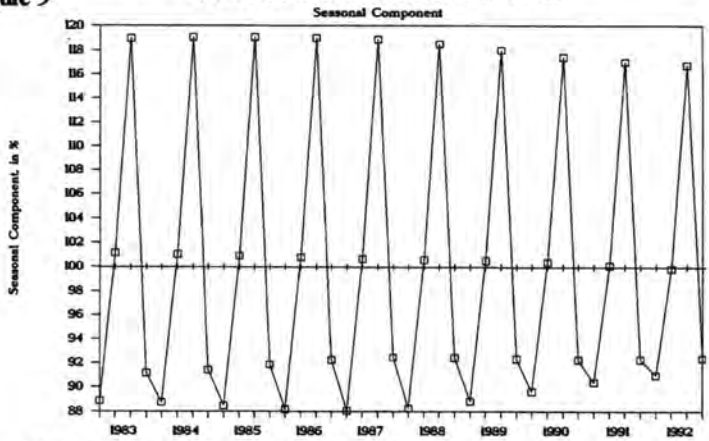
Source: Aviation Statistics Centre, STC

This argument can be addressed by an examination of international discount air fares. The international market includes both the United States market and overseas markets, which are well served with computerized information technology. However, these markets are still largely regulated in terms of access, capacity, and frequency restraints.

The seasonal factors for the international discount air fares are shown in Figure 9. The contrast with the domestic market is striking. The seasonal factors are larger and show little trend to diminished size. To see whether changing passenger travel patterns were obscuring a trend, the seasonal factors for the international discount index were plotted in Figure 10. However, the same results were obtained: large seasonal factors, with no significant diminishing trend.

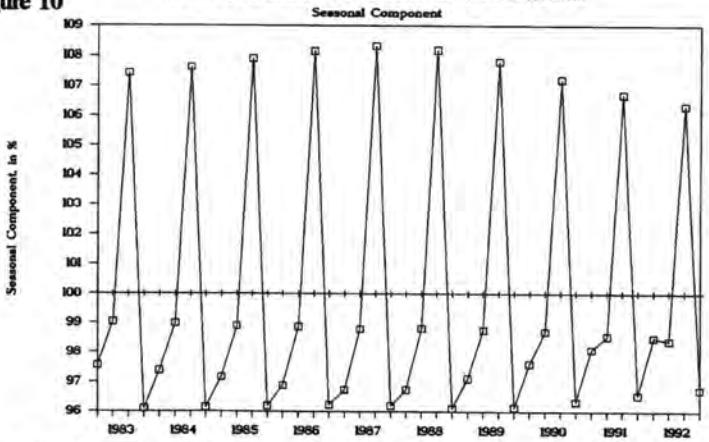
In conclusion, we have seen how the seasonally adjusted Fare Basis Survey data, available from the Aviation Statistics Centre, can yield extra information unobtainable by more conventional analysis. In particular, this paper has noted a trend toward a less seasonal pattern of prices in the domestic scheduled market, which indicates that there is a better match between capacity and demand over the course of the year. This is precisely the result predicted by the economic theory of allocative pricing in a free market[2], and is a genuine gain in real economic efficiency. In contrast, the regulated international market has shown very little tendancy toward greater seasonal efficiency, thus imposing a real cost on the industry and a loss on the economy in general.

Figure 9



Source: Aviation Statistics Centre, STC

Figure 10



Source: Aviation Statistics Centre, STC

These results should also be of interest to other modes of transportation besides aviation. Allocative pricing has been advocated in many transport modes and public utilities as a means of reducing peak demands and rationalizing the use of expensive infrastructure, but empirical evidence of successful cases is often lacking. This study provides evidence that for domestic scheduled air transport,

at least, free market pricing has succeeded in rationalizing capacity and demand throughout the year.

[1]Kobia, Kobina, "The Cost of Inefficient Allocation of Inputs in the Canadian Airline Industry", Proceedings of the 28th Canadian Transportation Research Forum, University of Saskatchewan Printing Services, 1993, pp. 269-281.

[2]Garfield, P.J., and Lovejoy W.F., Public Utility Economics, Prentice-Hall Inc., Englewood Cliff NJ, 1964, pp. 19-22.

[3]Bonbright, J.C., Principles of Public Utility Rates, Columbia University Press, 1969, pp. 357-358.

[4]Graham, D.R., and Kaplan, D.P., "Developments in the Deregulated Airline Industry", Office of Economic Analysis, U.S. Civil Aeronautics Board, 1981, p 39.

[5]Statistics Canada, Air Carrier Operations in Canada, April-June 1992, Catalogue No. 51-002, Special Articles. All data used in this paper has been published by the Aviation Statistics Centre, Statistics Canada, or is available on request.

[6]Statistics Canada, Canadian Civil Aviation, 1992, Catalogue No. 51-206, pp. 29-37.

[7]The survey samples the scheduled operations of all Level I Canadian air carriers. Since 1983 this has included Air Canada, and at various times CP Air, Eastern Provincial, Pacific Western, Nordair, Quebecair, Wardair, Canadian Airlines International Ltd, AirBC, and Time Air. Beginning in 1993, two Level II carriers were added to the survey: Inter-Canadien and Ontario Express. Changes in the coverage of the survey can affect average air fares. In the X-11-ARIMA programme, however, dummy variables compensate for coverage changes, and the seasonal adjustment is unaffected.

[8]Dagum, E.B., The X-11-ARIMA Seasonal Adjustment Method, Statistics Canada, Catalogue No. 12-546E, 1980.

[9]A fourth component, the trading-day component, is not significant for quarterly data and is ignored here.

[10]Smith, W.L., Macroeconomics, Richard D. Irwin Inc., Homewood IL, 1971, pp. 60-61.

The author wishes to acknowledge Rolf Hakka, who helped do the X-11-ARIMA modelling; Gabrielle Lorrain and Sylvie Moreau, who produced the quality survey data; Gord Baldwin and Lisa Di Pietro, who gave me the time and encouragement to do this paper; Jerry Ciasnocha, (NTA) who reviewed it; and David Dodds, the Director of the Transportation Division, STC.

CANADIAN RAILWAY RESTRUCTURING
A DISCUSSION PAPER

Malcolm Cairns and Terry Ganton

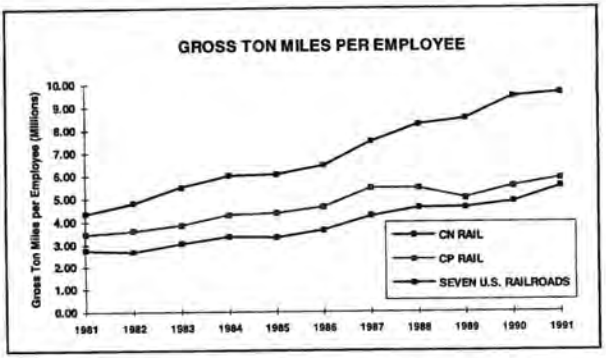
The purpose of this discussion paper is to explore various alternatives for the restructuring of the Canadian freight railway industry, and CN and CP in particular. None of the alternatives are intended to represent the future outcome but are presented in order to highlight a full range of issues for consideration, and to assist in the public debate.

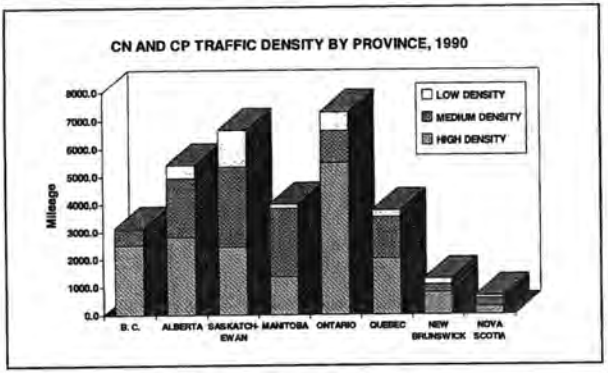
1. The Current Operating and Financial Performance of CN and CP

By way of introduction, the following is a summary of the recent operating and financial performance of CN and CP in order to highlight the chronic need for restructuring.

On the operating side:

- Resource-based rail traffic dropped by 4% annually between 1988 and 1990 and is not projected to return to the peak of 1988 until 1997;
- Intermodal rail traffic of principally manufactured commodities is subject to intense truck competition, and rail service has not generally been recognized as sufficiently reliable when compared to trucks;
- Overall, rail has continued to lose surface market share to trucking, down from 50% of domestic tonnes in 1981 to 38% in 1988;
- The NTA 1987 still subjects rail to significant economic regulation and limits the ability of the railways to reduce costs. This is in contrast to the trucking industry which is essentially de-regulated;
- Rail labour costs are excessive. Despite announced layoffs of 10,000 employees at CN for example, both railways have too many employees when compared to the US Class 1 railroads. During the 1980s, US railroads shed 50% of their labour force while CN and CP shed only 38%, so that by 1991 the average gross ton-miles per employee was 9 million in the US but only 5 million in Canada;
- Rail infrastructure is excessive. In 1990, some 33% of railway lines carried just 2% of rail traffic. Furthermore, the average traffic density of US railroads was 14 million gross ton-miles per mile in 1989 compared with 9 million in Canada;



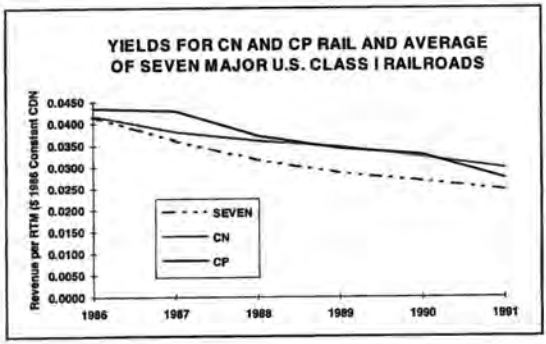


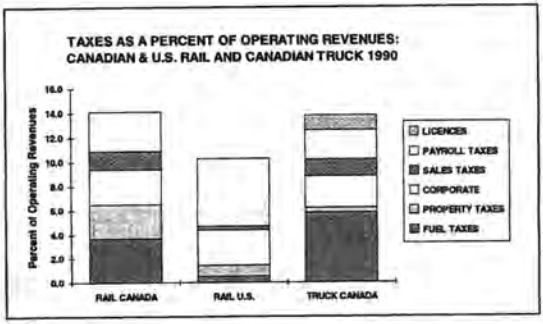
U.S. - CANADA COMPARISON OF RAILWAY ANNUAL TOTAL FACTOR PRODUCTIVITY	
U.S. RAILROADS 1981-1989 (ICC Deflated Expenditure Basis)	4.4%
U.S. RAILROADS 1981-1988 (AAR)	5.5%
U.S. RAILROADS 1981-1989 (ICC Gross Output Basis)	6.5%
CN 1981-1988 (Deflated Expenditure Basis)	3.3%
CP 1981-1988 (Deflated Expenditure Basis)	1.4%
CN 1981-1991 (Aggregate Output / Aggregate Input Basis)	3.0%
CP 1981-1991 (Aggregate Output / Aggregate Input Basis)	2.7%

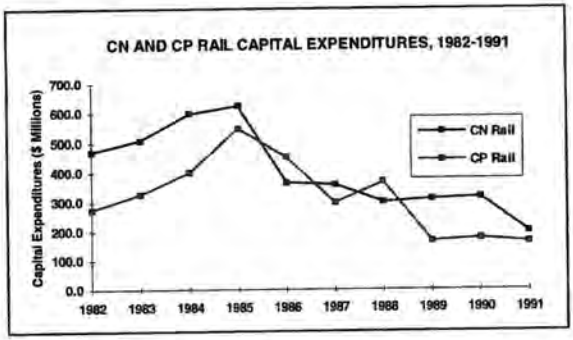
- Canadian rail productivity has lagged behind US railroad productivity by over 2% per year since 1980. As a result, by 1990 US railroads moved 7 times the traffic with only 4 times the operating expense, 4 times the investment and 3 times the number of employees.

On the financial side:

- Railway yields have declined significantly. CN experienced a real revenue per ton-mile decline of 33% between 1984 and 1991 while CP experienced a decline of 41% over the same period;
- Competitive pressures on railway yields continue, as the average yield of US railroads in 1991 was still 10 % lower than CN and CP;
- There has been a resulting decline in CN and CP capital expenditures since 1985;
- Operating ratios of CN and CP are deteriorating relative to US railroads;
- Rail taxation as a percent of operating revenues is 4.7% higher in Canada than in the US, particularly with respect to fuel (2.7%) and property taxes (1.0%);
- Both CN and CP experienced net losses in 1991 and 1992 and CNs net losses in 1993 were $95 million for a combined net loss of $385 million since 1990;
- In particular, losses in the eastern operations of CN and CP have been of the order of $2 billion over the past five years;







Overall, it is apparent that the financial viability of CN and CP is at risk. Competitive pressures on Canadian railways from domestic trucking and US railroads are not expected to diminish in the coming years. It is anticipated that continuing pressures on railway yields will outstrip current productivity gains on the cost side and leave the railways in a continuing difficult position unless corrective action is taken.

New trading arrangements under CUSTA and NAFTA as well as structural changes in the economy will likely favour truck over rail, as the balance in freight transportation continues to shift towards manufacturing and away from resource industries. As a consequence, truck is projected to move 75% of the increase in export trade to the US. In addition, for goods moving to US points by rail, the reach of CN and CP rail lines is such that the segment in Canada will be short. It is worth recalling that there are both international and domestic precedents for very serious railway financial difficulties: the bankruptcy of the Penn Central in the US in the mid 1970s; the enormous financial burden of the Japanese National Railway in the mid 1980s even after restructuring; the recapitalizations of CN in 1937, 1952 and 1978.

While the fortunes of Canadian railways may currently be in decline, it is nevertheless important to emphasize their significance to the national economy. The rail industry has a 95% market share in the surface movement of resource-based commodities (coal, iron ore, nickel/copper, wheat and barley, potash, sulphur, gypsum, lumber and woodpulp). Rail costs can represent up to 40% of the delivered prices of these largely export goods. As a consequence the rail industry is also important for the economic viability of Canada's major ports.

Overall, there is a belated recognition among shippers, carriers and governments of the need for significant rail restructuring particularly in eastern Canada.

2. Alternatives for Restructuring

The purpose of restructuring is to ensure the continuing access by shippers to efficient and effective rail service in Canada.

The first structural issue is the geographical extent to which railway restructuring is required. On the one hand, it is apparent that the financial difficulties of CN and CP relate to their operations in eastern Canada and in the north eastern U.S. (the rail network east of an axis through Winnipeg and Chicago) where manufacturing traffic predominates. Given the profitability of both CN and CP for operations west of that axis, and the desirability of retaining competitive rail service where it exists, the focus of attention should be limited to eastern operations.

On the other hand, in one important respect western operations differ from eastern operations with the existence of a very significant block of regulated and subsidized traffic, namely western grain. The current reform efforts associated with the Western Grain Transportation Act (WGTA) would see:

i) A relaxation of the protection afforded the 6,000 miles of grain dependent branch lines in western Canada and an acceleration in the pace of line rationalization;
ii) A more commercial freight rate regime for western grain traffic; and
iii) A redirection of a large part of the subsidy from rail transport to western farmers.

Since the current fiscal reality precludes significant subsidy of rail traffic in the east, regional equity between east and west requires completion of some of the WGTA reform effort as part of the overall rail restructuring effort. In particular, the introduction of transportation efficiencies into the movement of western grain (as represented by i) and ii) above).

In addition, somewhat less than 9,000 miles of non-grain dependent rail lines in western Canada are also protected from rationalization by Order-in-Council until the year 2000, and regional equity would also seem to require that rail restructuring require the removal of these prohibition orders. Rail restructuring in the east would also imply an end to the need for the internal cross-subsidy by CN and CP of eastern shipments by western shipments.

The balance of this discussion paper will therefore assume that such western reforms accompany the rail restructuring and that attention may therefore be focussed solely on the east.

The second structural issue to be addressed is whether it is a necessary condition that competitive rail service in the east be provided by Canadian carriers, a restructured CN and CP perhaps together with some new entrants. One of the alternatives to be considered (which involves the separation of the rail plant from train operations) could imply the eventual provision of train operations solely by US rail carriers or other new entrants, while CN and/or CP would manage the rail plant only. This is a rail policy question which should be borne in mind when considering the restructuring alternatives.

Two other structural issues which will bear on the alternatives and their implications are:

- The ownership of the rail plant in the east;
- The rights and obligations of rail carriers with access to the rail plant in the east.

In order to explore all the structural issues and to highlight a full range of issues for consideration, four alternatives for rail restructuring in the east have been identified:

i) A full merger which, at time of writing, is the most likely proposal from CN and CP as suggested in newspaper reports;
ii) Co-production which would be an extension of the partnership proposal for the Ottawa valley (recently approved by the National Transportation Agency) extended to the whole eastern network;
iii) Creation of a common user rail plant, which involves the separation of the rail plant from train operations; and
iv) Continuation of the two independent railways, with all practical structural adjustments included.

3. Implications

The restructuring alternatives identify an eventual outcome for the rail industry in the east, and the implications of these alternatives depend significantly upon:

- The extent of rationalization; and
- The extent of competition.

A comparison of the alternatives on these two themes, together with a comparison of the fiscal implications for the federal government, appears in summary form in Exhibit 1.

EXHIBIT 1: COMPARISON OF RESTRUCTURING ALTERNATIVES	FULL MERGER	CO-PRODUCTION	COMMON USER RAIL PLANT		CONTINUATION OF CN AND CP AS INDEPENDENT SYSTEMS
			UNREGULATED ABANDONMENT	REGULATED ABANDONMENT	
	(Relative Horizontal Rankings)				
EXTENT OF RATIONALIZATION					
Reduction in rail lines, other plant assets and associated labour	2	3	1	5	4
Reduction in equipment, facilities, associated labour and management	2	3	1	1	4
Investment in train control, crossing protection systems and connections	2	3	1	Uncertain due to potential for inefficiency at TRACKCO	4
Extent of net cost savings to the railways	2	3	1		4
EXTENT OF COMPETITION					
Complete loss of rail service as a result of abandonment	2	3	1	5	4
Retention of common carrier obligations	√	√	-	-	√
Retention of interchanges and connections between CN and CP	-	√	-	-	√
Retention of existing access provisions:					
- running rights	√	√	-	-	√
- competitive line rates (CLRs)	Reduced access	√	-	-	√
- interswitching	Reduced access	√	-	-	√
Improved direct access:					
- both CN and CP	-	√	√	√	-
- all qualified train operators	-	-	√	√	-
Lessening of competition on retained rail lines	1	3	4	4	2
FISCAL IMPLICATIONS					
Likely need for additional rail subsidies	3	2	4	1(TRACKCO)	1(CN)
Rail plant acquisition costs	-	-	TRACKCO as a public company		-
Privatization proceeds	-	-	TRACKCO as a private company		-
Need for a further write-down of CNs asset valuation	√	-	√	√	-
Long-run financial viability of exiting carriers in the east:					
Likelihood of CN viability	1	2	4	4	3
Likelihood of CP viability	1	2	3	3	4

NOTE: Ranking is from 1 = Most to 5 = Least

3.1 Full Merger

A full merger, at time of writing the likely proposal from CN and CP, would see a single new railway company (NEWCO) owning and operating the combined rail plant in the east. In effect, Canada would then be served by three Class 1 freight railways, CN (in the west), CP (in the west), NEWCO (in the east) and the situation in the east would not be very different from the current situation in the north-western US where Burlington Northern railroad is, by and large, the only Class 1 railroad servicing some half dozen states.

Such a full merger would imply significant rationalization of equipment, facilities, marketing functions and general administration as well as a significant reduction in railway lines and other plant assets such as terminals and yards.[1] It has been suggested that an additional 3,000 employees could be made redundant and that net cost savings to CN and CP combined could be of the order of $200 million. This is the alternative most likely to lead to the long-run financial viability of both CN and CP as well as NEWCO.

On the other hand, a full merger is the alternative most likely to raise concerns about the prevention or substantial lessening of competition for shippers. Some shippers will see a complete loss of rail service as a result of abandonment: for many of these shippers there will remain competitive transportation alternatives from the trucking industry, but for a few shippers, who are captive to rail by virtue of the traffic handling characteristics or the absence of road access, the loss of a rail line will pose difficulties.

Even for shippers who will not face line abandonment there will be a perception of a lessening of competition. Interchanges and connections between CN and CP, will be eliminated with the formation of NEWCO, and eastern shippers access to competitive line rates (CLRs) and interswitching will be reduced or eliminated. There may also be concerns that future shortline railways in the east will find their competitive position impaired by a merger. Some candidates for shortlines may currently have outlets to both CN and CP, an alleged competitive advantage in the negotiation of freight rate divisions which would be eliminated with the formation of a single NEWCO.

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[1] A limited economic analysis suggests abandonment of some 25% of rail lines in eastern Canada as uneconomic or as a result of co-production, particularly in northern Ontario. In addition, another 25% of rail lines could be conveyed to regional/shortline operators particularly in northern Quebec.

Overall, specific details of a merger proposal are not known at time of writing: the valuation of merged assets; whether the disposition of outside assets precedes, coincides with, or follows the merger; membership of the Board and management team; whether NEWCO will negotiate new improved collective agreements with rail labour unions; whether the headquarters of CN and CP will be relocated; and the legal avenues to be followed in obtaining regulatory and legislative approval.

3.2 Co-production

In November 1993, the National Transportation Agency (NTA) approved a partnership agreement between CN and CP for co-production through the Ottawa valley. This co-production arrangement served to permit the abandonment of one of the rail lines through the valley and to re-route all the bridge traffic of both CN and CP over the remaining line. Since more than 95% of the traffic is bridge traffic, very few local shippers were affected, and the net long-run cost savings from line rationalization were estimated to be more than 30% of current track and roadway costs.

A second alternative for the restructuring of CN and CP would be to extend the concept of co-production to the creation of a partnership agreement between CN and CP to include the combined rail plant in the east as partnership property.

On the one hand, such a model would see less extensive rationalization. Since both CN and CP would continue to provide rail service over the partnership property, there would be fewer savings from a reduction in equipment, facilities, associated labour, marketing functions or general administration. It is also possible that such a partnership would result in less reduction in rail lines, other plant assets and associated labour than a full merger. Fewer cost savings imply a lower chance of achieving long-run financial viability which in turn increases the risk of the need for rail subsidies from government.

On the other hand, such a model would likely see fewer shippers with a complete loss of rail service as a result of abandonment, and **all** shippers on the partnership property would have access to rail service by **both** CN and CP. This would have the effect of enhancing rail competition although it is always difficult to predict the precise behaviour of a duopoly. According to the NTA, existing access provisions associated with running rights, CLRs and interswitching would continue to exist under a partnership agreement although they would be rendered at least partially redundant.

Access to all shippers by both railways would likely alter the competitive positions of CN and CP: for example, the competitive advantage CN expects to

achieve with the completion of the Sarnia tunnel would be lost if it were included in the partnership property. Overall there is a perception that CN may currently be in a better competitive position for traffic in the east than CP. Whether equalizing CPs competitive position would be sufficient to coax their shareholders to accept such an imposed solution is unclear.

3.3 Common User Rail Plant

The creation of a common user rail plant would involve the separation of the rail plant in the east from train operations, with the intention of enhancing competition in the provision of rail service.

One of the many possible variants would see the rail plant administered as a public utility with train operators competing on the publicly-owned railbed: this would be comparable to the position of motor carriers who compete to offer service on publicly-owned highways. It is this variant that has been the subject of previous consideration in Canada (in 1975 following the Western Economic Opportunities Conference, in 1987 for the Economic Council of Canada, in 1991 for the Hyndman Commission and most recently in 1993 for the Rivard Commission) and this variant that has been implemented in Sweden and the United Kingdom.[2]

For current purposes it is important to recognize the two key structural elements of the general model:

- The presumed discontinuance of any common carrier obligations of train operators on the combined rail plant, including CN and CP; and
- The extent of economic regulation of the track operator.

Once a new railway company (TRACKCO) has been created to operate the combined rail plant in the east, whether in public or private ownership, its relationship with potential train operators is critical.

The many potentially qualified train operators who could offer service on the combined rail plant (CN, CP, shortline operators, US carriers, new entrants such as resource-based companies or manufacturing companies) would ensure competitive rail service, which in turn would ensure a significant rationalization of equipment, facilities, marketing functions and general administration of CN and CP. Whether such rationalization would ensure the long-run financial

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[2] Note that the general common user rail plant model does not require that the rail plant be in public ownership.

viability of CN and CP as train operators on the combined rail plant is uncertain, particularly for the crown operator CN. It is the creation of this potentially highly competitive market for the provision of rail service that is the attraction for the advocates of this alternative[3] .

However, once attention is focussed on the institutional arrangements surrounding TRACKCO the situation may become less attractive. It is generally assumed that TRACKCO would be subject to economic regulation with respect to the pricing of access to the rail plant. If not, then it would likely practice discriminatory pricing as the operator of a monopolistic rail network and the benefits of competition in the provision of train operations would be captured by TRACKCO and lost to the shippers.

With TRACKCO subject to price regulation, train operators would be free to "skim the cream" from large shippers and leave small and geographically isolated shippers without affordable service. This in turn would require TRACKCO to abandon large segments of the combined rail plant which would be uneconomic as a consequence. The overall impact of this scenario would be highly competitive rail service for large, well-positioned shippers at the expense of a very significant rationalization of rail lines, other plant assets and associated labour and a complete loss of rail service for corresponding shippers.

Alternatively, TRACKCO could also be regulated with respect to abandonment. However the outcome of this scenario would be the continuing politicization of abandonment applications, the extent of rationalization of rail lines would be minimal, and TRACKCO would require government subsidy.

Other issues relating to a common user rail plant include:

- The decoupling of responsibility for track maintenance from the responsibility for train operations has the potential for inefficiency at TRACKCO (this may be compared with the level of non-commercial decision-making concerning highway expenditures);
- If TRACKO were owned and operated as a public company then there would be significant costs associated with the acquisition of CP's rail plant.

In summary, this alternative would see an end to the implicit bargain in effect since Confederation, whereby Canadian rail plant is in commercial hands and

[3] One variant might be to partition the combined rail plant and auction franchises to be the sole train operator on each sement. Note however that competition might be considerably less vigorous assuming train operators had to meet common carrier obligations on their segment.

subject to strict controls on abandonment, in return for which the railways are not subjected to the full force of intra-modal competition. Over the years, and with the advent of trucking, the bargain has evolved, most recently in 1987 with passage of the National Transportation Act, when the bargain was stretched to give shippers the benefit of increased competition, but railways were not given the freedom to control their costs associated with the rail plant.

3.4 Continuation of Two Independent Railways

This alternative may be characterized as the status quo with the continuation of both CN and CP as complete railway systems operating in the east but with all practical structural adjustments included. The structural adjustments that might be considered include:

- Further rail line rationalization (localized abandonment, conveyance and co-production);
- An exercise of shareholder control over CN (elimination of the regional corporate structure, scrutiny of capital budgets);
- A concerted effort by carriers, with the implicit support of government, to improve rail labour practices; and
- A willingness by governments to reduce the tax burden on railways.

Overall, the extent of rationalization under the current regulatory and legislative regime will likely be inadequate and require an increase in branch line subsidies. There will be insufficient cost savings to the railways and, in the absence of main line subsidies, it is unlikely that CN and CP will attain long-run financial viability.

On CP's part it might seek a joint venture in the east with a US carrier, or perhaps an outright sale of selected assets, with deferred expenditures on the balance of the eastern system and a significant deterioration in quality of service to shippers. This latter option was the response to significant financial losses as a result of government inaction on the regulated Crow Rates in the late 1970s.

On CN's part it will likely require a recapitalization to avoid bankruptcy or require the government to manage its restructuring in a manner similar to the U.S. government in its handling of the Penn Central bankruptcy.

As a final note it is worth emphasising that rail carriers in dire financial straits will not be able to continue to provide competitive rail service to shippers in Canada.

4. Position of Stakeholders

There will not be a common position of **rail shippers** to any of the restructuring alternatives. In the west, resource-based shippers moving coal, lumber, potash or sulphur will favour rail restructuring as they will not expect to lose rail service and will benefit from the potential to negotiate lower freight rates from a more financially secure CN and CP in the west. Grain shippers who are in favour of market-based reform of the WGTA will not be in favour of a transportation efficiencies package without a simultaneous change in the Method of Payment (MOP) of the Crow subsidy. In contrast, some grain shippers will favour the transportation efficiencies while opposing any change to the MOP. While the mood in western Canada on WGTA reform is evolving to a recognition of the need for change, there will still be strong vocal opposition from farmers who will want to see the retention of their local rail line even if they may not use the line to ship their grain to market.

In the east, large manufacturing shippers who are not at risk of losing their rail line will favour restructuring provided competition is retained. For some, the common user rail plant will be attractive, provided TRACKCO is regulated and government provides the subsidy. For others, with US carriers as a competitive option, a full merger may be acceptable particularly as it will likely result in an improved quality and reliability of service from NEWCO.

Smaller shippers and shippers captive by virtue of their traffic handling characteristics will be particularly concerned with line abandonment although many will, in fact, be able to take advantage of the competitive alternative transportation services provided by motor carriers.

There will be concerns expressed by **passenger rail**, their customers and their advocates, from any loss of passenger rail service that results from a reduced rail line network in the east. A reduced line network may also result in increased rail traffic congestion at some bottlenecks which might imply a less convenient or less timely scheduling of some rail passenger services.

Rail labour unions will be very wary of any and all restructuring proposals and will be particularly concerned with the extent of redundancy, the continuation of employment security provisions and the future of collective agreements with any new railway company. The possibility of industrial action cannot be discounted, particularly if the creation of NEWCO were used as an opportunity to significantly renegotiate union contracts in favour of railway management requirements. Labour unions will also likely be concerned with rail safety: with a

reduced network and a consolidation of traffic on some routes there will be a concern about an increase in the risk of accidents.[4]

Transportation competitors and partners will be interested in the details of any railway restructuring. The **motor carrier industry** will be strongly opposed to any recapitalization of CN or an increase in rail subsidies in any form. Whether Canadian motor carriers will foresee a significant erosion of their market share from intermodal rail competition in the long-run remains to be seen. Major **ports** such as Vancouver, Montreal or Halifax who are dependent on competitive rail service will be supportive of rail restructuring on the understanding they will continue to receive full rail access.

Other ports such as Thunder Bay and Saint John will be concerned that they may be relegated to regional status while Churchill will continue to feel threatened by a complete loss of rail service. **Seaway interests** have already expressed their concern over rail restructuring in the east without WGTA reform in the west: however, even if both reforms were accomplished simultaneously, Seaway interests are unlikely to be supportive of any initiative which will further erode their already precarious competitive position.

Local and regional communities will object to any loss of rail lines, to any facility closures, to the loss of local rail employment and to the weakening of their economic base implied by discontinued access to rail service. Many communities particularly on the Prairies will also express concern about the adverse impacts of increased truck traffic on local roads and highways. Other communities with continued rail service will be concerned about the negative economic effects of an increase of rail traffic on their rail lines, such as a decrease in residential property values, and about any negative environmental effects. All of these public interest concerns would be addressed by the NTA in any regulatory process associated with rail restructuring.

Provincial governments will be particularly interested to ensure the continuation of a national rail network:

- Connecting major population centres
- Serving selected strategic marine and rail ports of entry and exit
- Providing access for significant industrial centres and resource areas
- Essential to the integrity of a national continuous east-west trunk rail system

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[4] There will be the need to upgrade some local rail crossing systems as a result of increased traffic although it is considered unlikely that an increase in grade separation will be required.

as already emphasised by a federal-provincial committee studying rail rationalization. While any realistic rail restructuring will meet these criteria, nevertheless the Provinces have shown determination to include almost all rail lines in such a national rail network, a position which would render restructuring ineffective.

Finally the **federal government**'s position will be strongly influenced by fiscal realities:

- The extent of fiscal exposure to the financial difficulties of CN
- The possibility of a significant increase in branch line subsidies
- Any acquisition costs or privatization proceeds that may be implied by some of the alternatives
- The need for new rail subsidies, such as a network subsidy for TRACKCO
- The size of any adjustment programs that may be required to ease a transition.

Regional equity will also be of paramount importance.

5. Discussion

In providing any overall assessment it is worth recalling the conclusions of the Rivard Commission in 1993:

> "The evidence demonstrates that Canadian railways face serious challenges in the 1990s. The current situation is not sustainable. The eventual cost to the national economy, and perhaps to the government as the shareholder of CN, could be very great...The trucking industry and US rail competitors pose a genuine threat to the future of Canada's railways and to the shippers who depend on them. If Canada does not wish to pay the price of a serious deterioration of the rail mode in this decade, it is essential that the carriers be allowed and encouraged to make the changes needed to compete."

The challenge facing the federal government in pursuing a competitive agenda for the nation's railways is daunting. It will be a difficult task to press for efficient railways in the face of decades of entrenched attitudes and the strong association between the presence of rail lines and the future of regions and municipalities.

Nevertheless, in the final analysis the outcome for railways is clear:

- A restructuring;
- Bankruptcies; or
- Subsidization.

The retention of two independent railways in the east is not viable in the long-run and the "achilles heel" is the public ownership of CN. Even with significant streamlining under government direction, CN will likely require recapitalization when capital markets, in the absence of government guarantees, are no longer willing to finance additional borrowing. Significant delays and/or government financial support of CN will drive CP to seek other options with the likely final outcome being CN as the sole Class 1 freight railway in the east.

The common user rail plant alternative would represent a radical departure for North American railways and its attractiveness evaporates for shippers if TRACKCO is unregulated or for government if TRACKCO is regulated and requires subsidy.

Co-production offers a partial restructuring solution with a continuation of rail competition but may not lead to long-run financial viability. It has been suggested that the extent of cost savings relative to a full merger would be considerably reduced, but a railway assessment of the advantages and disadvantages of such an approach and its financial implications would be of interest.

A full merger in the east, the preferred railway option at time of writing, appears to have the best chance of ensuring long-run financial viability and may well result in the best overall solution. Any railway proposal will probably require some modifications to suit the political imperatives, while some of its negative implications can perhaps be mitigated through adjustment programs to ease shippers adversely affected through the transition.

La fonction de coût du transport routier de marchandises sur longue distance en France[1]

Michel BEUTHE, David LAFFINEUSE et Alain SAYEZ

Introduction

Le transport routier est en pleine expansion en Europe, et les progrès de l'intégration économique de l'Union soumettent ce secteur à de nouvelles conditions de concurrence. Ainsi est-il important d'analyser la relation qui existe entre les coûts du transport routier et la dimension des firmes ainsi que les caractéristiques de leurs opérations, afin de mieux comprendre l'évolution de ce secteur et d'évaluer les dispositifs réglementaires existants.

Cet article a pour but d'estimer la fonction de coût de long terme du transport de marchandises de longue distance, sur base de données provenant de la Direction Générale des Transports Terrestres français.

Un modèle translogarithmique général avec transformation de Box-Cox a été retenu. Il nous permet de caractériser l'allure de la courbe de coût moyen par rapport à un output agrégé, d'identifier les rendements d'échelle, d'évaluer éventuellement la dimension optimale de la firme, et enfin de mesurer les élasticités.

La première section est consacrée à une brève revue de la littérature. La seconde section précise la spécification économétrique utilisée, tandis que la troisième détaille les données disponibles. La quatrième section analyse les résultats de l'estimation. De brèves conclusions clôturent cet article.

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[1]Cette recherche a été réalisée à la Faculté Universitaire Catholique de Mons dans le cadre du Programme "Transport et Mobilité" de la Programmation de la Politique Scientifique belge, que nous remercions de son appui. Nous avons bénéficié de l'aide et des commentaires constructifs de Monsieur Benoît du Ministère de l'Equipement, du Logement, des Transports et de l'Espace de France. Nous tenons à l'en remercier.

1. Revue des études récentes et de leurs résultats empiriques

De nombreuses études ont déjà été consacrées au transport routier de marchandises, principalement aux Etats-Unis. En se limitant aux études récentes, il faut citer principalement celles de Koenker (1977), Spady et Friedlaender (1978), Friedlaender et Bruce (1985), Daughety, Nelson et Vigdor (1985), Daughety et Nelson (1988), Gagné (1987,1990), et enfin Harmatuck (1981,1991). Excepté Koenker, qui estime une fonction de coût multiplicative, tous les auteurs cités estiment une fonction de coût translogarithmique comme approximation basée sur une expansion de Taylor limitée au second degré, afin de ne pas imposer une forme fonctionnelle a priori mais de n'en estimer que les dérivées premières et secondes.

Spady et Friedlaender (1978) étudient l'apport des fonctions de coûts hédoniques sur base d'un échantillon de 168 firmes pour l'année 1972. Le coût total dépend d'une mesure d'output hédonique qui est fonction des tonnes-miles et de plusieurs caractéristiques des opérations des firmes : le poids moyen d'un envoi, la distance moyenne de transport, la charge moyenne par camion, le pourcentage des lots d'un poids inférieur à la capacité d'un camion et le coût d'assurance à la tonne-mile. Les autres variables explicatives sont le prix de la main d'oeuvre, de l'énergie, du capital et du transport acheté. L'estimation hédonique se révèle de qualité supérieure, ce qui indique l'hétérogénéité de la production du transport routier. Elle fait apparaître des rendements d'échelle pratiquement constants par rapport à l'output hédonique, en fait très faiblement décroissants, car l'élasticité par rapport à l'output hédonique est de 1.03. Toutefois, comme les caractéristiques des grandes firmes sont plus favorables, celles-ci bénéficient d'économies de densité (ou d'utilisation) par rapport à leurs plus petits concurrents. Spady et Friedlander pensent que les caractéristiques des firmes résultent essentiellement de la réglementation de l'industrie et que, si les petites firmes pouvaient s'organiser de façon plus efficaces, elles pourraient mieux concurrencer les grandes firmes. Leur étude indique aussi une très faible élasticité de la demande de gasoil ainsi que de l'élasticité de substitution entre le gasoil et la main-d'oeuvre ou le capital.

Friedlaender et Bruce (1985) continuent cette recherche sur un échantillon de 85 firmes portant sur des données annuelles de 1974 à 1979, afin d'analyser l'impact de l'évolution technologique sur les coefficients des autres variables explicatives. A cette fin, ils incluent le temps comme variable supplémentaire qui multiplie toutes les autres variables de la fonction, de façon à faire apparaître comment les coefficients estimés varient avec le temps. La fonction de coût total ne contient plus un output hédonique mais les caractéristiques des firmes sont introduites comme variables séparées, ce qui est une spécification plus générale. Bien qu'ils ne parviennent pas à bien distinguer les divers mécanismes du progrès

technologique, ils mettent en relief le rôle joué par ces caractéristiques dans la croissance de la productivité. Il apparait aussi que la firme moyenne bénéficie de faibles économies de densité (0.95) et que ses coûts moyens décroissent asymptotiquement. Toutefois, les firmes dont les caractéristiques sont les plus favorables bénéficieraient de fortes économies d'échelle. Comme ils distinguent le matériel roulant du reste du capital, ils montrent que l'élasticité de la demande de matériel roulant est très faible et que ce facteur est complémentaire avec le carburant.

Daughety, Nelson et Vigdor (1985) et Daughety et Nelson (1988) s'efforcent d'analyser l'impact des variations de la réglementation sur les coûts des entreprises au cours de la période 1953-1982. Leur fonction de coût total introduit le coût moyen de l'assurance comme output à côté des tonnes-miles habituels. La distance et la charge moyenne ainsi que le poids moyen des expéditions sont considérés comme représentatifs des caractéristiques des réseaux sur lesquels les entreprises opèrent, ces réseaux étant définis par les licences d'exploitation obtenues. Ces caractéristiques conditionnent donc les coefficients des autres variables explicatives, en sorte que la fonction estimée comporte des termes triplement croisés où interviennent ces caractéristiques, ainsi que le temps. Leurs résultats montrent assez bien l'influence de la réglementation sur les coûts des entreprises. Par exemple, si les rendements de densité sont très légèrement décroissants lorsque la réglementation est faible, ils deviennent légèrement croissants lorsque la réglementation se renforce.

Harmatuck (1981) aborde le problème des productions multiples de son échantillon de 100 firmes relatif à l'année 1977 en distinguant les outputs qui correspondent à des charges complètes et incomplètes. Les outputs sont définis en termes du nombre d'envois et de leur poids, tandis que la distance moyenne constitue une cinquième variable commune d'output. La transformation de Box-Cox est appliquée à chacune de ces variables, ce qui donne une forme plus générale à la fonction de coût. Les facteurs de production sont relatifs à quatre activités : le transport, les chargements/déchargements, le travail en entrepôt et la facturation. Ses résultats indiquent que les petits transporteurs sont caractérisés par des rendements de densité croissants et des économies de spécialisation, tandis que les plus grandes firmes ont des rendements constants, mais ont intérêts à diversifier leurs opérations.

Harmatuck (1991) reprend cette étude en analysant séparément les données trimestrielles de dix-sept firmes sur la période 1974 à 1983. Il utilise les mêmes variables que précédemment pour les outputs mais ne distingue que deux activités comme inputs, le transport proprement dit et les opérations de prise en charge et de livraison. Il ajoute le temps pour tenir compte de l'évolution technologique. Les résultats suggèrent des rendements de densité constants ou légèrement

croissants pour les plus petits transporteurs. Les économies de spécialisation ou de diversification varient d'une compagnie à l'autre.

Enfin Gagné (1990) estime une fonction de coût total pour le transport de marchandises dans les provinces de Québec et Ontario. Les variables utilisées sont les tonnes-km, les prix du fuel, de la main d'oeuvre, du capital et de l'équipement, en plus des caractéristiques du transport qui sont la distance moyenne de transport, la charge moyenne des camions, l'utilisation de la capacité et les coûts d'assurance à la tonne-km. Il trouve des rendements de densité croissants (0.96). Mettant en exergue la liaison entre, d'une part, les tonnes-kms, et, d'autre part, la distance de transport ainsi que la charge moyenne, il montre que l'accroissement de ces deux variables, alors que le nombre d'expéditions reste constant, aurait pour effet d'augmenter les coûts plutôt que de les réduire (comme pourrait le suggérer le signe de leur coefficient).

Enfin, signalons l'estimation par Tyroyanni (1990) d'une fonction de coût simplifiée sur deux échantillons de firmes françaises des années 1986 et 1988. Cette étude suggère des rendements de densité croissants de l'ordre de 0.9 à 0.99.

2. Modélisation

Supposons une fonction de production F à m outputs et n inputs, soit $F(Y,X)\geq 0$[2] où Y représente un vecteur des quantités de chacun des m outputs produits durant une période et X un vecteur des quantités de chacun des n inputs utilisés durant la période. Sachant que F(Y,X) est définie et continue pour tous les Y et X non-négatifs et en supposant que le producteur peut acheter les inputs à des prix donnés par le vecteur W, la fonction de coût du producteur est définie comme la solution du problème qui minimise le coût de production des m outputs aux prix fixés des n inputs :

$$C(Y,W) = \min_{X_i \geq 0} \{ \sum_{i=1}^{n} W_i X_i \mid F(Y,X) \geq 0 \}$$

La fonction de coût C(Y,W) doit être non-négative, à valeur réelle, non décroissante, strictement positive pour Y>0, linéairement homogène dans les prix des inputs pour n'importe quel niveau fixé d'output et concave en W pour chaque Y.

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[2]F représente la fonction de transformation des inputs en outputs et l'égalité représente l'optimum technique.

Ne connaissant pas a priori la forme de cette fonction de coûts, nous allons essayer d'en trouver une approximation en estimant ses principales caractéristiques. C'est pourquoi nous utilisons une spécification translogarithmique de la fonction de coûts provenant d'une expansion en série de Taylor (en s'arrêtant au second ordre).

Dans cet article, nous utiliserons seulement une mesure agrégée de l'output Y, à savoir le nombre total de véhicules-kilomètres d'une firme. Etant donné l'information disponible, les prix de trois inputs seront introduits : W_1, le prix de la main d'oeuvre, W_2, le prix du gasoil, W_3, le coût de l'assurance véhicule.

L'utilisation d'une mesure agrégée d'output qui recouvre des transports très variés rend nécessaire l'introduction de variables caractérisant les opération des firmes. Ces variables sont au nombre de trois : Q_1, un indice de diversification, Q_2, le coût de l'assurance-marchandises, et Q_3, le tonnage rémunéré par voyage. Dans la mesure où l'information et les variables utilisées couvrent l'ensemble des coûts et des caractéristiques des entreprises, nous pensons bien obtenir l'estimation d'une fonction de coût de long terme.

Les estimations seront effectuées à la moyenne de l'échantillon, en sorte que les élasticités du coût par rapport aux variables explicatives seront données pour la firme moyenne par les coefficients de premier ordre .

La variable dépendante C représente les coûts totaux d'exploitation relatifs à une firme et sur base de ce qui précède, nous pouvons réécrire la fonction de coût comme $C=C(Y,W_1,W_2,W_3, Q_1, Q_2, Q_3)$.

Une spécification généralisée du modèle hédonique avec transformation de Box-Cox sur toutes les variables a été retenue, elle s'écrit sous la forme :

$$\ln C = \alpha_0 + \alpha_Y Y^* + \sum_{g=1}^{3} \beta_g W_g^* + \sum_{h=1}^{3} \theta_h Q_h^* + \frac{1}{2}\sum_{g=1}^{3}\sum_{t=1}^{3} \gamma_{gt} W_g^* W_t^* + \frac{1}{2}\delta_{YY} Y^{*2}$$

$$+ \sum_{g=1}^{3} \rho_{Yg} Y^* W_g^* + \frac{1}{2}\sum_{h=1}^{3}\sum_{r=1}^{3} \mu_{hr} Q_h^* Q_r^* + \sum_{h=1}^{3} \psi_{Yh} Y^* Q_h^* + \sum_{h=1}^{3}\sum_{g=1}^{3} \eta_{hg} Q_h^* W_g^* + \epsilon$$

Les équations de coût partagées sont :

$$S_j = \frac{w_j^* x_j}{C} = \beta_j + \sum_t \gamma_{jt} w_t^* + \rho_{Yj} Y^* + \sum_{h=1}^{3} \eta_{hj} Q_h^* \qquad j=1,2,3$$

où ε représente le terme d'erreur et * représente la transformation de Box-Cox.

3. Les données

Les données proviennent des enquêtes menées de 1986 à 1991 par la Direction des Transports Terrestres et les Directions Régionales de l'Equipement français dans un certain nombre d'entreprises spécialisées dans le transport routier de marchandises. Ces enquêtes ont pour but d'évaluer les conditions d'exploitation et le prix de revient du transport routier de marchandises longue-distance et sont donc, il est vrai, peut-être plus adaptées à ce type de recherche qu'à l'analyse des fonctions de coût. Les données concernent seulement des ensembles articulés dont la limite de poids total roulant autorisé est de 40 tonnes (depuis le 1er mai 1986), même si les firmes étudiées utilisent également d'autres camions plus légers et fournissent d'autres services de transport. Ceci signifie que les coûts analysés ne sont pas toujours ceux d'une entreprise mais correspondent plutôt aux coûts d'un certain nombre d'activités spécifiques. L'essentiel des observations, soit 88% des observations, concerne le transport de marchandises générales (savoyards, fourgons, etc.). Mais l'enquête prend également en compte deux autres types de transport : le transport frigorifique et celui par camion-citerne.

La composition de l'échantillon n'est pas entièrement stable d'une année à l'autre, et le nombre d'entreprises interrogées varie de 158 firmes en 1990 à 186 firmes en 1988. Nous utiliserons l'ensemble des données comme un seul échantillon sans tenir compte du temps. En effet, une variable de temps introduite dans l'analyse économétrique s'est révélée non-significative. Il ne semble donc pas qu'une évolution technologique sensible se soit produite au cours de la période analysée.

Le tableau 1 montre la répartition des différents types de transport dans l'échantillon des firmes, toutes les années étant confondues.

Tableau 1 : Nombres de firmes par types de transport*

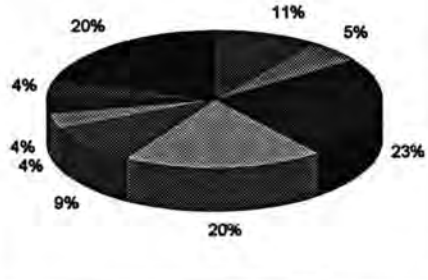
S	652	**S+F**	106
F	75	**S+C**	106
C	36	**F+C**	2
		S+F+C	18

*(S=Savoyard, F=Frigorifique, C=Citerne)

Les coûts d'exploitation totaux annuels sont constitués des frais de personnel de conduite, des dépenses de carburant, des dépenses d'entretien des véhicules, des coûts des pneumatiques, des péages, des frais d'assurances (véhicules et marchandises), des dépenses relatives au matériel roulant et des charges non-affectables. Toutes ces dépenses peuvent être distinguées par type de transport. Elles sont exprimées hors TVA déductible mais incluent les autres taxes. Tous les montants monétaires sont exprimés en francs constants de 1980. En ce qui concerne le matériel roulant, les dépenses ont été calculées sous forme d'annuités

en utilisant un taux d'intérêt réel de 4% et en se basant sur les prix d'achat ou la valeur de remplacement, sur la durée d'utilisation du matériel et sa valeur résiduelle[3]. Le graphique 1 montre la répartition de ces différents coûts dans le coût total.

Graphique 1 : Répartition des coûts



Les informations disponibles n'incluant pas sous forme directe les tonnes-kilomètres effectués, nous avons préféré utiliser comme output le nombre de véhicules-kilomètres. Par rapport à l'utilisation des tonnes-kms, cette variable a l'avantage d'être unidimensionnelle.

En ce qui concerne les prix des facteurs de production, nous utiliserons ce que l'on appelle généralement les prix des facteurs naturels, c'est-à-dire les prix réellement observés par les entreprises lorsqu'elles se fournissent en facteurs de production, à savoir : W_1, le salaire brut annuel moyen par chauffeur (représentatif du prix de la main d'oeuvre), W_2, le prix du gasoil au litre qui est la moyenne pondérée du prix du gasoil au litre pris à la citerne de l'entreprise et du prix du gasoil au litre acheté dans une station-service (à la pompe), et enfin, W_3, le prix de l'assurance-véhicules au véhicule-kilomètre calculé en divisant les coûts totaux en assurance-véhicule par le niveau d'output de l'entreprise (calculé en véhicules-kilomètres). Nous ne pourrons pas introduire un prix pour le matériel roulant.

Trois variables peuvent décrire les caractéristiques des transports effectués : Q_1 est un indice de diversification variant de 1 à 3 selon le nombre de types de

[3]Laffineuse (1993) expose le détail de ces calculs.

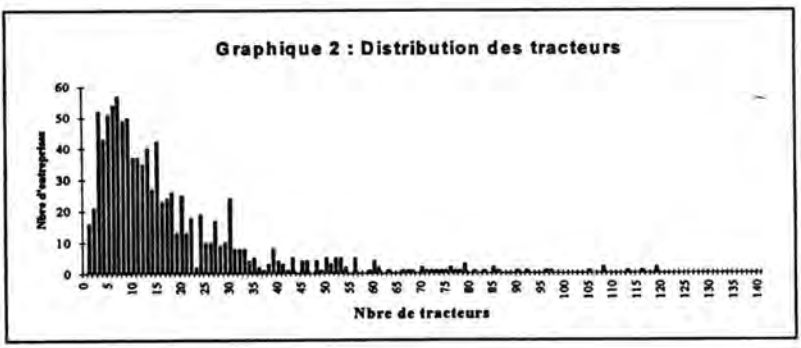
transport effectués par l'entreprise; Q_2 est le coût de l'assurance-marchandises à la tonne-kilomètre, qui mesure la valeur et la fragilité des marchandises transportées; enfin, Q_3 est le tonnage rémunéré par voyage qui dépend dans une certaine mesure de l'importance de la firme, de son organisation et des licences de transport dont elle dispose.

Le tableau 2 donne quelques statistiques sur les variables qui seront utilisées. On y voit combien les conditions d'exploitation varient d'une entreprise à l'autre.

Tableau 2 : Statistiques sur les variables

Variable	Moyenne	Minimum	Maximum
Coûts totaux (FF)	6429840,09	7274858,93	115313784,72
Total de véhicules-kms (kms)	2059999,21	80000,	31382759
Véhicules-kms pour S (kms)	1649218,19	80000,	12865000
Véhicules-kms pour F (kms)	1542700,64	61470,	11372182
Véhicules-kms pour C (kms)	1759295,93	74837,	31382759
Prix du gasoil au litre (FF)	1,59	0,85	1,90
Salaire brut annuel moyen (FF)	56296,17	34339,72	89365,49
Assurance-véh. au véh.-km (FF)	0,11	0,03	0,59
Indice de spécialisation	1,25	1	3
Coût assurance march. à la T-K (FF)	0,000016	0,00002	0,000107
Tonnage rémunéré par voyage (T)	21,649276	10,04	27
Coefficient de parcours en charge (%)	81,91	50	100

Le graphique 2 présente la distribution de la dimension des entreprises en termes de nombre de tracteurs. Notons que le nombre moyen de tracteurs est égal à 18,47 seulement.



4. Résultats empiriques

Tableau 3 : Estimation de la fonction de coût total

Paramètre	Estimation	Test de Student	Paramètre	Estimation	Test de Student
α_0	15.690880	2540.14	μ_{33}	0.048462	[illegible]
α_Y	0.986607	202.34	ψ_{Y1}	-0.007739	[illegible]
β_1	0.174265	161.98	ψ_{Y2}	0.007548	2.84
β_2	0.194416	184.85	ψ_{Y3}	0.007385	[illegible]
β_3	0.036574	161.93	η_{11}	0.001359	[illegible]
θ_1	0.030219	2.01	η_{12}	-0.001324	[illegible]
θ_2	0.073266	10.10	η_{13}	-0.001083	[illegible]
θ_3	0.079996	3.23	η_{21}	-0.005367	-3.86
γ_{11}	-0.054806	-4.38	η_{22}	-0.011578	-8.26
γ_{12}	0.152275	33.22	η_{23}	-0.002601	-9.70
γ_{13}	-0.005485	-6.12	η_{31}	-0.003301	[illegible]
γ_{22}	-0.044012	-15.51	η_{32}	-0.005668	[illegible]
γ_{23}	-0.006172	-15.05	η_{33}	-0.003956	-3.61
γ_{33}	0.034272	185.50	λ_1	0.031986	[illegible]
δ_{YY}	-0.035812	[illegible]	λ_2	0.114391	[illegible]
ρ_{Y1}	-0.002453	-2.58	λ_3	1.040453	3.22
ρ_{Y2}	.0000579	[illegible]	λ_4	0.771916	79.72
ρ_{Y3}	0.000516	2.94	λ_5	1.293882	[illegible]
μ_{11}	-0.012358	[illegible]	λ_6	0.462893	3.27
μ_{12}	-0.024504	-2.36	λ_7	-2.112041	-2.42
μ_{13}	0.015604	[illegible]			
μ_{22}	-0.009644	-2.35			
μ_{23}	-0.034335	-2.58			

R^2 (ln(C)) : .9820 R^2 (S_1) : .4149 R^2 (S_2) : .2381 R^2 (S_3) : .9069 Log-likelihood : 10566.3477

Nous pouvons remarquer l'excellente qualité d'ajustement de la fonction de coût total. Cependant les R^2 de deux des équations de coûts partagés sont relativement bas. Tous les coefficients des effets directs ainsi que ceux des effets croisés des prix sont bien significatifs. La moitié seulement des autres coefficients sont significatifs. La spécification de la fonction adoptée est toutefois confirmée par deux tests de vraisemblance.

En premier lieu, on pourrait analyser une fonction plus simple de type Cobb-Douglas. Cette spécification revient à imposer 35 restrictions éliminant tous les doubles produits du modèle. Dans ce cas, la valeur de la fonction de vraisemblance obtenue ne vaut que 667.6114. En la comparant avec celle obtenue dans le modèle ci-dessus, nous obtenons un $\chi^2_{\upsilon=35}$ observé de -2[667.6114 - 10566.3477] = 19797.4726 qui est supérieur au χ^2 critique de 63.66 pour un risque de première espèce α=.01. Nous pouvons donc rejeter l'hypothèse d'une

spécification de type Cobb-Douglas qui constituerait une sérieuse erreur de spécification et entraînerait dès lors un certain biais dans l'estimation des résultats.

Pour tester la validité de la spécification de Box-Cox par rapport à la spécification logarithmique, il suffit d'annuler tous les paramètres λ_i car la limite d'une transformation de Box-Cox pour λ tendant vers 0 est une fonction logarithmique. Pour la spécification logarithmique, nous obtenons une valeur de la fonction de vraisemblance de 9639.2468, ce qui donne un χ^2 observé de 1854.2018 qui supérieur au χ^2 critique de 18.475 (pour α=.01). Nous pouvons donc rejeter avec confiance l'hypothèse que les λ_i sont égaux à 0 et acceptons les transformations de Box-Cox.

Notons encore que la condition nécessaire de concavité de la fonction de coût est satisfaite pour 96% des observations de notre échantillon.

Le tableau 4 présente les élasticités-prix directes et croisées des trois inputs. Les signes des élasticités directes sont bien négatifs, tandis que les trois inputs apparaissent substituables les uns aux autres. Remarquons les très faibles élasticités de l'assurance-véhicule. Les autres élasticités tendent à être plus élevées que celles obtenues dans d'autres études. Ceci résulte peut-être d'un biais provoqué par l'absence d'un prix pour le matériel roulant. Cependant, la fonction estimée ne concerne que les opérations de transport à longue distance et ne peut être comparée aux analyses précédentes qu'avec prudence.

Tableau 4 : Elasticités-prix directes et croisées

ε_{ij}	**Main d'oeuvre**	**Gasoil**	**Assurance véhicule**
Main d'oeuvre	-1.1402	1.0682	0.0043
Gasoil	0.9575	-1.0320	0.0048
Assurance véhicule	0.0243	0.0256	-0.0264

Le tableau 5 présente les élasticités de substitution de Allen-Uzawa pour lesquelles les mêmes commentaires peuvent être faits.

Tableau 5 : Elasticités de substitution de Allen-Uzawa

σ_{ij}^{AU}	Main d'oeuvre	Gasoil	Assurance véhicule
Main d'oeuvre	-6.5431	5.495	0.664
Gasoil	-	-5.308	0.1320
Assurance véhicule	-	-	-0.7209

α_Y est égal à 0.986607 et significativement différent de 1, ce qui indique des rendements de densité légèrement croissants, comme dans plusieurs études mentionnées ci-dessus. Puisque δ_{YY} n'est pas significativement différent de 0, et que α_Y est inférieur à 1, la courbe de coût moyen décroît exponentiellement. Nous ne pouvons donc pas déterminer une taille optimale d'entreprise. Toutefois, la forme estimée de la fonction de coût moyen pourrait résulter en partie de la nature même des données. En effet, elles présentent un certain nombre de firmes comme indépendantes alors qu'elles font partie de holdings formés de plusieurs entreprises de transport, qui ne sont pas formellement regroupées sous un même nom, afin de tirer le meilleur parti des réglementations légales. Les opérations de ces holdings, qui constituent en fait de plus grandes entreprises, ne sont donc pas recensées en tant que telles. Pour la même raison, d'autres firmes peuvent aussi sous-traiter une partie de leur activité. Cette perte d'information pourrait expliquer en partie la décroissance asymptotique de la fonction de coût moyen.

L'impact des trois variables qualitatives sur les coûts est positif. Naturellement les marchandises de plus grande valeur occasionnent des coûts plus élevés. Les coûts s'accroissent également lorsque la charge des camions est plus grande, ce qui correspond au résultat obtenu par Gagné. Enfin, la diversification des activités tend à augmenter les coûts et il y a donc avantage à spécialiser les activités de transport. Notons toutefois le signe négatif du coefficient d'interaction entre l'output et l'indice de diversification (-0.0077), qui est pratiquement significatif. Ceci suggère que la diversification pourrait être utile à un niveau d'output plus élevé.

Pour calculer les rendements d'échelle, il faut considérer tous les ajustements possibles dans les opérations de transport et l'exploitation du réseau. Dans le cas présent, il convient donc de tenir compte des variations de la charge des camions qui peut en résulter. Dès lors, les rendements d'échelle sont mesurés par $(\alpha_Y + \theta_3)$ = 1.067, et seraient donc légèrement décroissants. Ces résultats expliquent assez bien l'organisation actuelle de l'industrie puisque l'entreprise moyenne, plutôt petite, bénéficie d'économies d'utilisation de son équipement, tandis que les

rendements d'échelle décroissants ne l'encourage pas à rechercher une plus grande dimension.

Conclusion

Nos résultats de l'analyse des données françaises recoupent largement ceux qui avaient été obtenus sur base de données nord-américaines.

Les entreprises de transport routier de marchandises paraissent bénéficier de rendements de densité légèrement croissants, tandis que les rendements d'échelle sont plutôt décroissants. Ceci explique la dimension réduite de la plupart des firmes.

L'absence d'économie d'envergure ou de diversification, sauf peut-être à un niveau élevé de production, correspond bien à la répartition des activités présentée par le tableau 1. Les entreprises spécialisées sont de loin les plus nombreuses.

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THE EFFECT OF DECREASING LONG RUN COSTS ON FARE STRUCTURE AND PROFITTABILITY AS APPLIED TO HIGH SPEED RAIL A STARLIGHT EXPRESS SOLUTION

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Introduction

In many transportation operations, the underlying production of an activity may well generate a profitable situation in the short term, when short run average and marginal costs are low. However long run average and marginal costs can often be "downward sloping" in the region where they intersect the market demand curve, resulting in an increasingly less viable, eventually unprofitable operation in the long run and the possible need for government subsidy, or a forcibly legislated "monopoly" with very sub optimal pricing or even abandonment of the operation (market failure).

The transportation sectors most vulnerable to this kind of market failure includes railways operation, both passenger and freight, ports and harbours, airports, highways, mass rapid transit facilities (both subway and commuter operation) and canals.

The problem arises in part due to the increasing "ageing" of capital intensive infrastructure and plant resulting in eventual major renewal often as capital intensive as the initial construction, and the inability (or political unwillingness) to create an adequate depreciation fund for eventual renewal.

This paper firstly discusses the problem generally, showing the long run effect to be either a subsidy, a monopoly, abandonment or more creativity a "multi part" pricing. The basic concept of Ramsey pricing is outlined by which an optimal pricing strategy can be established allowing an affordable quantity of transportation demand to be supplied which will maximize demand and hence profits, utilizing to the full the notion of "consumer surplus".

Ramsey pricing uses the theory of zero profit constraint by charging differentially for the various products, or, if a single product, by differential supply (e.g. time of day/day of week). When prices must be changed, all prices are changed proportionally, ie prices are changed to as to be efficient and attain a zero profit increase as a result of the change. The "load" is effectively shared in proportion to what the individual market segment will bear. The notion of "consumer surplus" considers the price at which a person will pay for a product rather than go without it.

Recent research (Hall 1990) has shown that a High Speed Rail (HSR) service between Edmonton and Calgary presents a practical, viable alternative for implementation by the early years of the new century. Passenger demand and modal split analysis establishing HSR's likely market share have been presented previously (Hall & Wirasinge, 1991), also an economic analysis (Hall & Wirasinghe, 1992) established that a satisfactory rate of return of 12% could be achieved.

The second part of the paper outlines an application of a differential pricing mechanism to the proposed High Speed Rail (HSR) corridor between Calgary and Edmonton. Known passenger demand, at a fixed marginal cost fare is tested against time of day pricing (TOD) and day of week pricing (DOW) for two segments, business and non business, using a practical example of Ramsey rules, establishing higher than median business fares and lower than median non business fares.

The demand for business trips is relatively inelastic, especially to fare, and for non business trips relatively elastic, which requires a modification of the rules whereby business fares would rise (for be initially set) comparatively higher above marginal cost than non business fares.

Again peak demand is more inelastic than off peak/weekend fares, even for non business travel and similar rules could apply to peak/off peak non business fares also to weekend/holiday periods.

The net result of the exercise is to establish a range of fares for two different market segments (business and non business) with different elasticities by time of day, and day of week which optimize demand by all segments and equally important, ensures the operator a fair rate of return on investment, above marginal cost, sufficient to meet all long run costs without recourse to subsidy or monopoly pricing.

The Alberta Corridor

Growing interest has been shown within recent years into High Speed Rail (HSR) service over short haul distances (less than 800 km) leading to increased research into likely demand for such service along with associated operating costs, fares and likely revenues in an era that is most definitely "post-passenger train" in the traditional sense. Figure 1 shows, in outline, the proposed H.S.R. corridor.

Fare Structure Overview

This paper takes the analysis performed to date a stage further by reviewing the fare structure types applicable to the corridor from a single "all day" flat fare through "Time of day" (TOD) peak/off peak pricing to a more refined TOD stucture incorporating differential business and non business class peak fares (a gold star and silver star service) together with a much cheaper off peak fare (bronze star service). The basis adapted is long range marginal cost pricing

with adjustments to individual fare levels using Ramsey pricing methodology. Day of week (DOW) pricing is reviewed in respect of weekend fare structures, with some general comments on further extension of the technique to cover students, families,seniors etc.

Decreasing Long Run Cost

Overview

In most transportation operations the underlying production of the industry will generate long-run average and marginal cost curves which are downward sloping in the region where they intersect the market demand curve, for reasons explained above.

In figure 2, D is the market demand curve, and LRAC and LRMC are the long-run average and marginal cost curves respectively. An economically efficient allocation of resources would require that the fare, P = MC, (marginal cost) which occurs at P,Q. A profit maximizing producer would not operate at this point, since price would be below LRAC, and in consequence the firm would suffer a loss of PABC (or BC per unit of output). This loss is represented by the shaded area on Figure 2.

A profit-maximizing producer would set a price = P1 and produce an output of Q1 (where MC = MR) (see Figure 3) and earn monopoly profits of P1EFG shown shaded on Figure 3. In this case, economic welfare is not maximized because P1 is greater than MC, and output is below the efficient level. It can be seen that an antitrust policy aimed at increasing the number of producers may be inappropriate, since the existence of two producers, for example, could lead to higher than optimal costs for both, as available economies of scale are not being attained.

Decreasing Long Run Costs

Essential Problem - Industrial

The essential problem is how to get the firm, or the industry, to produce a socially optimal level of output. The way not to do it is to force the firm to produce where price equals average cost, LRAC. In Figure 4 this would occur at P2Q2 resulting in socially suboptimal output (Q2 being less then Q). The "monopoly profit" and "undersupply" areas are shown shaded on Figure 4.

Essential Problem - Regulatory

There is a most extensive body of research showing that not only will P2 be suboptimal, but that the ACTUAL price charged to the public will be even higher than P2, and the output will be lower than Q2. This is because of the manner in which government attempts to regulate price. Typically, the producer is allowed to charge a price equal to MC PLUS a "normal" or "fair" rate of return on capital employed. In essence, the firm is allowed to "recover" both its variable and capital costs. Apart from the fact that Q2 is a suboptimal level of output to start

with, there are two major problems associated with the "fair" rate of return approach. First, the firm or the industry has no incentive to operate efficiently, as all costs are automatically passed on to consumers, because the firm is in effect guaranteed a "FAIR" rate of return on capital. As a consequence, there is no incentive for management to be efficient, since efficient management is not rewarded and inefficient management is not penalized. Thus, the absence of incentives causes the cost curves to shift upwards because of "X inefficiency" (sloppy management). The second problems arises in the context of the allowed rate of return. Averch and Johnson (1962) have shown that if the rate of return allowed by regulators is below the profit-maximizing, unregulated rate, but above the market rate (the rate at which the firm can borrow capital), the firm will substitute capital for other factors of production and thus not operate at a point on the production function where cost is minimized. The commonsense interpretation of the Averch-Johnson hypotheses is that an industry will enjoy a monopoly rate of return on capital employed and will thus move to increase the base rate. Historically both railways and airlines and, to a lesser extent, the intercity bus industry have applied this substitutional theory in practise. Then why would regulators set an allowed rate of return above the market rate of return? This could arise because of both the difficulty of simulating a market rate of return where the market clearly does not operate, in whole or in part, ie a monopoly or "Cartel" situation and the tendency to avoid setting a rate that is below the market rate. In the latter case, the firm would--in the long run--be unable to borrow capital, and in consequence, output would be restricted, unless heavily subsidized.

Potential Solutions

Given the nature of the Intercity transportation production function, how can the optimum (welfare-maximizing) marginal cost price be introduced?

One way is for the price P, to be set at the marginal cost, MC, with the resulting losses made up by a subsidy paid out of general tax revenues (often referred as the Hotelling Framework). This approach is traditional of government agencies especially where market failure has occurred (eg VIA rail, Amtrak) or where no market exists or cannot operate and market stimulation is needed ("pioneer" railways and roads in the former instance and regional disparities e.g Atlantic region freight movements, in the latter). Other political, defence, environmental or land use reasons could also arise to create a condition of subsidy.

Acceptance of this proposition is equivalent to advocating income redistribution from nonconsumers of the good to consumers. For example, users of the proposed HSR service would pay a price equal to marginal cost, and the capital costs would be met by levying taxes on the general tax-paying public, may of whom would be nonusers. This is clearly against present government policy both federal and provincial and is a premise that can be assumed not available under present circumstances. Figure 2 shows graphically the subsidy required where

P=MC. Average costs A=MR result in a subsidy of ABCP, show shaded. The greater the average costs increase over marginal costs, the greater the subsidy.

Another way (admittedly more difficult) would be to, somehow, get average costs equal to marginal costs, if not directly (which the nature of the passenger transportation industry precludes), at least indirectly, by some form of"equity in pricing", at least selectively across the market to optimize output, with prices set equal, overall to marginal cost. In this way price P becomes EFFECTIVELY equal to marginal cost MC, and the need for the subsidy shown in Figure 2 is eliminated.

Selective Pricing - Making use of Consumer Surplus

Notion of Consumer Surplus

The key to optimal pricing and equity lies in the notion of consumers' surplus. In figure 5 consumers enjoy a surplus (the amount they are willing to pay for Q units rather than go without the good LESS what they actually pay), from marginal cost pricing of area HPC. This amount is much larger than the sum needed to pay for the "loss" which arises from marginal cost (MC) pricing, area PABC shown in Figure 2. Thus COLLECTIVELY, consumers of the good are willing and able to pay for the total cost of production without nonconsumers being taxed to provide a subsidy. Figure 6 shows the "net" consumer surplus versus the "net" loss or subsidy requirement of setting prices at marginal cost MC.

Two-Part pricing

The extraction of the required sum from consumers' surpluses can be accomplished by an application of a two-part pricing principle. The operator could set a uniform--or discriminatory--"admission fee" (a seasonal flat fee, or time of day pricing (peak/offpeak) or day of week/weekend pricing for example) that would in aggregate be equal to the fixed costs and also set a price per unit equal to marginal cost. The government could act as enforcer of this system, if the market cannot or can only partially enforce (imperfect market conditions) either by restricting the producers' ability to extract more than is required, or by collecting "lump sum" regulatory taxes on users and remitting the proceeds (in whole or part) to producers. In most applications, the introduction of two-part pricing schemes also requires the presence of an "incentive mechanism" so as to ensure that "X inefficiency: (sloppy, lazy management) or overcapitalization (substituting capital for production) does not lead to higher than optimal production costs.

Multi Product Selective Pricing

Multi Product Effect

This discussion of pricing in the presence of decreasing long run average costs has implicitly assumed that the firm is producing a

single product. Market failure of the type discussed above can also arise when a single producer is able to supply a number of different products more efficiently than can a number of separate firms.

This situation may well arise in an Inter City corridor if HSR service could supply collectively, more efficient service for, say, business and non business, high income, non business low income, leisure travel, courier and package express services, than individual firms catering for separate markets eg airlines catering to business, high income non business and intercity bus catering only to lower income groups.

A Market situation using Ramsey pricing

Let us assume that the HSR operator, offering a variety of services is regulated on the basis of a zero-profit constraint, efficient prices can then be determined according to a simple Ramsey rule which states that the price of the firm's outputs must be changed in such a way that ALL prices are changed proportionately. Assume that the firm is producing two products, A and B (they could be offpeak and peak services, for instance) and that QAMC and QBMC are the quantities of A and B that are produced under marginal cost pricing. Denoting QA and QB as the outputs of A and B that would be produced when the firm's prices are changed so as to be efficient and attain zero "additional" or "monopoly" profits, the Ramsey rule requires that:

(1) QAMC/QBMC = QA/QB.

If the demand for A is assumed to relatively elastic and the demand for B to be relatively inelastic, as, indeed would be the case in the instance of off peak and peak fares, then in order to maintain the ratio QAMC/QBMC, the price of good "B" must be raised comparatively more with respect to its marginal cost than is the situation for good "A". Business trips are relatively inelastic to price, non business trips being relatively elastic. Hence the desirability of a two part "time of day" pricing. This principle could be extended to apply to different in "levels of service" such as differential business and standard class accommodation. Business/peak fares (Good B) would rise comparatively more than offpeak/standard fares (Good A). Overall Q is optimally produced at marginal cost without either subsidy, loss, or monopoly profit.

Application of Ramsey Pricing to HSR Service

This section applies Ramsey pricing to a proposed HSR service in the Alberta Corridor.

The initial scenario (Hall, 1990) created a set of travel demand and modal split models to establish passenger demand and HSR's modal share, being initially based on a marginal cost assumption of $80, (1990 prices) later modified to a $80 peak, $45 off peak scenario. These scenarios produced overall rates of return that were acceptable but not necessarily representing the optimum, ie revenue was not necessarily maximised, but they did give adequate market shares, given

the nature of the corridor. Table 1 gives details of the Intercity fares, by mode, at 1990 prices, against which our proposed fare policy would have to compete.

This basic scenario is now re-analyzed using a Ramsey pricing to establish "differential" peak/off peak fares to meet the business/non business allocation to rail, produced by the modal split models. Initially a flat fare effect is considered (the basis of the calibration of the initial models) followed by various peak/ off peak time of day (TOD) fares. Finally a differential peak business/non business scenario with a further much cheaper off peak fare is analyzed. A Day of Week (DOW) fare is briefly looked at, for separate application at weekends and public holidays.

Time of Day (TOD) Pricing

Peak/Off Peak Fares

Considering initially the "marginal cost" of business (B) and non business (NB) and the resulting modal splits to be indicative of the "quantity" of good produced, in the Ramsey equation:-

$$(2) \quad \frac{NBMC}{BMC} = \frac{NBAC}{BAC}$$

where NBMC = Non Business marginal cost
NBAC = Non Business average cost
BMC = Business marginal cost
BAC = Business average cost

In our case, a fare of $80, one way, (1990 prices) is a virtual "marginal cost". At this level modal splits of 7.98%(NB) and 16.8%(B) occur, resulting in the following equation:-

$$(3) \quad \frac{NB}{B} = \frac{7.98}{16.80} = 0.475$$

Total modal split = 24.78. Revenue/100 = $1982.

The revenue/100 figure is the revenue per 100 "potential" passengers based on the modal split and the fare . The Ramsey factor of 0.475 sets the "scene" for all further fare policy options. Setting fares to Ramsey is not enough, however as it is not necessarily an indication of maximum revenue. Likewise the business/non business split is not necessarily a good surrogate for the corridor peak/off peak journey patterns. Many non business trips occur in the peak (here defined as before 10.00am), similarly some business trips are initiated after 10.00am.

Restructuring on the basis of peak/off peak journey patterns (see Hall, 1990) we get, at a flat fare of $80:-

Peak trips(P) (business & non business)	=	21.79
Off peak (OP) (business & non business)	=	2.99
		24.78

Giving:-

$$(4) \quad \frac{NB}{B} = \frac{2.99}{21.79} = 0.137$$

Clearly our fare policy has shown that:-

$$(5) \quad \frac{NB}{B} \neq \frac{OP}{P}$$

However the peak/off peak split is the only sensible basis of a fare policy, whereas business/non business split represents a sensible division of journey purposes. The problem is to establish a peak/off peak fare policy which will attract both of the trip purposes in such proportions that:-

$$(6) \quad \frac{NBMC}{BMC} = \frac{(NB\ peak + NB\ off\ peak)}{(B\ peak + B\ off\ peak)} = 0.475$$

Utilizing the modal split equation developed we can establish a set of peak/off peak fares that both satisfy the above requirement and maximize revenue in a realistic manner.

Cheap fare policy "A" $80/$45

Let us now consider a cheap fare available at $45 on the basis of availability between 10.00am and 2.00pm and after 6.00pm on weekdays. (Note, in practise, the availability period would need to be carefully set, 9.30am, for instance, may be a more suitable time). Running the modal split models on a TOD basis gives an off peak modal split of 8.49%. The peak modal split at $80 one way changes to 21.50% indicating some abstraction of business trips for peak to off peak (lower fare inducement). Applying Ramsey:-

$$(7) \quad \frac{OP}{P} = \frac{8.49}{21.50} = 0.395$$

Total modal split = 29.99. Revenue/100 = $2102.

However the Ramsey factor = 0.395, shows that we are quite definitely sub optimum in our allocation across the two markets, either the off peak fare is too high or the peak fare too low, or both! Let us "hold" the peak fare at $80 and establish the level of which the cheap fare should be set, to satisfy Ramsey.

Cheap Policy "B" $80/$26

Running the modal split model and holding the peak fare to $80, to achieve the Ramsey balance the off peak fare needs to be set to $26, resulting in peak and off peak modal splits of 21.28% and 10.10% respectively, giving:-

$$(8) \quad \frac{OP}{P} = \frac{10.10}{21.28} = 0.475$$

Total modal split = 31.38. Revenue/100 = $1965.

It is interesting to compare the resultant modal splits (see Table 2).

Cheap Fare Policy "C" $45/$144

Let us try now "holding" our $45 non business fare and running the models to find an equivalent peak fare to satisfy Ramsey.

The fare, under these circumstances becomes $144 peak for Ramsey to apply, i.e at $144/$45 we must get modal splits of 18.21% and 8.65% giving:-

$$(9) \quad \frac{OP}{P} = \frac{8.65}{18.21} = 0.475$$

Total modal split = 26.86.

However, the competing airlines fare (1990) was only $116. Clearly we could not get away with such a peak fare, Ramsey rules not withstanding. We have in fact priced ourselves out of the market at this level. (The modal split equations still give a rational answer since other factors are included such as access and journey time differentials).

Cheap Fare Policy "D" $116/$34

Let us now try setting the peak fare equal to air fare at $116. We find that the equivalent off peak fare needs to be $34, giving modal splits of 8.75% and 18.39% respectively, giving:-

$$(10) \quad \frac{OP}{P} = \frac{8.75}{18.39} = 0.475$$

Total modal split = 27.14. Revenue/100 = $2430.

Peak/Off Peak Summary

On a simple peak/off peak basis, our fares should be set to $116 in the peak (equivalent to air) and $34 in the off peak ($10 more than the bus). (These modal split equations allow for difference in access and journey time as previously explained).

The HSR peak fare set to the airfare level is still attractive, being quicker in overall time and more accessible (see Hall and Wirasinghe 1992, 1993 and Hall, 1990). However this is as a high as we dare set the fare. We have apparently maximized our revenue on this basis - but in fact have we?

Business/Non Business Pricing

The Alberta Corridor market is, however, not as clear cut as a simple peak/off peak market. There are four distinct types of journey pattern.

1) Business trips - relatively inelastic to fare (usually fare paid by employer).

2) "Inelastic" non business trips - relatively inelastic to fare but not as inelastic as business trips (usually paid by consumer).

3) "Elastic" non business trips - relatively elastic to fare (usually paid by consumer).

4) "Down Market" trips-low income, non car available. Highly elastic to fare (usually paid by self or by a social service agency).

Groups 1, 2 and 3 are usually the studied groups and account for approximately 40%, 30% and 30% of total studied travel. Group 4 is usually ignored but accounts for about 8% of the real total studied.

ie the TRUE percentages are:-

1)	Business	37.0%
2)	Non business inflexible	27.5%
3)	Non business flexible	27.5%
4)	Down market	8.0%

In all cases approximate percentages are given.
We can restructure our fare policy accordingly.

Differential Peak Fares - The "Starlight Express"

Let us look at two levels of peak service - a "business class" (Gold Star service) at a price equal to air and a non business class (Silver Star service) set at a lower price. In the past, traditionally, Pullman and standard passenger cars were available, Pullman cars having superior appointments. However we are into fixed formation trains sets and since we need to maximize our passenger car seats over the entire day and over weekend and holiday periods, we could not offer this level of rolling stock provision.

We can however follow the airline (and AMTRAK) lead of a dedicated Gold Star area, with a high service level (pre boarding, free catering, newspapers etc) with a 100% flexible ticket availability. Let us assume such a service set at $116. We are now offering a service quicker than air and with a higher level of service.

Analyzing the peak period split between business (B) and "inflexible" non business (NBI) shows that at our "Gold Star" fare of $116 and "Silver Star" fare of $94 we get:-

$$(11) \quad \frac{\text{Silver Star (NBI)}}{\text{Gold Star (B)}} = \frac{6.85}{14.40} = 0.475$$

Total peak modal split = 21.25. Peak revenue/100 = $2314.

Our fare policy has now evolved into two peak fares at two service levels of $116 and $94 plus an off peak fare, (previously set to $34).

Re running the models, for a peak modal split of 21.25%, we require an off peak modal split of 10.09% to achieve the Ramsey balance.

Giving:-

(12) $\frac{\text{OP (Bronze Star)}}{\text{P(Gold \& Silver Star)}} = \frac{10.09}{21.25} = 0.475$

Total modal split = 31.34. Revenue/100 = $2576.

A "Bronze Star" fare of $26 ($2 higher than the bus fare) will yield the necessary off peak modal split.

The final fare policy that emerges is given in Table 2 and consists of two levels of peak fare (Gold Star and Silver Star) at $116 and $94 respectively plus an off peak fare (Bronze Star) set after 10.00am to $26. These off peak fares would, by their very nature, be of limited availability (off peak only, outward portion dated as to day of use, return portion availability restricted but not as severely as airline seat sales).

The Ramsey rules have been met, our pricing is not monopolistic nor unfair and our modal split to rail overall is 31.34%, excluding down market, or 29% overall. Mode captive traffic should be considered as an "add on" to the 29% overall modal split, but is not modellable in the conventional sense. A special regression model developed for this traffic showed that it represented 8% of all traffic (Hall, 1990) of which about one quarter would be attracted to HSR on a "bus fare equivalency" basis (which we have, in effect, after 10.00am). Our total modal split would rise to about 31%. However, while this traffic is fragile at best, it is eminently worth attracting as it greatly helps to distribute the load factor over the day.

A comparison of the various modal splits and revenues per passenger is given in Table 2. Revenue is maximized and Ramsey rules hold if a three part pricing policy is implemented, which in fact no other corridor operator can offer. HSR's flexibility in catering "across the board" to all market segments is clear from a study of Table 2.

Day of Week Pricing (DOW)

Saturday and Sunday collectively represent 60% and 40% of weekday volume, however business travel is very limited and most non business travel is optional and highly elastic to fare.

Again we can set an all day fare by comparing overall weekend modal split to overall weekday split. Our weekday modal split is 31.34% overall. Running the non business modal split models for weekend traffic shows that at a fare of $26 one way, "all day", we achieve an overall modal split of 31.68% which is near enough for our purposes. Accordingly offering the weekday "Bronze Star" off peak fare of $26 "all day" at weekends will maximize our revenue on these two days.

Other "Starlight Express" Options

Other options for analysis exist. The first departure of the day (at about 6.00am) may load poorly at peak fares. In this case "Morning

star" fare set to off peak (with similar TOD return restrictions) could be offered, also "Day Star" fares, valid out and return same day. If evening trains (say after 7.00pm) have surplus capacity, "Evening Star" fares (outward one day after 7.00pm, return at a later date in the evenings) may be valid, especially if offered with a Sunday return. Traditionally children over 5 and under 14 travel half fare. We could analyze further options such as student fares (over 14 under 25, generally) and senior citizen discounts. Family and group fares can also be considered to further maximize revenue on a TOD or DOW basis, especially at such times as school holidays. Promotions such as "Teddy bear days", where children under 11 travel free or at a very big discount providing they are accompanied by a teddy bear and an adult (any fare, including discount, applies). Teddy bears, incidentally, travel free.

Conclusions

One of HSR's major advantage over other modes is its ability to cater for all sections of society from business travel (relatively inelastic to fare) through both relatively inelastic and relatively elastic non business travel right through to socially disadvantaged "limited income" travel. Flexibility can be further made for other scenarios such as families, students, etc, on restricted travel budgets.

Modal split is maximized at peak Gold Star and Silver Star fares of $116 and $94 and an off peak/weekend Bronze Star fare of $26, all one way at 1990 prices. Other promotions such as Morning Star, Day Star, and Evening Star fares can be offered.

In effect a whole series of "Starlight Express" fares could be offered to cater for the "richest and the poorest". Establishing HSR service as a "Train for all Reasons".

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Table 1

1990 Modal Fares

Air	$116.30
Bus	$24.00
Auto	$32.00

From Hall (1990)-Auto is "out of pocket" cost.

Table 2

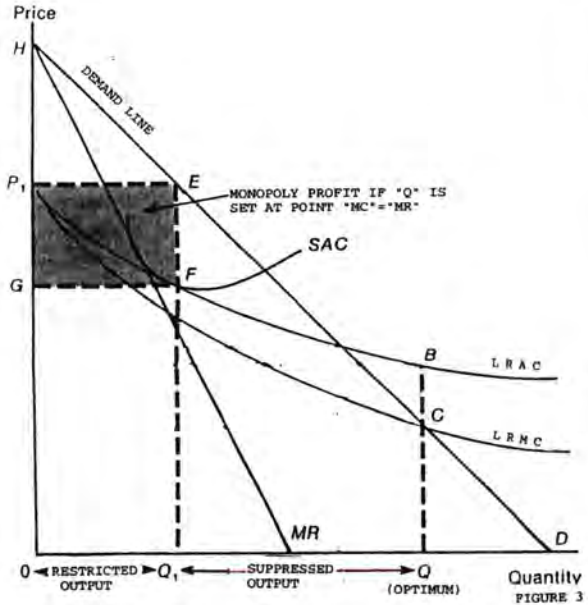
Differential Fares

	Base Fare $80	Option A $80/$45	Option B $80/$26	Option C $116/$45	Option D $116/$34	Gold $116	Silver $94	Bronze $26
Peak (a)	21.79	21.50	21.28	18.21	18.39	14.40	6.85	-
Off Peak (a)	2.99	8.49	10.10	8.65	8.75	-	-	10.09
Total	24.78	29.99	31.38	26.86	27.14	21.25	31.34	10.09
Ramsey Factor	0.137 (b)	0.395 (b)	0.475	0.475 (c)	0.475	0.475		
Revenue per 100 (d)	$1982	$2102	$1965	Note C	$2430	$2576		

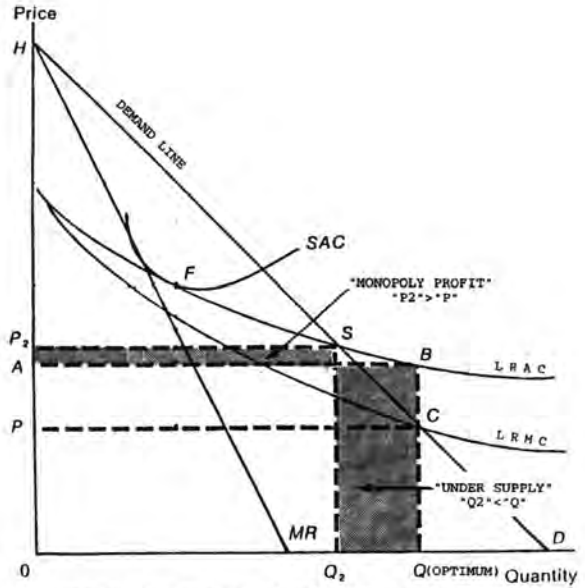
Notes (a) Downmarket traffic not included in the above tabulations.
(b) Rejected - non Ramsey value.
(c) Rejected - fare too high - only applicable under monopoly conditions
(d) Revenue per 100 represents the revenue per 100 "potential" passengers and is derived from the modal split figures.

THE ALBERTA CORRIDOR FIGURE 1

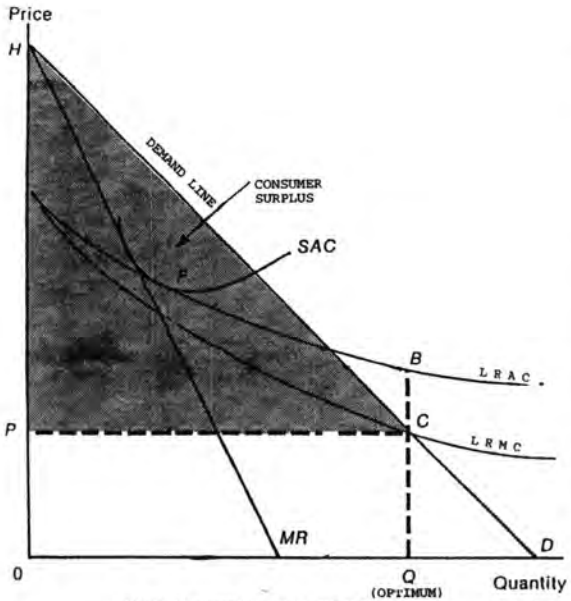
EFFECT OF PRICE "P" SET EQUAL TO MARGINAL COST "MC"="Q" FIGURE 2



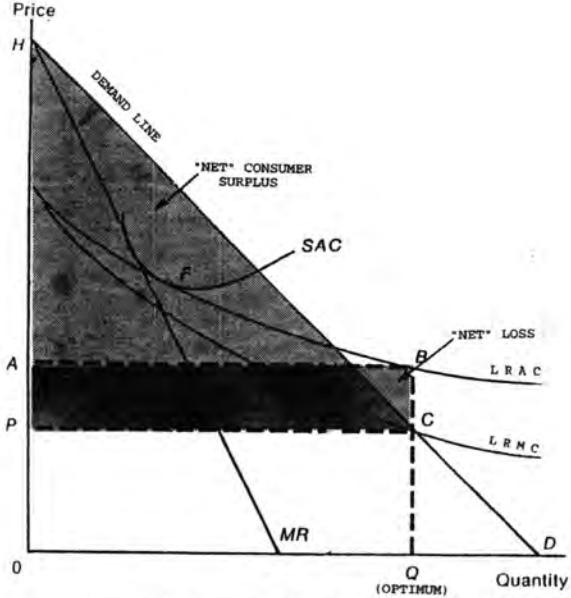
MONOPOLY PROFIT/SUPPRESSED OUTPUT WHERE "Q" IS SET AT "MC"="MR" FIGURE 3



"UNDERSUPPLY EFFECT" WHERE "P2">"P" (GIVING "Q2"<"Q") FIGURE 4



TOTAL CONSUMER SURPLUS AVAILABLE FIGURE 5



"NET" CONSUMER SURPLUS vs "NET" LOSS FIGURE 6

Le système d'évaluation des cadres dirigeants dans l'entreprise et le choix intermodal de transport

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Introduction

Au cours des années, plusieurs modèles ont été développés afin d'expliquer le choix que font les expéditeurs entre différents modes de transport. Certains de ces modèles sont de nature conceptuelle et ont pour objectif d'aider les décideurs dans les entreprises à optimiser leur choix dans ce domaine. D'autres, modèles interprétatifs ont plutôt pour but d'expliquer les différences de comportement pouvant exister entre divers expéditeurs qui auraient dû selon les modèles purement économiques opter pour le même mode de transport. Les variables discriminantes identifiées dans le passé ne tiennent pas compte des biais pouvant être occasionnés par le système d'évaluation de la performance des décideurs. Dans cet article nous proposerons en nous appuyant sur certaines études empiriques de les y inclure.

Antécédents de l'étude

C'est après le développement du transport par camions et avions, venus concurrencer le transport par voie ferrée et maritime que les scientifiques ont commencé à s'intéresser au choix intermodal. Au cours des années, un certain nombre de modèles théoriques et conceptuels ont été proposés pour d'une part expliquer le comportement d'expéditeurs, mais surtout pour fournir des schémas normatifs ou prescriptifs à ceux dont les fonctions englobent la détermination d'un mode de transport.

Il est important de noter à ce stade-ci la différence qui existe entre choix du mode de transport et choix de transporteur. Ce dernier type de préoccupation manageriale, quoique méritant beaucoup d'attention, est généralement

tributaire de décisions prises préalablement au sujet du moyen de transport privilégié.

Dans un article[1] paru en 1989 le professeur Mc Ginnis a fait l'inventaire de ces modèles normatifs en les catégorisant en quatre archétypes. Tout d'abord on retrouve le Modèle économique classique. Essentiellement ce modèle est un cas particulier, de l'analyse de seuil de rentabilité (point mort), technique développée dans le cadre de la théorie de la production. Dans le cas du choix de mode de transport c'est une combinaison des variables "distance à parcourir" et "poids des marchandises à expédier" qui déterminera la nature du moyen de transport à utiliser, étant bien entendu que certains moyens, entraînant un déboursé en coûts fixes supérieurs à d'autres, ne seront économiquement avantageux qu'une fois atteinte une certaine taille de cette variable combinatoire. Ce modèle cependant ne tient pas compte de la rapidité relative de chaque moyen de transport, en dépit du fait qu'il s'agit d'un facteur qui peut affecter les délais de livraison à la clientèle. Or, cette dernière variable peut constituer une considération de taille pour les expéditeurs.

La deuxième famille de modèles normatifs développé au départ par Baumol et Vinod[2] pour être ensuite perfectionnée par d'autres chercheurs, est appelée Inventory-Theoretic Model[3]. Sa caractéristique principale est que l'on incorpore d'autres coûts à minimiser. Plus particulièrement on considère que lorsque l'on examine des alternatives de modes de transport, il faut ajouter au coût de transport par unité, les dépenses constituées par les coûts en inventaire associés à chacun des moyens de transport considérés.

Plus le délai de livraison augmente, plus les dépenses en inventaire (coût en immobilisation de capital, assurance, dégâts, vols, etc.) s'accroissent. Les deux autres catégories de modèles normatifs recensés par Mc Ginnis: le "Trade-off Model" et le "Constrained Optimization Models" ne sont à notre avis que des variations sur le même thème déjà proposé par Baumol. Dans le premier cas il s'agit de trouver le mode de transport pour lequel la somme des coûts direct de transport et des coûts indirects sera minimisée. Dans le deuxième cas on tentera de déterminer l'alternative qui minimisera les

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1 M.A. Mc Ginnis, "A Comparative Evaluation of Freight Transportation Choice Models", The Transportation Journal, Vol. 29, no. 2, Winter 1989, pp. 36-46.

2 W.J. Baumol et H.D. Vinod "An Inventory Theoretic Model of Freight Transport Demand", Management Science, 16, No 7 (March 1970), 413-421.

3 Mc Ginnis op cit. note 1

dépenses directes de transport, ceci à la condition de respecter des normes minimales en termes de service à la clientèle, et en tenant compte d'autres contraintes liées à la nature du produit, du marché etc.

En fait nous constatons que force est de revenir au concept classique de coût total de distribution c'est-à-dire à l'idée qu'il est inutile de tenter de minimiser les coûts de transport proprement dit ou les coûts d'inventaires en tant que tels ou n'importe quel autre coût relié à la distribution.

Il faut plutôt minimiser l'ensemble des coûts reliés à la distribution du produit et ceci une fois déterminé le niveau de service désiré de service à la clientèle.[4]

En dehors des efforts de modélisation prescriptive normative, tout une série de chercheurs[5] ont essayé au cours des années de découvrir de façon empirique quels étaient les facteurs considérés par les transporteurs comme étant ceux qui affectaient leur choix de mode de transport. Ces recherches ont été faites sur la base d'interviews avec des expéditeurs et il est clair que les réponses données par ces derniers sont faites sur la base de la perception qu'ils ont de leur propre façon d'analyser les choses. Ce type de méthode présente une faiblesse méthodologique potentielle, dans la mesure où les perceptions des individus peuvent être biaisées (généralement de façon involontaire), afin qu'elles soient conformes aux intérêts ou la façon de voir les choses de la personne interviewée. Dans la littérature psychosociologique on réfère souvent à ce phénomène sous le vocable de dissonance cognitive[6].

Mc Ginnis[7] ayant sélectionné onze études empiriques donc des études qui n'ont pas au départ d'objectif prescriptif mais plutôt un but descriptif, fait ressortir sept variables qui semblent être déterminantes du choix de mode de transport. Il s'agit 1- du prix du mode de transport, 2- sa fiabilité, 3- sa rapidité, 4- les dommages et pertes probables qui y sont associés, 5- les caractéristiques de marché telles que perçues par l'expéditeur, 6- les éléments dont tient compte le transporteur, 7- les caractéristiques du produit.

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4 M. Flaks, "Total Cost Approach to Physical Distribution", Business Management, Vol. 24 (August 1963), pp. 55-61. R. Lekashman et J.F. Stalle, "The Total Cost Approach to Distribution", Business Horizons, Vol. 8 (Winter 1965), pp. 33-46.

5 Voir Mc Ginnis op cit note 1

6 L. Festinger, "A Theory of Cognitive Dissonance" Stanford, California, Standard University Press, 1957, p. 260.

7 Op. Cit note 1

Si ces résultats correspondent à la réalité et non pas seulement aux perceptions des répondants, ils indiqueraient que peu d'expéditeurs optimisent véritablement leurs décisions en matière logistique. En effet, des éléments tels que le coût d'entreposage, l'assurance sur le prêt, les coût d'emballage, de manutention etc. ne semblent avoir été pris en considération (s'ils l'ont été) que de manière indirecte par le biais de la variable rapidité (transit time). Il n'est pas évident que des calculs sérieux aient été faits à ce sujet par les expéditeurs. Il n'est pas non plus évidents que les entreprises aient tenté de déterminer leur politique en matière de moyen de transport dans le cadre d'une stratégie de minimisation du coût total de distribution.

On peut à juste titre, se demander pour quelles raisons, un si grand nombre d'entreprises persiste à poursuivre une démarche d'optimisation partielle de leurs politiques de transport alors qu'elle peut aboutir à un résultat de sous optimisation globale relativement à l'ensemble de leur distribution physique. Ce phénomène est d'autant plus surprenant que le concept de coût total de distribution est maintenant relativement bien connu. Ceci nous amène à la deuxième partie de cet article qui traitera de l'impact des politiques d'évaluation dans l'entreprise sur les décisions en matière de logistique.

II. Évaluation des responsabilités et politique de transport

Dans une étude effectuée sur le choix d'un transporteur par des entreprises utilisant le mode de transport par camion[8],les relations entre l'évaluation des performances du décideur et le choix du camionneur ont été observées. Les résultats de cette étude ont indiqué qu'un tel lien existait effectivement. Plus particulièrement les répondants qui privilégiaient les camionneurs capables d'assurer le meilleur service plutôt que le meilleur prix étaient eux-même généralement évalués sur la base de la qualité du service à la clientèle. D'un autre côté ceux qui préféraient engager les camionneurs les plus concurrentiels au niveau des prix, étaient généralement évalués sur la base de leur performance relative à la minimisation des coûts de transport. Ces résultats n'ont rien de surprenant, en effet comme l'indiquent les auteurs[9]: "Il est plausible de penser que si un employé croit qu'un contrôle maximum des

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[8] M. Arcand, J. Picard, J. Roy, "Variables de segmentation dans l'industrie du camionnage public: influence de l'évaluation des performances du décideur sur le choix d'un transporteur", Rapport du Congrès annuel de la section marketing de l'Association des sciences administratives du Canada, 1990, édité par J. Liefeld pp 1-10.

[9] Id. p. 2

coûts lui vaudra un excellent rapport d'évaluation par son (ses) supérieur(s), il sera très sensible aux tarifs des transporteurs, aux règlements de réclamations et à tout ce qui touche l'aspect financier de la relation avec les transporteurs. Au contraire, s'il croit qu'un minimum de plaintes de la part des clients lui vaudra un excellent rapport d'évaluation, il privilégiera les aspects ayant trait au service lors du choix d'un transporteur".

Si de claires relations semblent exister entre les critères d'évaluation de la performance du décideur et le choix d'un transporteur particulier, il est tout à fait raisonnable de penser qu'un tel lien existe aussi avec le choix d'un mode de transport. Il y a lieu cependant de noter qu'il s'agira de critères d'évaluation plus complexes.

Dans une étude effectuée dans les corporations ayant des filiales de ventes à l'étranger[10], une distinction fut faite entre différents types de systèmes de distribution de physique utilisés. La principale base de différence étant le maintien de stocks et d'entrepôt de stockage au niveau de la filiale. C'est ainsi que furent observés quatre types de modèles: Le système classique, le système direct, le système transit, le système entrepôt multinational. Nous fournirons des détails sur les trois premiers modèles.

a) le système classique: La filiale de vente à l'étranger possède un entrepôt dans lequel elle stocke les produits fournis par la maison mère, et qu'elle écoule progressivement, au fur et à mesure que les commandes de ses propres clients arrivent. Elle conserve aussi des stocks de sécurité.

b) le système direct: Dans ce cas les stocks sont centralisés au niveau de la maison mère. La filiale à l'étranger s'occupe du marketing et prend les commandes pour les produits de l'entreprise. Ces commandes seront livrées directement à partir de l'entrepôt de la maison mère.

c) Le système transit: Dans ce cas la filiale de vente ne constitue pas de stocks, et en cela ce système ressemble et est opéré de la même façon que le système direct. Néanmoins les marchandises destinées aux clients de la filiale transitent, pour une courte période de temps, par l'entrepôt de cette dernière. Ce transit peut être nécessaire pour diverses raisons:

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[10] J. Picard, "Typology of Physical Distributions Systems in Multinational Corporations", International Journal of Physical Distribution & Materials Management, Vol. 12, Number 6, 1982, pp. 26-60.

> Besoin de faire un contrôle de qualité sur place, licence d'importation octroyée uniquement à la filiale etc.

Il est bien évident que l'utilisation des deux derniers systèmes entraîne l'utilisation de modes de transport plus rapides par l'entreprise globale. Beaucoup de facteurs vont affecter le choix d'un système plutôt qu'un autre. Certains sont d'ordre strictement économique, d'autres sont reliés à des contraintes qui ne sont pas sous le contrôle de la firme. D'autres, enfin sont d'ordre organisationnel et parmi celles-ci on retrouve un facteur pertinent à notre dialectique: il s'agit de l'imputation des coûts d'entreposage et de stockage à la filiale [11]:

> "In almost all the companies surveyed, the subsidiaries were considered as profit centres and, consequently, their management's performance was evaluated on the basis of the subsidiary's profit. However, in many cases the subsidiaries were not fully charged, if at all, for the costs of carrying inventory. This creates a situation in which the subsidiary's management will tend to increase its inventory since this enables him to provide, at little additional cost, a better level of service to its customer, a step which in turn should generate more sales. Under those circumstances, it is not surprising that the subsidiaries' manager will prefer and advocate in favour of the classical system, since if the company used another system it would not be possible for him to continue keeping inventory. The study revealed that when the subsidiaries had to finance their inventory or were fully charged by their parent company from the moment the goods left the country of origin, the attitude changed and inventory was no longer the "most essential thing in the world". The subsidiary management was much more likely to suggest to the headquarters the use of a direct or transit system."

On peut donc raisonnablement se demander si le fait que, selon les études mentionnées par Mc Ginnis[12], les décideurs en matière de choix de moyen de transport ne semblent pas tenir compte directement des autres dépenses rentrant dans le cadre du coût total de distribution, n'est pas attribuable au fait que leur performance n'est sans doute pas évaluée sur la base de la minimisation de l'ensemble de ce coût total. Plus probablement ils sont évalués sur la base des résultats obtenus relativement aux coûts de transport, ceci dans le cadre de contraintes au niveau du service à la clientèle. Il s'agit

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[11] id. p. 38

[12] op. cit note 1

alors d'une lacune assez grave, dans la mesure où un choix optimal de moyen de transport selon les critères du décideur risque d'être un choix sous-optimal pour l'entreprise. En effet la réduction des coûts de transport, par le choix de modes de transport moins dispendieux, sans qu'en soit affectée la qualité du service à la clientèle, risque de se traduire par une augmentation des coûts de stockage et d'entreposage, dépassant les économies produites. Le fait que dans les études précitées les expéditeurs aient tenu compte de la rapidité du mode de transport (temps de transit) dans leur choix peut signifier plusieurs choses. Soit comme l'indique l'étude d'Arcand et al[13] parce que certains expéditeurs sont évalués sur la base de la qualité du service à la clientèle et que la rapidité de la livraison est donc le facteur prédominant. Soit alors parce que certains décideurs sont évalués sur la base de deux éléments: minimisation du coût de transport et service à la clientèle. Il est aussi envisageable que la variable temps de transit soit mesurée sur la base des coûts de stockage et autres coûts correspondant à chaque heure de transit, dans quel cas l'idée de minimisation du coût total de distribution serait respectée. Cette possibilité est cependant mince, car les répondants auraient alors sans doute parlé de "coût du temps de transit" de façon plus précise. Il n'en demeure pas moins que si l'on tient compte des études déjà effectuées sur l'effet des critères d'évaluation de performance sur les choix en matière de transporteur[14] ou sur les systèmes de distribution dans les entreprises multinationales, un même effet doit également exister en ce qui concerne le choix d'un mode de transport. Il serait donc important à l'avenir d'incorporer cette variable dans les modèles explicatifs des décisions dans ce domaine. Dans un autre ordre d'idée, il serait temps que les entreprises réalisent non seulement que c'est le coût global de distribution qu'il faut minimiser (pour un niveau de service à la clientèle prédéterminé), et non pas le coût de transport, mais qu'en plus le système d'évaluation de leurs cadres soit fait de telle sorte qu'il agisse comme incitatif à la réalisation d'un tel objectif. En d'autres termes il faut qu'au moins un individu ait la possibilité de déterminer quelle sera le système global de distribution physique de l'entreprise, mais qu'en plus sa performance soit évaluée sur la base du coût du système dans sa globalité[15].

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[13] op. cit note 8

[14] id.

[15] Une fois le niveau de service à la cliente déterminé, évidemment.

Conclusion

Nous avons tenté, dans cet article d'examiner d'abord quels étaient les modèles de choix de mode de transport développés au cours des années. En ce qui concerne les modèles normatifs nous avons conclu qu'il était difficile de développer un modèle optimisateur sans retomber d'une manière ou d'une autre dans le concept de minimisation du coût global de distribution pour un niveau de service à la clientèle prédéterminé. En ce qui concerne les modèles descriptifs nous avons constaté que les critères d'évaluation des expéditeurs dans leur choix de mode de transport ne semblaient pas inclure les coûts indirects de distribution qui découlaient de ces choix. L'argument présenté dans cet article est que cette lacune est sans doute due au système d'évaluation des décideurs qui ne tient probablement pas compte de l'impact de leur décision en matière de moyen de transport sur les autres éléments du coût global de distribution. De plus il est soutenu que le mode d'évaluation des performances du décideur doit être incorporé dans les modèles explicatifs de leur comportement quant au choix de moyen de transport. Nous espérons que des recherches empiriques viendront étoffer ce point de vue.

Transportation Demand Management through Carpooling and High Occupancy Vehicles: A Regulatory Perspective

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I. Introduction

Transportation demand management (TDM) comprises various actions aimed at influencing travel behaviour to reduce vehicle-trips and vehicle-kilometres of travel.[2] TDM is increasing in importance to transportation agencies as a means of (1) reducing vehicular demand on increasingly scarce urban highway infrastructure (notably during peak traffic periods), (2) decreasing vehicular congestion, and (3) improve air quality. In addition, effective TDM measures can permit the deferring of highway capital expansion by more effectively allocating existing roadway capacity to meet commuter demand.

Carpooling and high occupancy vehicles (HOVs) are two forms of TDM[3] which effect an intramodal shift by encouraging, through incentives, relatively more passengers per vehicle.[4] Although there are few dedicated HOV facilities in Canada, some existing highways and arterials are being retrofitted to provide for such facilities during peak traffic hours (during non-peak hours, HOV lanes revert to general purpose lane status).

Where carpooling and HOV facilities are provided, however, there must be a regulatory regime in place to ensure that all users are accommodated for in a

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[1] This paper represents the viewpoint of the author and should not be construed as a policy document or position of the Government of British Columbia.

[2] For a discussion of categories of TDM measures, see "Transportation Demand Management Measures and Their Potential for Application in Greater Vancouver".

[3] The author suggests that carpooling and high occupancy vehicles (including the provision of incremental or existing lane capacity for such uses) could be termed "transportation supply management". The intent of such programs is more or less to make better use of existing roadway capacity to more commuters -- not vehicles. Demand is only affected through a reduction in vehicles used, not the absolute number of commuters. The primary mechanism of effecting this decrease in demand (absolute number of vehicles) is through the reallocation of road capacity so as to give a preference to carpools and high occupancy vehicles.

[4] Incentives for using carpools and HOVs are economic (reduce out-of-pocket costs for commuters in the form of fuel, parking, and vehicle maintenance) and convenience (reduced trip times where HOV preferential lanes are provided).

safe manner, that specifies the categories of vehicles that can use the HOV lane when meeting the occupancy requirement, and, in the case of carpooling, which are in accord with other regulations which set out the terms and conditions for regulated/licenced for-hire motor carrier operations (eg., taxis, motor coaches) that provide commuter services. This paper examines some of the considerations in designing a regulatory regime for HOV facilities and carpools.

II. HOV (shared facility) Regulatory Issues

There are basically two types of HOV facilities. First, there are physically separated lanes, distinct from general purpose lanes, which are dedicated, more or less, to high occupancy vehicles. Second, HOV facilities can consist of general purpose lanes which, during peak traffic periods, are designated as HOV lanes. These lanes are not physically separated from general purpose lanes and must be accessible to non-HOV traffic (under certain conditions as set out in regulations) for the purposes of accessing properties adjacent to the roadway and turning at intersections. From a regulatory perspective, part-time HOV facilities utilizing arterial roadways pose unique problems with respect to devising regulations and tests for enforcement.

Designing the Regulatory Framework

The regulatory framework represents the skeletal nature of a set of regulations. Although specific regulations for specific facilities may not change, the basic framework which contains the regulations should provide for flexibility, where necessary, in tailoring different regulations for different facilities. Such a framework gives flexibility to traffic design engineers in accommodating regulations for different facilities. For example, operational and safety parameters may permit cyclists to use one HOV facility, but not another. In addition, where a HOV facility crosses from a provincially regulated roadway to a municipal jurisdiction, a flexible regulatory framework can differentiate between the two jurisdictions in terms of applicable regulations.[5]

Figures 1 and 2 depict a conceptual view of two extreme case regulatory formats. Figure 1 depicts a regime in which all regulations apply to all facilities. Where facilities are homogeneous in operational design, such a format may be desirable for each of regulatory administration. Figure 2 depicts a matrix type of regime whereby different facilities can be afforded separate regulatory treatment, if necessary. Figures 1 and 2 are not mutually exclusive because insofar as Figure

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[5] Another approach to differentiating HOV facilities for regulatory purposes if based on highway functional classification. For example, differentiation can be based on defined highway service classifications which are typically broken down as either freeway, expressway, arterial, collector, or local for both rural and urban areas. See "Highway Functional Classification Study".

2 is concerned, all facilities could be treated similarly. The advantage of the matrix type regime is the flexibility it affords.

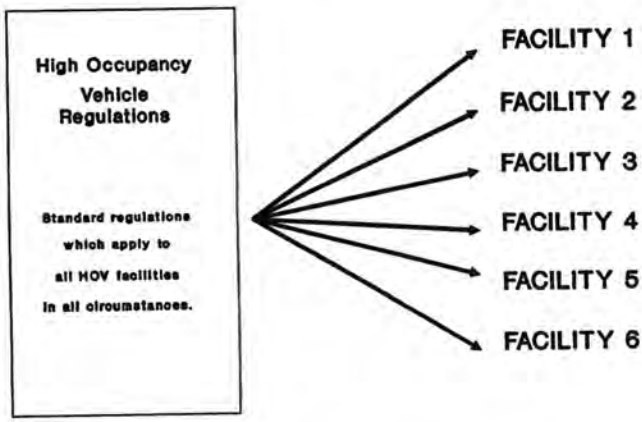


Figure 1: Omnibus HOV regulatory framework

HIGH OCCUPANCY VEHICLE FACILITY

REGULATION BY SECTION	1	2	3	4	5	6	7
Freight vehicles ...	x	x	x	x	x	x	x
Bicycles ...	x	x		x		x	
Emergency vehicles ...	x	x	x	x	x	x	x
Parking ...	x	x	x	x	x	x	x
Combination of vehicles ...	x	x	x	x	x	x	x
Disabled vehicles ...	x	x	x	x	x	x	x
Occupancy requirements ...	x	x	x	x	x	x	x
Taxis ...		x	x		x		
Traffic control devices ...	x	x	x	x	x	x	x
Other prohibitions ...	x	x			x		x

Figure 2: Matrix format HOV regulatory format

Arguably, there is a downside to a flexible regime in which different HOV facilities can be assigned different regulations. First, signage may need to be tailored to each facility -- or even different segments of the same facility. This could lead to signage which is confusing to motorists crossing from one facility to another. For example, one HOV facility may permit cyclists whereas others may not. Again, one HOV facility may specific a vehicle occupancy requirement which varies from that required for other HOV facilities. The first downside of a flexible regulatory regime are the required permutations of signage required to convey the rules of access and use to motorists. In addition, all forms of regulatory signage, which when violated carry a ticketable offence, must be defined and scheduled in the *Motor Vehicle Act Regulations* of British Columbia.

The second downside involves the aspect of driver education and enforceability. Where a common set of regulations apply to all HOV facilities, driver education and enforcement of signage by peace officers is relatively simpler than when regulations vary by HOV facility.

Enforcement Issues

The most problematic issue for designing regulations for part-time, arterially-based high occupancy vehicles lanes is defining what situations constitute a ticketable offence for non-HOV vehicles. For example, where an HOV lane is the right-most lane it must be permissible, under certain circumstances, for non-HOV vehicles to use the HOV lane to make a right turn at an intersection or access properties along the roadway. The issue is how long (in terms of time) or for what distance may a non-HOV vehicle use the HOV lane before committing a ticketable offence. Where HOV facilities are dedicated and physically segregated from general purpose lanes, the enforcement issue is much easier relative to an arterially-based urban HOV lane.

The enforcement issue is problematic not only in terms of defining a ticketable offence (other than not meeting occupancy requirements), but also for peace officers who must use their judgement in assessing a probable violation. If a non-HOV vehicle accesses the HOV lane from the general purpose lane to make a right turn at an intersection, but then moves through the intersection, this may be a reasonable test for issuing a ticketable offence for being a non qualifying vehicle in the HOV lane.

In designing such tests, it is paramount that regulators discuss such matters with peace officers of the jurisdictions involved and with appropriate legal staff. It may be the case that, after due consideration, enforcement of some HOV regulations will not be practical if ticketable offences will likely be struck down if challenged in court.

III. Carpool Regulatory Issues

Carpooling and vanpooling is the most widely considered form of transportation demand management.[6] The idea is clear: consolidate drivers of single occupant vehicles (SOVs) into fewer vehicles and congestion will be reduced, hence making better use of scarce roadway capacity during peak traffic periods. Carpools can be formal and informal, with the former being a group of individuals acting on their own, and the latter deliberately formed by a public agency, an employer, or by an agency that coordinates the carpooling activities of many employers.[7]

Regulations for carpool operations typically establish requirements in four areas:

- Method of operation
  - provincial regulation
  - municipal regulation
  - conditions regarding fares
- Vehicle registration
  - classification of vehicle (car or bus)
  - private versus public vehicle
  - registration fees based on GVW
- Driver licencing
  - personal versus public use may determine licence class
  - visual standards higher for some licences
  - provisions for medical examinations prior to licencing
  - driver tests based on licence classification
- Liability
  - ownership of van may affect liability
  - liability considerations where fares are collected

Most of these regulations are technical in nature and beyond the intent of this paper to discuss. For jurisdictions that are considering legislative and/or regulatory amendments to promote carpooling as a TDM initiative, the basic issue requiring careful analysis is developing a regulatory framework which sufficiently distinguishes carpool and vanpool operations from for-hire public vehicles (eg. taxis) both serving the commuter market. Absent this distinction carpool operations may meet with disapproval of private, for-hire, entrepreneurs.

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[6] Zupan, p. 2.

[7] For a discussion of the various institutional arrangements, see The Potential for Vanpooling in Manitoba.

Institutional enabling arrangements

There are basically four arrangements regarding carpool operations: private operation by a group of commuters, employer sponsored carpools, commuter associations or societies, and third-party agencies.[8] Regulatory definitions of carpool vehicles vary across provinces, where such definitions exist. For example, in Ontario[9]

> "car pool vehicle" means a motor vehicle as defined in the *Highway Traffic Act*,
> (a) with a seating capacity of not more than twelve persons,
> (b) while it is operated transporting no more than twelve commuters including the driver, none of whom pay for the transportation more frequently than on a weekly basis,
> (c) that is not used by any one driver to transport commuters for more than one round trip per day, and
> (d) the owner, or if the vehicle is subject to a lease, the lessee, of which does not own or lease another car pool vehicle unless the owner or lessee is the employer of a majority of the commuters transported in the vehicles,

In contract to the operationally oriented definition of a car pool vehicle used in Ontario, British Columbia[10] focuses more on the institutional arrangements of the pool for regulatory purposes:

> "passenger transportation pool vehicle" means any motor vehicle that is operated at any time or from time to time on a highway under the following conditions:
> (a) For the transportation of passengers from the vehicle owner or operator's residence or the residence of a passenger of that vehicle to a place of employment or to a common destination adjacent thereto or, in the case of an employer owned or operated vehicle, for the transportation of that employer's employees to and from a place of employment;
> (b) The carriage of such persons is conducted in conjunction with a transportation pooling arrangement for passengers which is sponsored and coordinated by an organization or agency working in conjunction with the Federal Government of Canada, the Government of British Columbia, the governing body of any city or municipality in British Columbia, or any combination of these governmental bodies;
> (c) The compensation charged to passengers for such transportation does not exceed, in the aggregate, an amount equivalent to that required to pay operating costs and capital costs of the vehicle used for such transportation during the period of usage when the vehicle is employed in providing such transportation.

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[8] For a discussion of each arrangement, see Implementation Handbook: A Guide for the Private Operator.

[9] Section 1, Public Vehicles Act, RSO 1990, Chapter P.54.

[10] Section 1, Motor Carrier Regulations, B.C. Reg. 59/59.

If the British Columbia Motor Carrier Commission is satisfied that all three conditions are met, the Commission may exempt the pool vehicle from licensing requirements applicable to public for-hire vehicles.

Carpool versus public for-hire vehicle

One of the salient features of these two provincial approaches to carpool regulation is compensation. In British Columbia, the definition of carpool vehicle (referred to as "passenger transportation pool vehicle") stipulates that fares charged to users can only recover vehicle capital and operating costs. The definition prohibits the earning of profits, or the recovery of full costs. On the other hand, the Ontario definition of carpool vehicle is silent on the recovery of costs and the earning of profits by carpool operators.[11]

This dichotomy between the provinces illustrates how different regulatory regimes maintain a distinction between carpools and public for-hire vehicles. Ontario relies on regulations which stipulate how the vehicle shall be used for carpool purposes. Cost recovery through fares, and institutional arrangements, are not an issue. British Columbia relies on regulations which stipulate the need for (1) sponsorship and coordination of the carpool by a organization working in conjunction with a government agency, and (2) the extent to which costs can be recovered through fares.

From the point of view of promoting carpooling as a TDM initiative, British Columbia regulatory requirements do not permit the recovery of full costs (capital, operating, administrative overhead). Furthermore, the current regulatory regime does not recognize private commuter carpool initiatives, employer-sponsored carpool initiatives, or commuter association/society carpool initiatives absent the sponsorship of the program through a government agency.

IV. Concluding Comments

As indicated at the outset of this paper, high occupancy vehicle lanes and carpooling initiatives are means of effecting transportation demand and supply management. The design of the regulatory regime governing both TDM measures can influence the effectiveness of these measures in making more efficient use of scarce roadway capacity during peak traffic periods.

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[11] In fact, the Ontario publication Implementation Handbook: A Guide for the Private Operator indicates that "Any financial profit made from the operation of a vanpool must be reported as income for tax purposes. A loss may be claimed as a deduction from other income, provided the vanpool was established with the intention of eventually making a profit." (p. 13)

Where high occupancy vehicle lanes are arterially-based, the design of the regulatory regime should consider being flexible enough to permit the assignment of specific regulations on a facility-by-facility basis (even if the end result is the similar regulatory treatment of all facilities). A balance needs to be struck, however, between flexibility and other considerations, including signage requirements, driver education, and enforceability.

If a policy decision is made to promote the use of carpools, a regulatory balance must be struck between measures to permit the easy creation of carpools through a variety of institutional arrangements and the legitimate concerns of public for-hire motor carriers serving the commuter market. Regulations governing carpools can be structured such that vehicle use and restrictions can be an effective means to ensure that carpools do not take on the appearance or function of public for-hire motor carriers.

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Upgrading Transportation Infrastructure in the Far East Dealing with the Present; Planning for the Future

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1.0 Introduction

In the last 20 years, emerging Asian cities experienced unprecedented growth, charged by booming economies. This is evident today, with cities whose transportation infrastructures are overburdened by heavy traffic and congestion. Other cities in this part of the world are now experiencing similar emerging economies, especially in China, Vietnam and Cambodia. Will they be the victims of similar transportation problems?

To meet their transportation needs in the 1970's and the 1980's, cities such as Hong Kong, Singapore, Manila, Jakarta and Bangkok constructed urban expressways. Most of these expressways were built with insufficient planning and to modest objectives in order to quickly solve local road traffic congestion problems. This was exacerbated by a lack of proper development control policies where in many places no formal planning process was followed initially.

The results were poorly developed residential subdivisions, industrial parks and redevelopment within existing city centres where travel demand quickly outstripped roadway capacity. The North American glamour of the suburban home quickly followed, causing chronic congestion. Poor geometric design, limited capacity interchanges and ineffective expressway to local network linkages magnified the breakdown of the cities' lifelines.

In southeast Asia, the automobile is considered as the most convenient and comfortable way to travel to and from work or school. In Bangkok for instance most children are driven to school every day by their parents, even though the trip may take 1 to 2 hours. The automobile is also the most comfortable way to travel on very hot days. Finally, most of these cities do not have a rapid transit system in place, and although measures have been taken to create bus priority lanes, the vehicular traffic problems plaguing cities like Bangkok make this attempt futile.

Traffic congestion, which resulted in increased road user travel times and a reduction in the number of these users, prompted the concern by local authorities over lost revenue on urban expressway networks. In Bangkok, officials have been

searching for ways to increase revenues on the urban expressway system, while minimizing travel times and reducing congestion.

Canadian expertise in the field of transportation infrastructure planning and design for small and large urban environments offered thorough diagnosis of the problems encountered on Bangkok's First Stage Expressway System (FES) and provided effective alternatives to improve road capacity while maintaining the performance of these congested facilities. SNC♦Lavalin International put forward proposals to deal with the problems faced by the expressway authority in Bangkok.

Access to this growing market for improvements to existing infrastructures was not easy. In 1992 SNC♦Lavalin International (SLI) associated itself with Thai Professional Engineering Consultants (TPEC) to undertake a study commissioned by Thailand's Expressway and Rapid Transit Authority (ETA). The study identified the Expressway's operational deficiencies and the implication of proposed improvements to the system. SLI provided the Preliminary Design and Transportation Engineering Services, while TPEC provided the Detail Design and Economic Analysis.

An integral part of this feasibility study, was the development of a modelling process to quantify changes in traffic demand and operations amongst the many combinations of improvements. The modelling process entailed forecasting of future traffic volumes and simulation of traffic operations by combining capabilities and results of two modelling software packages. As well, the modelling process was developed within the confines of available data bases and was supplemented with traffic surveying efforts. This paper presents the modelling process, and the main results of the feasibility study.

1.1 Background

The existing expressway system in the City of Bangkok is the first stage of a planned expressway network, and it is aptly referred to as the First Stage Expressway System (FES). The FES is a 6 lane mostly elevated toll expressway with a total length of 27 kilometres. It comprises three sections which interchange in the Port area, as shown in Figure 1.

Since its opening in 1987, the FES experienced a steady growth in traffic to the current annual average daily traffic volume of over 300,000 vehicles per day entering the expressway. Segments of the FES are at capacity for extended periods of the day and congestion is occurring at the ramp terminal intersections. This chronic congestion has resulted in substantial financial and economic losses for both the operating authority and the road users.

In view of the current traffic conditions on the FES and the anticipation of continued high traffic growth, the ETA is planning to implement the following improvement plans:

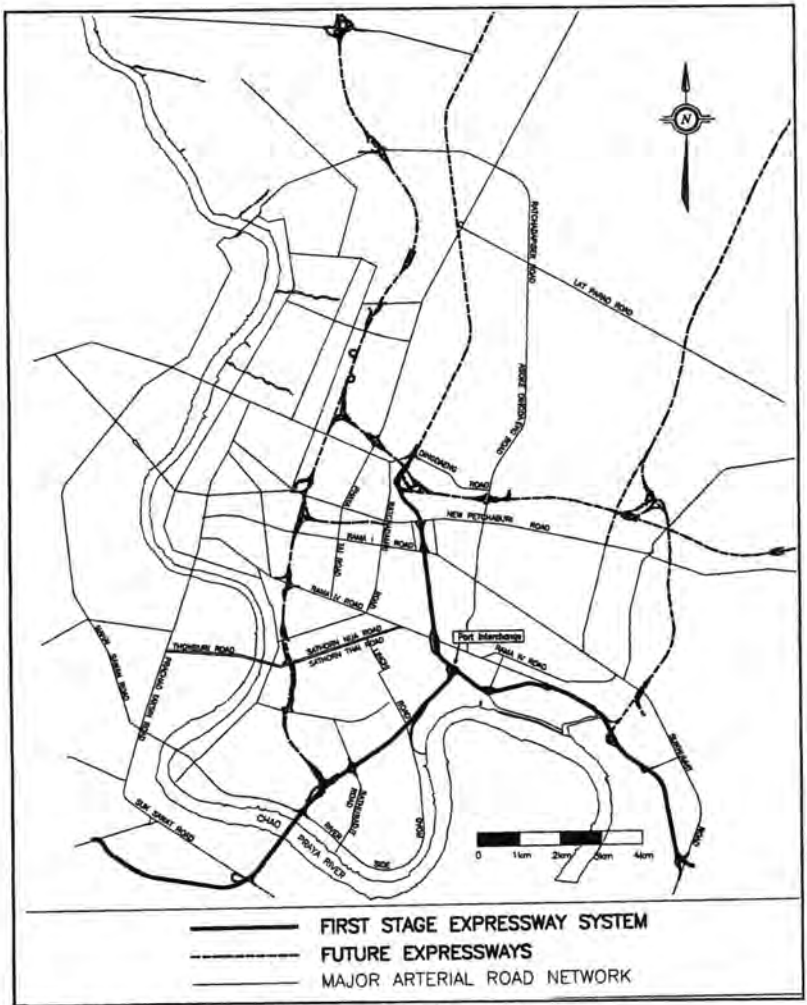


Figure 1 - Key Plan of Metropolitan Bangkok

1) The expansion of the existing expressway network which involves the addition of approximately 50 kilometres of expressway over the next 25 years.

2) The addition of new ramps and improvements to existing ramps on the

FES to improve traffic flow, alleviate congestion and provide better accessibility.

1.2 Study Objectives and Requirements

The feasibility stage of the study required a large amount of data analysis and outputs such as average speeds, delays and link volumes. Expressway networks for various horizon years were assessed in conjunction with the proposed ramp improvements. This necessitated the development of a computerized travel demand model to assist in the analysis within a relatively short time frame.

The objectives and requirements of the modelling process as it pertains to the overall feasibility study are summarized as follows:

1) Develop a macro level traffic assignment model to determine traffic demand on the future expressway network within the Bangkok urban area.

2) Develop a micro level traffic operation model to estimate average speeds and delays for the various combinations of ramp improvements along the FES.

3) Assess traffic operations along the FES taking into consideration delays at ramp terminal intersections, queuing and the effects of merging and weaving.

4) Use available data bases such as origin-destination matrices to minimize data collection efforts and cost, and maintain study schedule.

5) Provide the ETA with modelling capabilities for future planning applications.

2.0 First Stage Expressway System (FES)

2.1 Existing System

Access to the FES is via full and half diamond type interchanges. Most of the off-ramp terminals are signalized and during peak periods these signals are manually controlled. The freeway is elevated along most of its route and has a directional interchange (Port Interchange) connecting the three legs of the expressway as shown in Figure 1.

2.2 Traffic Conditions

The existing traffic conditions on the FES are characterised by near capacity operation, low operational speeds and substantial delays, especially in the peak

periods. To quantify the existing traffic conditions and to provide data for the calibration of the traffic model, a number of traffic surveys and data collection exercises were conducted:

- A one day roadside origin-destination survey conducted at all on-ramps to the FES in which motorists were asked their trip origin and destination. A sample size of approximately 10% was interviewed. This information was used in the calibration of both traffic models and provided a base for the modelling of the future expressway networks.

- The collection of toll booth statistics on type of vehicles and hourly variation in traffic volumes.

- Traffic volume counts at all the on-ramps and off-ramps.

- Speed-delay surveys conducted to determine average speeds on the FES.

- Surveys of queue lengths at selected off-ramp terminals to determine delays.

- A review of the on/off ramp terminal configurations, lane balance and signal timings.

The collection, processing and analysis of this data allowed the study team to quantify current conditions on the FES and to identify problem areas. It provided the necessary base for future traffic forecasting and simulation of traffic operations.

The main findings of the analysis for the existing conditions were as follows:

- The operational volumes reached a maximum of 2,200 vehicles per hour per lane on the mainline.

- Sectional mainline hourly volumes reached 7,700 vehicles per hour, which was only possible by the presence of vehicles encroaching on the shoulder which operated intermittently as a 4th lane in heavily congested sections.

- Traffic peaks between 7:00 and 8:00 a.m. and between 5:00 and 6:00 p.m. with the afternoon volumes exceeding the morning volumes by an average of 20%;

- Traffic composition on the FES (cars, buses and trucks).

- For extended periods of the day, the volume to capacity ratio was within the range of 0.8 to 1.0.

- Heavy queuing occurred at two of the three main entrances to the expressway system. The north entrance to the expressway with 10 toll booths was the most capacity deficient resulting in substantial queuing in the morning with a 15

minute average wait time and to a lesser extent in the afternoon.

- The off-ramp analysis revealed that with the exception of the end exit locations, all off-ramps displayed some degree of congestion due to the green time constraint at the ramp terminal intersection. At some exit locations the waiting time exceeded 8 minutes.

- Operational problems along the expressway mainline were identified on a section by section basis. Many of these operational deficiencies were caused by short weaving sections between on and off ramps, as well as the back-up of exit ramp queues onto the mainline.

- During peak periods the operational speeds dropped on average between 20 and 80 km/h. Combined with the excessive delays at the off-ramps, the journey times on the FES were beyond the expected range for an expressway of this type.

Figure 2 shows the locations of the most pronounced operational problems, and shows the 1992 A.M. Peak Hour volumes.

2.3 Expressway Ramp Improvement Proposals

Based on the results of the traffic analysis and the problems identified, ten improvement proposals were developed along the entire system. Three locations that experienced the worst conditions are reviewed below:

Location A: Sukhumvit Road on-ramp and Petchaburi Road off-ramp

A short 150 metre weaving section between the Sukhumvit Road on-ramp and the Petchaburi Road off-ramp was impeding traffic flow on the FES mainline due to queue backups from the off-ramp section. While on-ramp traffic was not heavy, it was also impeded by the queue of the off ramp to a point where manual police control was required in order to allow on-ramp traffic to cross the off-ramp queue. The queue was caused by the heavy two lane right turn movement at the ramp terminal currently under traffic signal control. Petchaburi Road is also a major arterial in the city's local road network.

Location B: Petchaburi Road on-ramp and Sukhumvit Road off-ramp

A similar problem to that occurring at Location A was occurring in the Petchaburi Road on-ramp/Sukhumvit off-ramp weaving section. It too had a short 150 metre weaving area resulting in the same conditions as occurred in the northbound direction. It should be noted that the expressway was elevated in this area, had a main railway line to one side of it with at grade crossings at the arterial road level and was surrounded by intense urban development. These constraints limited the available improvement options.

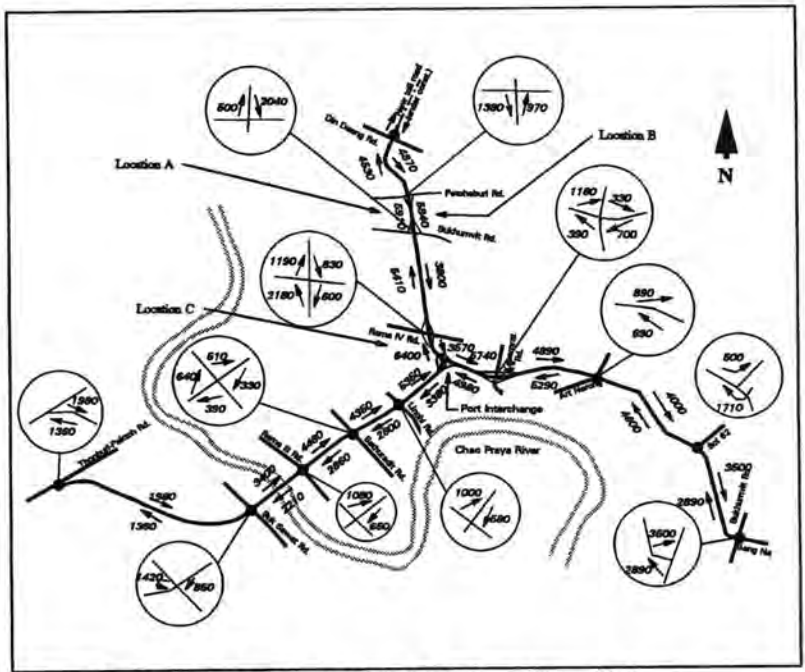


Figure 2 - Existing FES and 1992 A.M. Peak Hour Volumes

Location C: Rama IV Road off-ramp and Port Interchange

Traffic exiting at the Rama IV off-ramp backed up onto the expressway mainline and into the main Port interchange area which is a fully directional expressway interchange. The backup occurred due to heavy weaving of traffic destined for the off-ramp from the southeastern leg of the expressway system with traffic from the southwestern leg. The problem was very pronounced in the A.M. peak period which required manual police intervention at the Port interchange ramp terminals. Essentially the directional ramp system was temporarily turned into a police controlled merge. This condition in turn caused massive backups on both the southeast and southwest legs of the expressway system.

3.0 Modelling Process

Using a macro then a micro modelling approach, the proposed improvements would then be tested to confirm that they would,

- generate operational benefits, and reduce or eliminate operational deficiencies,

- be financially feasible by generating an acceptable rate of return,
- provide an economic benefit to both the road user and the managing authority.

The purpose for the modelling process was to provide an analysis tool to quantify the benefits of various ramp improvements and determine their feasibility. Accordingly, the key inputs for the feasibility analysis identified at the outset were as follows:

- Future link volumes on the FES by type of vehicle. A link is defined as a section of expressway between two ramps.
- Future weave volumes at key weave sections of the expressway.
- Average vehicle speeds on the FES links to derive travel time and vehicle operating costs.

To determine the above information for the various horizon years, expressway networks and ramp improvement alternatives were simulated by using two models:

1) A trip assignment model to determine the future link volumes on the FES using a computer software package, TMODEL2, and consequently develop horizon year origin-destination matrices.

2) A traffic operations model , CONTRAM5, to determine average vehicle speeds, delays and queue lengths.

The trip assignment model was used at a macro-level to estimate future traffic volumes on the road network of the Bangkok urban area. The traffic operations model was used at a micro-level performing detailed simulation of traffic flow along the FES. The two models were integrated whereby results from the trip assignment model were used to run the traffic operations model.

The sequence of tasks to conduct a model run for a particular horizon year and expressway network are summarized as follows:

1) The future stages of the expressway network were coded into the calibrated assignment model, as well as the FES improvement proposals.

2) The future auto O-D trip matrix was assigned to the road network resulted from item 1) to estimate future traffic volumes on the FES. An on-ramp to off-ramp trip matrix was extracted from the assignment model.

3) The on-ramp to off-ramp trip matrix was input to the traffic operations model to compute the average link speeds, delays and queue lengths at the ramp terminal intersections.

Model runs were conducted for the 1997, 2001, 2006, 2011 horizon years, each having expressway network alternatives and FES improvement proposals.

3.1 Trip Assignment Model

Previously developed O-D trip matrices were used in the trip assignment model to forecast traffic volumes on the FES. These matrices for years 1989, 1997 and 2006 were provided by the ETA from a previous transportation study (Seventh Plan Urban and Regional Transport Study "SPURT", 1991).

The trip assignment model was calibrated to replicate current traffic volumes on the FES and its on and off-ramps. The tasks followed to develop and calibrate the trip assignment model are shown in Figure 3.

The trip assignment model developed was based on a coarse zonal scale and used a volume-delay function. The model successfully achieved its intended purpose which was to,

- provide adequate replication of current mainline and ramp traffic volumes, and the on-ramp to off-ramp travel patterns on the FES,
- provide an acceptable indication of future traffic volumes on the FES by effectively modelling the changes in travel routes due to the expansion of the expressway network,
- provide future on-ramp to off-ramp trip matrices for use in the traffic operations model.

3.2 Traffic Operations Model

Future traffic operations on the FES were modelled by using CONTRAM5. CONTRAM5 simulates average speeds, delays and queue lengths by assigning time varying on-ramp to off-ramp traffic flows on the FES. The sequence of tasks to calibrate the traffic operations model are shown in Figure 3.

CONTRAM5 produced the following data for use in the economic analysis portion of the study:

- Delays and queuing at the ramp terminals and the effect of the queue back-up on the expressway mainline operation.
- The effect of merging on the FES mainline flow.
- The delays and speeds along sections of the FES mainline.

4.0 Financial and Economic Analyses

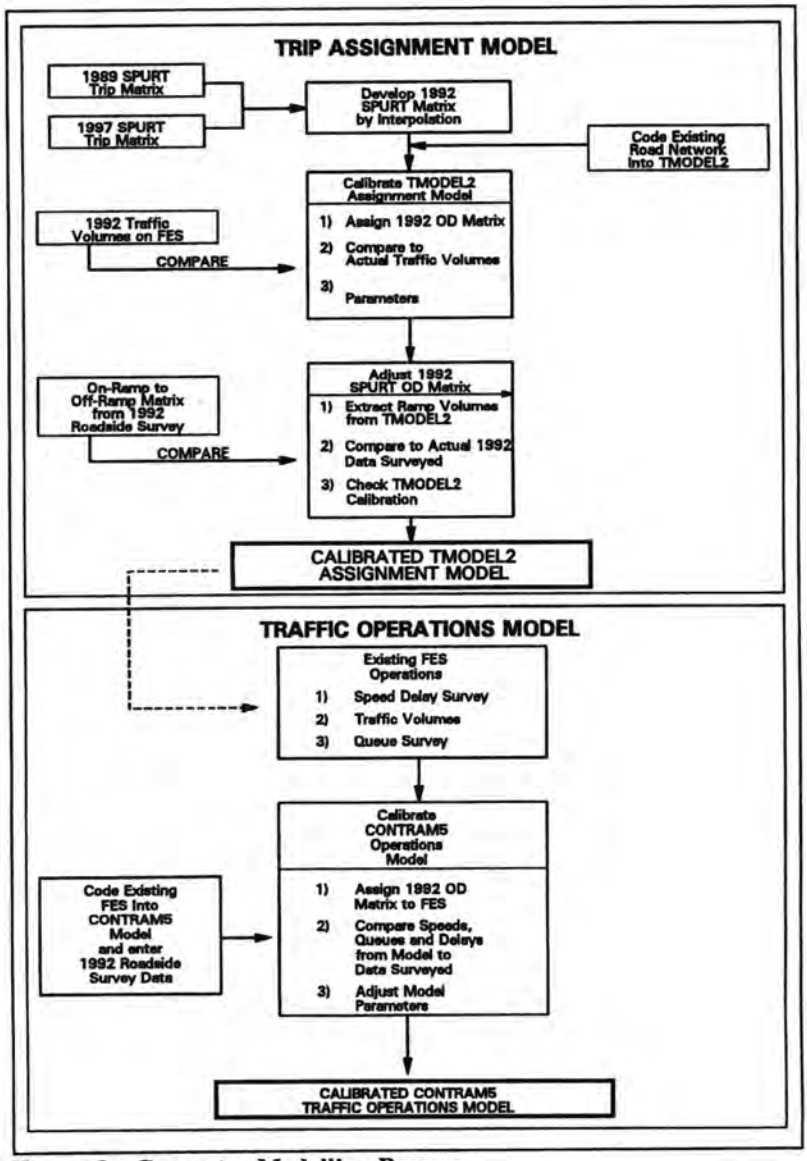


Figure 3 - Computer Modelling Process

The results from the CONTRAM5 model runs were used in performing the analyses of financial and economic viability of each ramp improvement proposal. In the analysis of financial viability, the rate of return was computed for each ramp improvement proposal based on the increase in annual revenue and cost. The modelling process indicated the increase in traffic volumes on the FES and the associated increase in toll revenue, while the increase in cost was based on the initial construction cost, land acquisition and compensation costs, and annual operating and maintenance costs.

Summary of Vehicle Operating and Travel Time Costs

BANGKOK ON/OFF RAMPS **LOCATION A - NORTHBOUND**
ECONOMIC ANALYSIS DATA **BETWEEN SUKHUMVIT ROAD AND PETCHABURI ROAD**

YEAR 2006 AM PEAK PERIOD *WITHOUT* RAMP IMPROVEMENTS (3 HOUR)

Link Number	Volume (Vehicles)				Speed (km/h)				COST ANALYSIS: VEHICLE OPERATING COST FOR PERIOD (BAHTS)				TIME COST FOR PERIOD (BAHTS)		LINK LENGTH km
	4 wheels	6-10 wheels bus	6-10 wheels truck	>10 wheels	4 wheels	6-10 wheels bus	6-10 wheels truck	>10 wheels	4 wheels	6-10 wheels bus	6-10 wheels truck	>10 wheels	4 wheels	Buses	
2006	14378	190	1301	0	60	51	51	0	14079	554	3971		10784	1823	0.25
2005	18414	244	1667	0	40	34	34	0	11948	476	3209		12430	2101	0.15
2004	16593	220	1502	0	60	51	51	0	33797	1330	9531		25886	4376	0.52
1379	1821	24	165	0	N/A	0	0	0	N/A	N/A	N/A		N/A	N/A	0.344
1382	*0*	*0*	*0*			*0*	*0*								
2386	4036	53	365		20	17	17		5408	213	1362		9445	1597	0.26
* *2388*	*0*	*0*	*0*		*0*	*0*	*0*								
									65232	2573	18074	0	58544	9898	

YEAR 2006 AM PEAK PERIOD *WITH* RAMP IMPROVEMENTS (3 HOURS)

Link Number	Volume (Vehicles)				Speed (km/h)				COST ANALYSIS: VEHICLE OPERATING COST FOR PERIOD (BAHTS)				TIME COST FOR PERIOD (BAHTS)		LINK LENGTH km
	4 wheels	6-10 wheels bus	6-10 wheels truck	>10 wheels	4 wheels	6-10 wheels bus	6-10 wheels truck	>10 wheels	4 wheels	6-10 wheels bus	6-10 wheels truck	>10 wheels	4 wheels	Buses	
2006	14017	186	1269	0	70	60	60	0	13198	520	3780		9011	1523	0.25
2005	18121	240	1640	0	55	47	47	0	10788	430	3032		8896	1504	0.15
2004	17319	229	1568	0	60	51	51	0	35275	1388	9948		27018	4568	0.52
1379	544	7	49	0	N/A	0	0	0	N/A	N/A	N/A		N/A	N/A	0.344
1382	258	3	23	0	35	26	26	0	925	38	251		1062	204	0.8
2386	4104	54	371	0	30	26	26	0	4987	199	1306		6403	1082	0.26
* 2388	3569	47	323	0	20	17	17	0	6621	261	1667		11563	1955	0.36
TOTALS									71793	2836	19985	0	63952	10836	

*The introduction of the new off-ramp at Sukhumvit Road (Link 2388) attracted some traffic from the existing ramp at Petchaburi Road (Link 1379) and also diverted more trips from the arterials to the expressway network.

Figure 4 - Cost Summary of Location A

In the analysis of economic viability, the incremental benefits and costs were compared for each ramp improvement proposal. The incremental benefits included savings in vehicle operating cost and travel time cost, as well as the increase in annual revenue. The vehicle operating cost savings were determined based on the type of vehicle and the cost of operating that vehicle at various speeds. The travel time cost were determined based on the type of vehicle and trip purpose. An example summary table of these costs for Location A, horizon year 2006, is shown in Figure 4. Similar tables were prepared for each location, each horizon year and each time period. Figure 5 shows an example of the results of the financial and economic analyses for the proposed ramp improvement at Location A.

5.0 STUDY OUTCOME

Based on the results of the financial and economic analyses the ten improvement schemes were ranked in order of implementation priority based on predominantly financial and economic benefits, followed by engineering and environmental benefits. The three locations described earlier received top priority. The recommended improvements to these three locations are reviewed below and schematically shown in Figure 6:

Location A: Sukhumvit Road on-ramp and Petchaburi Road off-ramp

To eliminate the queue occurring at the off-ramp to Petchaburi Road, a second loop ramp was recommended. This second loop ramp would direct the right turning traffic over the existing ramp terminal intersection and loop down to merge with Petchaburi Road. This would have the effect of eliminating most of the queuing and provide a directional ramp for eastbound traffic.

Another ramp was also recommended for westbound traffic to exit at Sukhumvit Road rather then at Petchaburi Road. This would divert most of the westbound traffic away from the weaving area where most of the problems occurred.

Location B: Petchaburi Road on-ramp and Sukhumvit Road off-ramp

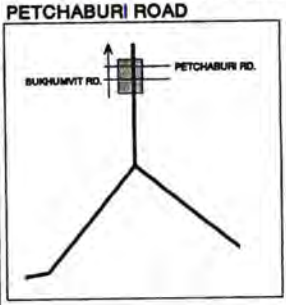
The presence of a railway line parallel to the expressway and the adjacent highly built up area left few options for solving the weaving problems at this location. The study team recommended a basket weave in order to eliminate the weave between the on-ramp and off-ramp traffic. The off-ramp would be of sufficient length to contain most of the existing and future queuing that would continue to occur due to the existing traffic problems at the signalized ramp terminal.

Location C: Rama IV Road off-ramp and Port Interchange

The weaving problems were severe in this area causing unacceptable backups along the southeast and southwest legs of the FES. The study team recommended a new off ramp to Rama IV Road in the form of a basket weave as show in Figure 6.

LOCATION A
SAMPLE OF ANALYSIS SUMMARY

NEW OFF RAMP NB AT SUKHUMVIT RD. AND NEW OFF RAMP SOUTH TO EAST AT PETCHABURI ROAD

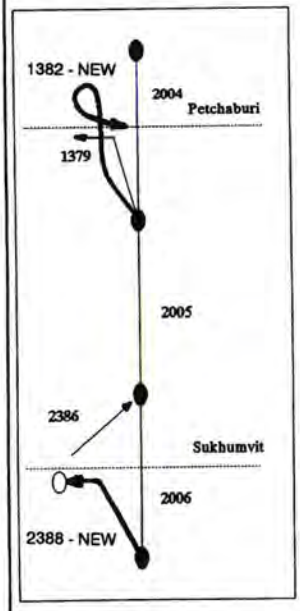


MAIN OPERATIONAL IMPROVEMENTS

1. Relief of high exiting demand at Petchaburi will improve operation for Petchaburi Traffic
2. Placing the S-E turn on free flow thus by passing the signalized intersection.
3. Improving the weave between Sukhumvit on-ramp and Petchaburi off-ramp.
4. Eliminate queuing on the weave section.

NON-QUANTIFIABLE BENEFITS

- Improvement of operations at the Petchaburi / Witthayo Rd.



TRAFFIC ANALYSIS

ADDITIONAL TRAFFIC (AADT 1997):	2300 veh.
LOCAL SPEED INCREASE	5 to 35 km/h

COSTS

LAND/COMPENSATION COSTS	274.84 M Baht
CONSTRUCTION COSTS	108.9 M Baht

FINANCIAL ANALYSIS

REVENUE COST RATIO	2.4
FINANCIAL RATE OF RETURN	21%
NET PRESENT VALUE	574 M Baht
PAYBACK PERIOD	12.45 Years

ECONOMIC ANALYSIS

BENEFIT COST RATIO	7.16
NET PRESENT VALUE	1,802 M Baht
EIRR %	39%

Figure 5 - Analysis Summary - Location A

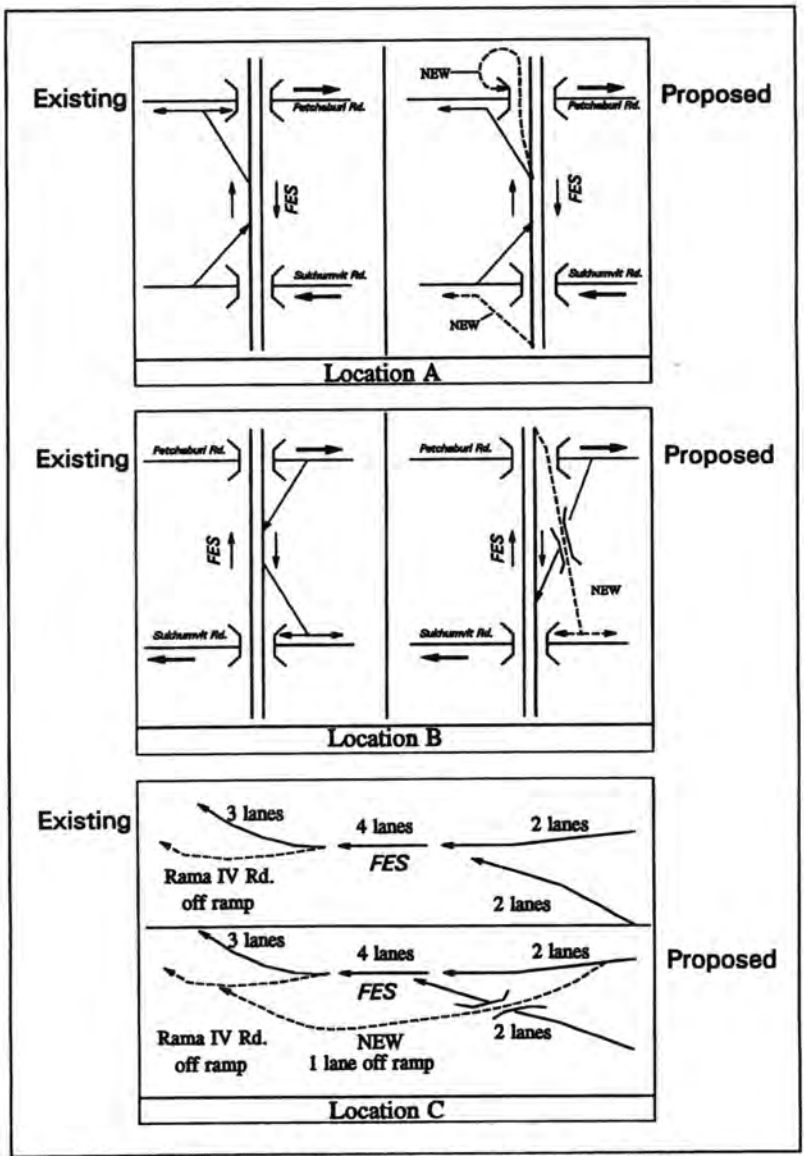


Figure 6 - Recommended Schemes for Locations A, B and C

This would eliminate the weaving problems and increase queue storage. In additional to the weave elimination, normal traffic operations would return to the mainline towards the north end.

5.1 Implementation Plan

The ten recommended improvements were ranked to develop an implementation schedule for staged design and construction between 1993 and 2002. The plan was submitted to the ETA in the form of a draft report for review. ETA reviewed the study recommendations and adopted seven of the ten schemes for immediate implementation. Terms of Reference for a turnkey contract for design and construction are under preparation. In the next stage, the improvements will undergo detailed design by the local Consultant and construction in accordance with the implementation schedule.

5.2 Future Modelling Capabilities

The two models used in the study were transferred to the ETA for their use in future planning exercises. Potential applications of the models include testing of additional ramp improvements for the FES and testing of on-ramp and off-ramp configurations for future stages of the expressway network.

The key features of the model was its ability to quickly estimate future traffic volumes on a large road network and also simulate traffic flow and operations on an expressway system at a very detailed scale, by combining the capabilities of the TMODEL2 and CONTRAM5 computer software packages. This general approach could be applied to other situations such as arterial corridors and sections of expressway networks.

A key component of SLI's success in securing and completing this project was the offer of technology transfer. At the end of the study, two representatives from ETA visited Canada last year and were trained on the two computer models used in the study. SLI's staff trained the individuals within a period of three weeks. During this time they toured the various highway and transit systems of Metropolitan Toronto, including the Highway 401 Freeway Traffic Management System, better known as "COMPASS", and the Toronto Transit System. They not only benefited from the software training but also learned in more detail the approach to solving transportation problems.

6.0 Reference

1. SNC♦Lavalin International for The Expressway and Rapid Transit Authority of Thailand, "The New On-Off Ramps and U-Turns on the First Stage Expressway System, Feasibility Study", Toronto, Ontario, 1993.

Transportation and Growth Management in the Greater Toronto Area

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1. INTRODUCTION

In keeping with many of the world's major metropolitan areas, Greater Toronto is faced with continuing challenges in providing sustainable transportation.

To be sustainable in the long term, I suggest that a transportation system should be:

- **capable** of delivering the required capacity and performance;
- **renewable**, which ultimately means using solar energy or, failing this, a relatively inexhaustible energy source such as nuclear fusion;
- **compatible** with the kinds of places we want to live in;
- **clean**, so that environmental quality is maintained or enhanced; and
- **affordable** in terms of capital and operating/maintenance costs.

In short, sustainable transportation is not only renewable and clean in terms of its energy and environmental impacts, it also has to deliver the required performance, cost-effectively and in manner which does not degrade the quality of our living places.

This paper provides a brief look at the major challenges and opportunities to achieve more sustainable urban transportation, focussing on the greater Toronto Area. Growth trends over the past 30 years and projected for the next 30 years are examined and their implications discussed. Growth

management prospects are reviewed, focussing on **land use, networks,** and **system management**, and conclusions are drawn regarding the outlook.

2. CHALLENGE AND RESPONSE

2.1 MAJOR CHALLENGES

Major GTA transportation challenges mirror the dark side of sustainability requirements.

In terms of system management, they include:

- **financial constraints** which have limited our ability to provide needed improvement and expansion of the area's transit and road systems;
- resulting **supply/demand imbalances** as demand has outstripped supply and congestion levels have increased; and
- **deferred maintenance** with growing concerns regarding impacts on safety and efficiency as well as higher costs which will be incurred in the future because of further system deterioration.

Environmental challenges include:

- **negative impacts on air, water and soil quality**, major contributions to local pollution, global warming, acid precipitation and high-level ozone depletion;
- **resource consumption**, including land, agricultural capability and energy; and
- **neighbourhood disruption**, including congestion, sterilization of large areas for parking and major roads, separation of activities beyond the human scale, and accidents.

Transportation also poses significant challenges to the GTA economy, including:

- **economic inefficiency** in terms of lost person-hours and delayed goods movements, valued at hundreds of millions of dollars per year;

- **lost jobs and income** because of delays in system construction and related urban developments; and

- a resulting **loss of competitive advantage** relative to other metropolitan areas in North America and abroad.

It is not an exaggeration to say that current urban trends and transportation system attributes in the GTA do not meet the area's needs appropriately and are not sustainable.

2.2 ACTION LEVERS

There are, of course, a substantial number of things which can be done to address this situation, some of which take more investment than others, and some of which will require a significant amount of innovative thinking and political will. For convenience, these action levers are grouped under three headings:

1. **Land Use**: more compact, mixed land use which leads to shorter trips, supports the use of public transportation, walking and cycling, and reduces dependency on automobile trips; this requires coordinated planning and delivery of land use/infrastructure on a continuing basis, over a period of decades;

2. **Networks**: continuous and appropriately designed and located networks of roads, rapid transit lines, walkways and bikeways, including streetscapes which are more conducive to transit, walking and cycling;

3. **System Management**: operational, regulatory and pricing measures to encourage more efficient use of the transportation system and its cost-efficiency in meeting the mobility requirements of people and goods as well as their vehicles.

2.3 THE URBAN TRANSPORTATION BALANCE

As illustrated in Exhibit 1, there are very substantial interactions among these three groups of policy levers. For example, changes in the form, density and mix of land uses can greatly reduce overall vehicular travel effort by allowing transportation needs to be met effectively through pedestrian, cycling and transit movements, and through auto and truck trips which are, on average, shorter because various activities are located closer together. Transportation demand management can significantly reduce peak period travel demands, particularly by single occupant discretionary auto trips. The

combined effects of land use and demand management initiatives can, in turn, reduce the requirements for network expansion, since overall vehicular travel effort is reduced, and transportation infrastructure is used more efficiently.

The result of such initiatives, if effectively coordinated, can be significant gains in transportation sustainability.

2.4 INITIATIVES FOR SUSTAINABLE TRANSPORTATION

This is illustrated more fully in Exhibit 2, which shows more detailed types of initiatives which can be taken to improve urban structure/design policies, transportation infrastructure, and various types of transportation management and improved technology. The manner in which each such initiative is likely to improve urban travel sustainability, which is described in terms of some 14 measures, is illustrated, with a large circle showing a major impact and smaller circles showing less significant impacts.

While the emphasis in this paper is on growth management, which is interpreted to mean both urban development growth and transportation demand growth, transportation infrastructure initiatives are also illustrated since these interact directly with the other two types of action levers.

3. GTA GROWTH TRENDS

Before discussing specific initiatives in the GTA to achieve more sustainable transportation, it is useful to put these remarks in context by summarizing relevant GTA growth trends and some of the major factors underlying them.

3.1 THE LAST 30 YEARS

As shown in Exhibit 3, while the growth in GTA population over the past 30 years (1961-1991) was very substantial (101%), employment grew even more (171%) and the growth in daily trips was larger yet (189%). The number of daily vehicular trips per capita increased by about 44%, average work trip length by about 26%, and car ownership per capita by 70%.

There were a number of important factors creating this explosive growth, including the following:

- following the unprecedented drop in fertility in the mid-1960's (which marked the end of the 1946-1966 "baby boom") the average household size dropped significantly (from 3.8 persons in 1961 to

2.8 in 1991) as fewer children were born, more women joined the work force, and the number of adults per household increased with correspondingly more travel generated;

- increasing prosperity since World War II generated higher real incomes and greater car ownership which meant that growing numbers of people used automobiles for their trips to work and for other purposes;

- during the same period, the construction of freeway networks and the demand for quicker and more reliable door-to-door deliveries produced a major shift of goods movement from rail to truck, adding additional vehicular demand on top of the burgeoning passenger travel by road.

The significant increase in average trip length resulted from a number of addition factors, including the following:

- the greater scale of the Greater Toronto Area in 1991 versus 1961;

- rapid household formation by the baby boomers, most of which occurred on "greenfields" land in low density residential suburbs, in response to regulatory and market forces and was increasingly distant from many job locations, particularly those in central areas;

- difficulties in living close to work when there are two or more workers per household, often with widely separated job locations.

As can be seen from Exhibit 3, the fact that each person in 1991 was making on average 44% more trips than in 1961 and each trip was, on average, 26% longer, means that the transportation system had to cope with about 81% greater demand **from each person** in terms of vehicle-km than it did 30 years earlier. Compound this by the 101% growth in population in the GTA and the transportation problems we are now facing become somewhat easier to understand.

3.2 THE NEXT 30 YEARS

Projected trends in the same variables are summarized in Exhibit 4, for the period 1991-2021.

Considerable population and employment growth is expected (57% and 64% respectively), with commensurate increases in daily trips. The average work

trip length is expected to continue increasing, from 14.4 to 17.3 km (a 20% increase) if existing low density suburban development trends continue; a smaller (16%) increase to 16.7 km is anticipated if more compact, mixed use "nodal" development can be achieved. The number of daily vehicular trips per capita is expected to increase slightly by about 2%.

The increased travel demand is expected to be driven by continuing but much smaller declines in average household size, a high proportion of working adults in the population, plus continuing but slower increases in real incomes and car ownership. Growth rates of other contributing factors are also expected to be more moderate: for example, the rate of entry of women into the labour force is reaching saturation levels and, as noted earlier, the demand for first home purchase by baby boomers will start slackening off at about the turn of the century. Similarly, the shift of goods movement from rail to truck is saturating and is not expected to fuel the growth of truck traffic as much as previously.

Speaking somewhat simplistically, and assuming that future immigration levels remain similar to average levels during the past few decades, it is possible that the next ten or fifteen years may be the most challenging in terms of meeting rapidly growing transportation requirements. After that, the imperative for more and more new facilities/services may slacken somewhat although citizens of the day will be faced with greater costs for maintaining and operating a larger transportation system, possibly without the added tax revenues of a rapidly growing population.

3.3 TRENDS, PROBLEMS AND OPPORTUNITIES

There are a number of implications to be considered regarding these trends:

- growth rates are likely to be slower, relative to those during the past three decades and it is possible, depending on immigration rates, that Canada's and Ontario's population levels may tend to stabilize in the 2020 decade and subsequently, with a resulting shift in public policy emphasis from meeting the needs of growth to serving the requirements of an aging population with stable or declining tax revenue;

- the type of urban development which occurs over the coming three decades will have a major impact on transportation requirements and cost-effectiveness, including the real challenge of matching urban concentration centres (nodes) with junction points in the rapid transit and commuter rail networks rather than the highway

network only, which occurred for some suburban centres initiated during the 1950's and 1960's;

- growth of broad-band, interactive telecommunications and computer technology will make it more convenient for workers in information industries to telecommute (work at home) or telework (work at a nearby office location hooked into the information network) for one or more days per week, thereby reducing peak period travel demand growth;

- there will be increasing demand management and related regulatory actions to reduce discretionary use of automobiles by single occupants during peak periods in our large urban areas, encourage much greater use of transit, walking and cycling, and also to develop automobiles, transit vehicles and trucks which produce zero emissions and use more sustainable forms of energy;

- all of these actions will have to be accomplished within extremely tight financial limits, while Canadians wrestle with public and private sector debts for the next one or two decades and while we attempt to maintain and improve Canada's economic efficiency and competitiveness.

Clearly, while there are significant opportunities, managing this process will be a major challenge.

4. GTA GROWTH MANAGEMENT PROSPECTS

A number of the more recent planning and management initiatives taken in the Greater Toronto Area to address these challenges are discussed briefly under the three headings of land use, networks, and system management.

4.1 LAND USE

There is general agreement as to what kind of urban form provides the maximum potential for sustainability. Pedestrian- and transit-supportive cities are characterized by:

- a compact urban form, with average densities of at least 4,000 persons per square kilometre;

- concentration of development in mixed-use nodes and corridors, (e.g. placing shops and services near all residential areas and creating focal points for public transit routes);

- orientation of buildings close to and facing the street, with parking minimized and/or place away from the area between the building and the street;

- a continuous road grid providing 600-800 meter spacing between arterial and/or collector roads and maximum walking distances of about 400 meters from interior sites to main roads/transit routes;

- wide sidewalks and other pedestrian amenities.

These principles have been reflected in a number of design documents. The Province of Ontario released in 1992 a document titled ***Transit-Supportive Land Use Planning Guidelines*** to help those responsible for urban development make it more transit-supportive. These guidelines are being observed by all five regional municipalities and many of the 30 area municipalities in the GTA, including rapidly growing suburban areas such as Burlington, Markham and Vaughan.

Exhibit 5 summarizes three generic urban forms prevalent in the GTA and other Canadian cities. It can be seen that average densities drop off sharply from the central city (City of Toronto, 6550 people/km^2) to the post-World War II suburban community (typified by North York, 3178 people/km^2) to the more recent suburb (represented by Markham, 1690 people/km^2) and the transit ridership per capita drops off proportionately, while car ownership and metres of road per capita increase as the density decreases. In designing policy initiatives to make urban form more pedestrian- and transit-oriented, these three situations present distinctly different challenges, and have prompted a range of initiatives.

Central Urban Areas

In older core areas, the challenge is to protect the existing character of the urban form, retain downtown employment, retain or increase downtown population and enhance the transit, pedestrian and cyclist environments.

The City of Toronto has protected downtown neighbourhoods using traffic calming techniques, has successfully encouraged development of more housing in the core area, has carried out urban design projects to beautify the streetscape, and has created many pedestrian-transit linkages and

underground walkways. For trips remaining within Toronto's Central Area (about 10 km^2 in extent) walking is the most commonly used mode (38%) followed by transit (32%) auto (24%) and bicycle/other (6%).

Older Suburban Areas

In the post World War II suburbs such as much of North York, policies are needed to increase densities, create mixed-use nodes and corridors, and improve pedestrian access and the pedestrian environment. These are being applied in North York's "downtown" along Yonge Street between Highway 401 and Finch Avenue to the north.

The Metropolitan Toronto official plan has long encouraged the growth of suburban town centres. The new Official Plan sets out planning strategies for the "reurbanization" of Metro Toronto, encouraging intensification and the redevelopment of selected arterial roads into "main streets". It will also foster urban design which maximizes safety, accessibility and a liveable pedestrian environment.

New Suburban Areas

In peripheral growth areas which have grown rapidly during the past two or three decades, the priority is to discourage further urban sprawl and create more compact, balanced and diversified communities, planned according to transit-supportive principles. Official plans and transportation planning in the GTA, including newer suburban areas, are increasingly reflecting this approach.

Nodal Urban Structure

The Province of Ontario has created the Office of the Greater Toronto Area (OGTA) to address the problems of urban sprawl and encourage coordinated planning and delivery of urban development and infrastructure by the area's five regional governments and 30 area municipalities. A nodal urban structure concept has generally been accepted as the common goal. This emphasizes compact mixed-use redevelopment/development based on greatly expanded transit services but also allows for some additional greenfield development and growth in auto use. As summarized in Exhibit 6, the **nodal** concept has significant sustainability advantages over the trends (**spread**) concept in terms of transportation energy use and emissions; the **central** concept would have even more advantages but is generally considered too extreme in terms of land use and possible market impacts.

The Province of Ontario has also recently issued new ***Growth and Settlement Policy Guidelines*** which state that peripheral urban development should be restricted until areas within the existing urban envelope are fully developed. This and the ***Transit-Supportive Land Use Planning Guidelines*** document provide an excellent policy framework for more sustainable urban development.

4.2 NETWORKS

Capital expansion plans for transportation networks are not detailed here since the emphasis in this paper is on land use and transportation system management. The major thrust of current GTA infrastructure plans and programs is to expand the commuter rail (GO Transit) and municipal transit facilities/services very significantly, with less substantial expansion of the road network (in conjunction with transit priority/HOV lanes in many instances), the intent being to change the modal balance such that transit will carry a significantly increased share of travel in urbanized parts of the GTA. Ongoing financial constraints may curtail the rapid transit expansion program, however, such that relatively more emphasis may have to be placed on expansion of the commuter rail system and of the surface transit system, providing the latter with greater priority through transit priority/HOV lanes on major arterial roads. As the rapid transit expansion situation is clarified, hopefully during the next few months, it will be important to analyze the implications of the situation and determine the extent to which the transit priority/HOV lane network and related measures can effectively increase transit's market share, in conjunction with the ongoing GO Transit expansion and surviving parts of the rapid transit expansion program.

4.3 SYSTEM MANAGEMENT

Transportation demand management (TDM) is used here to describe various measures for moderating transportation demand by reducing the **amount** of vehicular travel (through shorter and fewer trips, more persons per vehicle), influencing its **timing** (to flatten peaks) and changing the **modal split** (to reduce the growth of discretionary auto trips so that the transportation system will be used more efficiently). While land use and network changes can contribute significantly to at least two of the above three objectives, we focus in this section on other measures such as flexible work hours/weeks and telecommuting to reduce peak period commuting travel; managing the supply and price of downtown parking and parking at other major destinations in order to encourage greater use of public transportation; providing real-time information to travellers both before and during their trip in order to encourage selection of the most appropriate travel mode and

travel route to make efficient use of the system; operational measures to encourage more efficient use of road space to carry people and goods rather than simply automobiles (including transit priority/HOV lanes and related measures); and possible introduction of road pricing, using electronic toll collection with higher toll levels during peak periods and on more congested facilities, thereby encouraging drivers to use the system more efficiently and, equally important, providing dedicated funding to help improve and maintain the transportation system.

A number of examples of TDM measures applied in the GTA, particularly in regard to travel to and from the Central Area, are provided below.

Flexible Hours and Telecommuting

Metropolitan Toronto and the City of Toronto introduced flexible hours over ten years ago and this resulted in a noticeable spreading of travel from the peak hours to the "shoulder" parts of the peak period. More recently, telecommuting (in which employees work at home or at a satellite office for one or more days per week with appropriate telecommunications links to the main office) has been increasingly practised, particularly in the "information industries" and according to some estimates may be expected to reduce the growth in peak period commuting trips to the Central Area by 0.3 - 2% during the coming decade and by as much as 3 - 10% over the next few decades.

Parking Management

Following completion of the Central Area Parking and Loading Study in the mid 1970's the City of Toronto acted to increase parking rates for all day parking in the Central Area relative to short term rates and to establish maximum as well as minimum parking requirements for various land uses in the area in order to encourage greater use of public transportation, particularly for commuting trips. Subsequently, similar measures have been taken by other municipalities in the GTA. At the same time, until the onset of the recession in 1990, market forces resulted in parking rate increases in Toronto's downtown area, also helping to encourage a shift from auto to transit.

Transit Priority and HOV Lanes

For major urban roads on which a significant proportion of person movements occur by transit (bus, streetcar) as opposed to private autos, the introduction of transit priority lanes and HOV lanes is an important means

of encouraging greater use of transit and higher automobile occupancy levels, both of which contribute to more efficient road use in moving persons and goods rather than catering primarily to private vehicles. At the same time, traffic signal priority and turning movement regulations can be used to provide greater ease of bus and streetcar movements, thereby encouraging greater use of these modes. Relevant measures of this type include previous introduction of the Bay Street Clearway and similar transit priority/HOV lanes on Eglinton Avenue and the Allen Roadway. The Metropolitan Toronto Transportation Department is currently implementing a very substantial network comprising some 600 km of HOV lanes throughout Metro Toronto, linking eventually to similar networks under development in adjacent municipalities and on provincial highways.

Communications and Information Systems

A number of important initiatives have been taken in the GTA to provide real-time information to travellers so that they can choose their travel mode and route to reduce travel time and increase travel time reliability. These include introduction of automated telephone information systems providing transit riders with information on the arrival times of buses at their local stops; e.g. the TTC Timeline System. Metropolitan Toronto has recently begun full scale operational testing of the Gardiner/Lake Shore Corridor Management System, which will provide motorists with real-time information on incidents/congestion ahead and advice on alternate routes to avoid the congestion. The Ministry of Transportation Ontario (MTO) has operated such freeway traffic management systems (FTMS) on the Queen Elizabeth Way, the Burlington Skyway and Highway 401 serving the GTA for a number of years with excellent results in terms of reduced accidents and delays and increased travel time reliability. Sophisticated intelligent vehicle highway systems (IVHS) are being developed to achieve similar objectives more widely throughout the area.

Road Pricing

The MTO is currently reviewing bids from two major consortia to build and operate Highway 407 (now under construction in an east-west corridor north of Highway 401) as a tollway some 68 km long, in order to provide increased funding and accelerate construction of this important facility and, at the same time, encourage travellers to use the facility more efficiently. Many metropolitan areas throughout the world are now planning or introducing road pricing schemes, and it seems likely that this will become increasingly common (possibly involving other major roads in the GTA within the coming one or two decades) in response to the dual needs for more effective

transportation demand management and more dedicated funding sources for infrastructure.

Conclusions

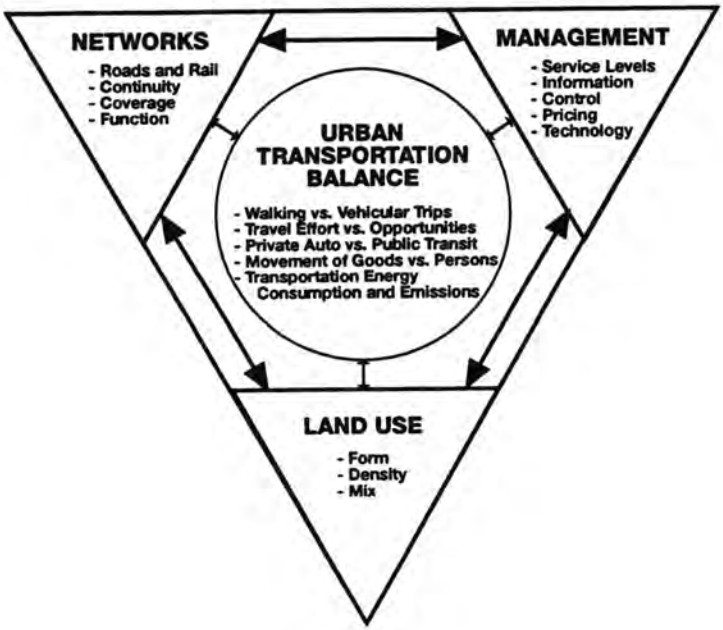
All of the above are examples of growth management measures which have already been introduced or are being planned or implemented in the Greater Toronto Area to encourage more efficient use of the transportation system and, in particular, to moderate the growth of single-occupant, discretionary auto trips in peak periods. It is reasonable to conclude that measures which have been taken, as summarized above, have contributed to the relative stability of peak period auto traffic entering Toronto's Central Area (as summarized in Exhibit 7) and that ongoing implementation of such measures, in conjunction with continuing increases in public transportation services and limitations in road capacity serving the Central Area, will lead to similar trends during the coming decades.

4.4 THE OUTLOOK

Major decisions and ongoing programs will determine the effectiveness of growth management to achieve more sustainable transportation in the Greater Toronto Area. Among these will be the publishing and implementation of a provincial urban structure policy for the GTA; development of an integrated land use/transportation plan and strategy for the entire GTA; decisions regarding the funding and timing/extent of the rapid transit expansion program; implementation of the transit priority/HOV network; timing and extent of ongoing commuter rail and major road expansions and related network improvements; and continuing actions to implement effective transportation demand/supply management measures, including possible more widespread implementation of road pricing during the next decade or two.

If, as seems likely, ongoing financial limitations significantly curtail network expansion, increasing emphasis will have to be placed on both urban structure growth management and transportation demand/supply management in order to achieve the system capability, compatibility, energy/environment sustainability, and financial affordability that will be required to meet the GTA's transportation requirements during the next three decades and beyond.

EXHIBIT 1
THE URBAN TRANSPORTATION BALANCE



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EXHIBIT 2
SUSTAINABLE URBAN TRAVEL: INITIATIVES AND INTERACTIONS

Measures of More Sustainable Urban Travel / Major Types of Initiatives	REDUCED VEHICULAR TRAVEL EFFORT				GREATER CONSERVATION OF RESOURCES		IMPROVED ENVIRONMENTAL QUALITY		IMPROVED ECONOMIC EFFICIENCY		ENHANCED QUALITY OF LIFE		BROADENED LIFESTYLE CHOICES	
	Shorter Trips	More Walking	More Transit	More Cycling	Possil Fuels	Farm-land	Air Emissions	Water Runoff	Less Conges-tion	Lower Transp'n Costs	Greater Safety	People Places	Housing Types	Travel Modes
URBAN STRUCTURE/DESIGN POLICIES														
• Compact Mixed Land Use	●	●	●	●	●	●	•	•	•	●	●	●	●	●
• Pedestrian-Friendly Streets	•	●	●	●	●	•	•	•	•	•	●	●	•	•
• Joint Transportation/Land Use Planning	●	●	●	●	●	•	●	●	●	●	•	●	•	●
• Dev. Nodes and Intermodal Transfer Nodes	•	•	●	•	•	•	•	•	●	●	•	●	●	●
• Parking Supply Management	•	•	●	•	•	•	•	•	●	•	•	•		•
TRANSPORTATION INFRASTRUCTURE														
• Continuous, multi-modal Arterial Roads	●	•	●	•	•		•		●	•	•	●		●
• High Occupancy Vehicle (HOV) Facilities	•	•	●	•	●	•	●	●	●	●	●	●	•	●
• Rapid Transit and Commuter Rail Networks	•	•	●		●	●	●	●	●	•	●	●	•	●
• Local Transit Improvements		•	●	•	•	•	•	•	•	•	•	●	•	●
• Cycle and Pedestrian Ways	●	●	•	●	●	•	●	●	●	•	●	●	•	•
DEMAND MANAGEMENT PRACTICES														
• Parking Price Management	•	•	●	•	•	•	•	•	●	•	•	●		•
• Congestion Pricing for Road Use	●	●	●	●	●	●	●	●	●	●	●	●	•	•
• Alternative Work Schedules			•	•	•		•	•	●	•	•	•		•
• Ridesharing		•			•		•	•	●	●	•	•		•
• Telecommuting	●	•	•	•	●		●	●	●	●	•	•	●	•
TRANSIT MANAGEMENT PRACTICES														
• Fare Integration and Schedule Coordination		•	●		•	•	●	●	●	●	●	●		●
• Transit Priority		•	•		•	•	•	•	•	•	•	•		•
• Traveller Information Systems	•	•	•	•	•	•	•	•	•	•	•	•		•
TRAFFIC MANAGEMENT PRACTICES														
• Advanced Traffic Management Systems	●	•	●		•		•	•	•	•	●	•		•
• Driver Information Systems	•	•	•	•	•		•	•	•	•	•			
• Traffic Calming		•	●	•							●	●		
CLEANER VEHICLE TECHNOLOGY DEVELT														
• Low-emission Vehicles			•		•		●	●				•		•
• Energy-Efficient Vehicles					●		•	•						•
• Emissions Monitoring/Testing Programs					●		●				•			
PUBLIC OUTREACH AND AWARENESS PROGRAMS	●	●	●	●	●	●	●	●	●	●	●	●	●	●

Source: ***Urban Travel and Sustainable Development: The Canadian Experience***, prepared for Canada Mortgage and Housing Corporation by IBI Group, 1993

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LEGEND: Anticipated Impact of Initiative in Helping to Achieve Sustainable Urban Travel:
● Large Impact ● Moderate Impact • Modest Impact Negligible Impact

EXHIBIT 3

HISTORICAL GTA[1] GROWTH:
1961-1991

	1961	1991	1961 - 1991 % Increase
• POPULATION	2,106,000	4,236,000	101%
• EMPLOYMENT	846,000	2,292,000	171%
• DAILY TRIPS	2,948,000	8,528,000	189%
• DAILY TRIPS PER CAPITA	1.40	2.01	44%
• AVERAGE WORK TRIP LENGTH	11.4 km	14.4 km	26%
• CAR OWNERSHIP PER CAPITA	0.30	0.51	70%

REASONS FOR MORE TRIPS PER PERSON

- MORE ADULTS PER HOUSEHOLD
- MORE WOMEN IN THE WORK FORCE
- HIGHER REAL INCOMES AND CAR OWNERSHIP
- GOODS MOVEMENT SHIFT FROM RAIL TO TRUCK

REASONS FOR LONGER TRIPS

- GREATER SCALE OF GTA
- RAPID HOUSEHOLD FORMATION
- HIGH LAND COSTS AND MORE SUBURBAN HOUSING
- MORE HOUSEHOLDS WITH 2+ WORKERS
- SHORTAGE OF RENTAL ACCOMMODATION

[1] INCLUDES THE REGIONAL MUNICIPALITIES OF DURHAM, HALTON, PEEL, YORK AND METROPOLITAN TORONTO

Sources: Transportation data are drawn from Statistics Canada, the 1964 MTARTS Survey and the 1986 and 1991 Transportation Tomorrow Surveys

EXHIBIT 4

ANTICIPATED GTA GROWTH: 1991-2021

	1991	2021	1991 - 2021 % Increase
• POPULATION	4,236,000	6,668,000	57%
• EMPLOYMENT	2,292,000	3,757,000	64%
• DAILY TRIPS	8,528,000	13,669,000	60%
• TRIPS PER CAPITA	2.01	2.03	2%
• AVERAGE WORK TRIP LENGTH	14.4 km	16.7 - 17.3 km	16 - 20%
• CAR OWNERSHIP PER CAPITA	0.51	0.55 - 0.6	8 - 18%

TREND INDICATORS

- SMALL, MORE ADULT HOUSEHOLDS
- SLOWER GROWTH OF INCOMES/CAR OWNERSHIP
- SATURATION OF FEMALE LABOUR FORCE LEVELS
- SLOWER RATE OF HOUSEHOLD FORMATION
- SATURATION OF RAIL-TRUCK GOODS MOVEMENT SHIFT

Sources: 2021 estimates of population and employment were prepared for the Office for the GTA by Hemson Consulting Ltd., 1993; future GTA trip attributes were estimated by IBI Group as part of recent transportation studies in the area.

EXHIBIT 5

GENERIC URBAN FORM AND TRANSPORTATION IMPLICATIONS

	Central City (City of Toronto)	Post-WWII Suburb (City of North York)	Recent Suburb (Town of Markham)
Population	635,395	562,564	153,811
Urban Form			
Size of Urbanized Area (km2)	97	177	91
Residential Density (people/km2)	6550	3178	1690
Employment Density (jobs/km2)	4323	2292	665
Transportation System			
Automobile Ownership (vehicles/1000 people)	388	450	555
Road Extent (m/person)	1.7	3.6	5.5
Transit Ridership (annual rides/person)	199	143	90

Source: ***Urban Travel and Sustainable Development: The Canadian Experience***, prepared for Canada Mortgage and Housing Corporation by IBI Group, 1993.

EXHIBIT 6
LAND USE: COMPARISONS OF GTA URBAN STRUCTURE CONCEPTS

	1986 BASE	2021 SPREAD	2021 CENTRAL	2021 NODAL
URBANIZED LAND (KM^2)	1,520	2,420	1,870	2,110
GTA EMP./POP. (M)	2.1/3.7	3.4/5.0	3.4/5.0	3.4/5.0
SUBURBAN REGIONS EMP./POP. (M)	0.8/1.5	1.7/3.6	1.2/2.2	1.6/3.2
METRO TORONTO EMP./POP. (M)	1.3/2.2	1.7/2.4	2.2/3.8	1.8/2.8
GROSS DENSITY (POP./KM^2)	3,800	3,900	5,040	4,470
RURAL LAND CONSUMED (KM^2)	1,520	+900 =2,420	+350 =1,870	+590 =2,110
NETWORK ADDITIONS				
• HIGHWAYS (LANE-KM)	-	2,035	784	1,024
• ARTERIALS (LANE-KM)	-	5,237	3,908	5,472
• RAPID TRANSIT (KM)	-	81	178	181
PERCENT TRANSIT (AM PEAK PERIOD)	25	26	35	29
AVERAGE TRIP LENGTH (KM)	13.4	15.0	13.2	14.3
TRANSPORTATION ENERGY CONSUMED (MJ IN AM PEAK PERIOD)	26.4	46.7	37.2	42.1
ANNUAL AUTOMOTIVE EMISSIONS (TONNES IN AM PEAK PERIOD)	1,900	5,200	2,600	3,000

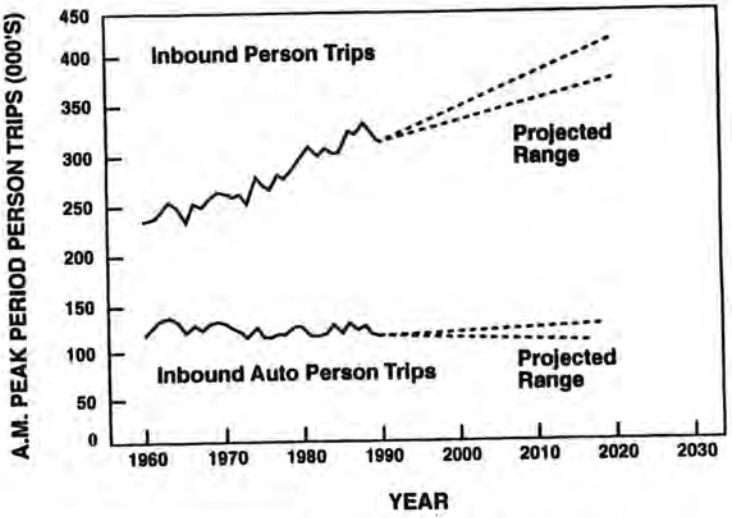
Source: *Greater Toronto Area Urban Structure Concepts Study* prepared for the Greater Toronto Coordinating Committee and Office for the GTA by IBI Group et al., 1990.

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EXHIBIT 7

PAST/FUTURE CENTRAL AREA TRAVEL TRENDS TO THE CENTRAL AREA OF TORONTO



Source: *Toronto Central Waterfront Transportation Study, Report 15* prepared for the Royal Commission on the Future of the Toronto Waterfront by IBI Group et al., 1991.

Internal Trade Barriers and the Trucking Industry

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Introduction

According to Canada's trade ministers, "Internal trade barriers lead to inefficient use of resources, limit the ability of industry to take advantage of economies of scale and consequently result in increased costs that are passed on to consumers and taxpayers."[1] Trucking regulations are identified as one of these trade barriers.

This paper examines to extent to which regulatory differences or regulatory multiplicity acts as an impediment to trucking in Canada. It does so by outlining work done for Transport Canada (fall of 1993)[2] in response to the trade ministers' concerns and by looking at the empirical evidence developed from a preliminary examination of Statistics Canada's trucking origin-destination data.

Background

Because roads are a provincial responsibility and because activity on the roads has been regulated primarily by the provinces--since 1954 aspects of this regulation have been delegated federal powers--there has grown up in Canada a series of different regulatory/tax regimes governing trucking. These regimes--the vehicle registration system, fuel tax collection methods, economic regulation (entry/exit/rates/service), truck weight and dimension rules, safety regulations--have not developed in isolation. Obviously, as a province introduced or amended its regulatory/tax structures, it looked at neighbouring (provincial or state) systems. Nevertheless, a great deal of diversity did develop.

This diversity did not matter much in the 1920s and 1930s as trucking was then primarily a local matter. However, by the 1940s as trucking increasingly became an interjurisdictional activity, there were calls for the federal government to take over the regulation of trucking to ensure uniformity. This did not happen, but throughout the 1950s, 60s and 70s, the issue of uniformity became more important.

The consequence was that several agreements, arrangements and other attempts at accommodating interjurisdictional trucking emerged. The regulation of the transportation of dangerous goods is uniform through the mechanism of having provincial/territorial legislation mirror federal legislation (although the industry

argues that enforcement varies). The Interjurisdictional Sales Tax Agreement, started in 1969, allows for the proration of sales tax among the eight participating provinces in proportion to distances driven. CAVR, the Canadian Agreement on Vehicle Registration to which all ten provinces belong, is a similar plan allowing for the proration of vehicle registration taxes. The National Safety Code came into existence because of an agreement signed by all jurisdictions prior to the passage of the Motor Vehicle Transport Act in 1987. The code covers such things as the way vehicles are inspected on the road, load security, driver's hours or work, maintenance and driver standards. The MVTA itself enforces a uniform regime for economic regulation (or "deregulation") of extraprovincial trucking on the provinces and territories. Vehicle weights and dimensions have been the subject of two agreements, signed by all jurisdictions, specifying minimum acceptable limits.

There are other agreements, works-in-progress, regional agreements and institutional arrangements seeking, among other things, to achieve uniformity in the regulatory/tax regimes. For example, the Prairie provinces are working on a common method of issuing permits for long combination vehicles; the Maritime provinces are working on their own agreement covering several areas; all provinces are cooperating on research into load security; a 1991 agreement covers the way periodic vehicle inspections are done. Without trying to provide a comprehensive list of the entire regulatory structure surrounding trucking, the point to observe about the last few decades is that there has been a tremendous amount of effort put into achieving uniformity or into developing institutions to accommodate trucks operating across domestic borders.

Without judging the success, or lack thereof, of this effort, the developments to date have not been enough, apparently, to satisfy the pace of developments within the trucking industry. At the time of the NTA Review Commission's work, the trucking industry made much of the "lack of uniformity."[3] The NTA Review Commission agreed and made some strong recommendations about uniformity[4] and others--including the National Transportation Agency and Transport Canada--joined the chorus of those saying something had to be done about the lack of uniformity.[5]

Previous Research

There has not been much research on the impact of differing or multiple regulations. One 1988 study[6] is interesting because of the methodology employed. Here, the analysis is of the impact of the institutional barriers between two countries and the authors attempt to quantify this impact by comparing domestic and transborder trucking rates:

> "This study was undertaken to examine the regulations, fees and practices which pertain to Canada-U.S. trans-border trucking . . . Carriers provided truckload rates for both trans-border and domestic routes, which were used to approximate the relative importance and magnitude of current institutional barriers. . . The aggregate effect of regulatory costs is significant. Using

> average truckload rates, they were estimated to add approximately 15 to 20 cents per mile to transport costs . . ."

Another paper, in 1993 by Copeland[7], reviews recent work on the subject of inter-provincial trade barriers. The author writes as follows (*this is in his review of a 1986 study by Norrie, Simeon and Krasnick*[8]):

> "As the Conference Board study indicated very clearly, there are a number of conflicting regulations in the trucking industry which impose costs on trucking firms. In addition, increased shipping costs can act as a trade barrier between provinces and result in higher consumer prices. Whalley and Trela attempted to quantify the inefficiency caused by these regulations. Norrie et al . . . find that Ontario and Alberta gain from the existing rules, and that other provinces are harmed. . . Unfortunately, the trucking regulations are so complicated that it is very difficult to capture their effects in simple quantitative models. As a result, the numbers quoted by Norrie et al. are unlikely to be very accurate, and in fact when Whalley and Trela published their monograph, they chose to omit their study of the trucking industry because they recognized that the results were likely to be inaccurate." (p 27)

Copeland's conclusions, which concern many things besides trucking regulations, are of interest. First, he suggests that the available evidence indicate efficiency losses due to interprovincial trade barriers are likely quite small. Second, on the specific issue of regulatory diversity he writes as follows: "It is extremely difficult to develop an empirical model to simulate the effects of such problems [*excessive and conflicting regulations*]. Even the most careful researchers in this area have used *ad hoc* approaches (such as assuming that 'red tape' adds 2% to the costs of interprovincial trade), and have obtained small numbers. In my own view, any attempt to obtain an aggregate measure of these costs is likely to lead to a fairly small number." (p 35)

Transport Canada Survey

In the fall of 1993, the authors undertook a survey to analyze the impact of differences in trucking regulations. There are limitations to this work. First, it looks only at Canadian regulations. Many Canadian trucking operations are heavily influenced by American regulations. For example, Western truckers with 5-axle tractor semitrailers on long triangle runs (Western Canada to US mid-west to Southern Ontario back to Western Canada) are operating equipment heavily influenced by US size and weight regulations and US DoT safety requirements.

Second, the study relies on interviews with only 29 truckers--admittedly, large ones with a combined fleet of 9,399 power units--to gain an insight about how these carriers manage their operations in light of differing or multiple regulations. These

interviews developed little quantifiable information and they tended to miss smaller regional concerns of local truckers operating across one or two borders.

Third, the scope of the study did not allow for the "provincial" side of the story--that is, an actual catalogue of existing regulations to see how they differ and a documentation of the (many) efforts underway to achieve greater uniformity. To a limited extent, the provinces themselves have done this job.[9]

As the interviews progressed, it became evident that it is quite difficult to isolate several facets of regulatory impacts. In fact, in any discussion with carriers, the following four topics are invariably intertwined:

- the impact of regulations (particularly a new one). For example, several carriers complained about the costs they had faced in developing new procedures as a result of one or more of the standards in the NSC.

- the impact of different regulations. For example, many carriers had opinions on whether a 48-foot or a 53-foot limit for trailers was preferred and, of course, what the impact of such a limit would mean for their operations.

- the impact of a multiple regulations. For example, all provinces have requirements for vehicle registration and they all belong to CAVR to accommodate commercial vehicles operating between jurisdictions. Even if the registration requirements were identical in each province, this is still a more complex system than one where there is only one registration requirement for Canada.

- the impact of regulatory differences. This is the cost or operational consequences of operating between two (or more) jurisdictions with different regulations in each jurisdiction.

Strictly, it was only this last item which was included within the scope of the Transport Canada work, although as a practical matter the third item (multiple regulations) was rolled into this subject.

Regulatory Differences & Multiple Regulations

VEHICLE WEIGHT & DIMENSION REGULATIONS The most important aspect of these regulations is the agreement signed by all provinces and territories allowing trucks configured to minimum limits to operate coast to coast. Surprisingly, given that the original version of this agreement came into effect in 1988, there remains a great deal of diversity in weight and dimension regulations in Canada. The two best known instances concern trailer lengths (14.65 m in the East and 16.2 m in the West) and overall combination length limits (23 m in the East and 25 m in the West for double-trailer configurations). However, recent changes in Eastern Canada have gone a long way to eliminating these particular aspects of non-uniformity. What

remains is a long list of less well-known areas of non-uniformity--higher axle loads in Eastern Canada, different policies on tolerances, different gross weights for some truck configurations, different arrangements of axles allowed, and many other minor (but annoying) differences in such things as axle-spacing requirements.

Many carriers interviewed have been adversely affected by the lack of uniformity. In particular, carriers operating between the 25-metre regime in Western Canada and the 23-metre regime in Eastern Canada use tractors they considered less desirable (and perhaps more costly to operate) than other tractors. Other carriers find it difficult to operate fleets of trailers with a mixture of different sizes (48 and 53 feet). (Trailer length difference have now practically disappeared.) Bulk truckers and other operators using trucks closely "spec'd" to the regulatory limits find the differences which exist preventing them from standardizing on one optimal design for all of their operations. The consequences are sometimes higher equipment prices or the use of suboptimal trucks in some situations.

Notwithstanding these instances of where carriers are (or were) affected by the non-uniform weight and dimension regulations, no carrier can say precisely what the impact has been in terms of increased costs (efficiency losses) or increased prices (equipment or owner-operator rates in some circumstances). Further, to keep things in balance, it also should be pointed out that there are many carriers either totally or relatively unaffected by the differences in weight and dimension regulations in Canada. Examples include: less-than-truckload carriers with standard double 28-foot pups; carriers concentrating on transborder hauls that configure to the (generally) lower US limits; carriers operating primarily in Western Canada (a relatively uniform zone); and specialty carriers such as the one hauling nothing but 40-foot containers.

NATIONAL SAFETY CODE Although carriers interviewed complain about the difficulties the provinces/territories have had in implementing the NSC uniformly, the most common thread developed from the interviews is that interjurisdictional differences which do exist are having little impact on operations. Depending on the person interviewed, this may be because the differences, while annoying, are not actually that important or it may be because enforcement is too weak to mean much in terms of the differences which exist. This is also where the intertwining of the four aspects of regulations became most apparent: some carriers have felt the impact of new regulations being introduced and other carriers complain about the specific aspect of certain regulations (say the hours of work allowed), but these subjects are not strictly a result of regulatory differences and/or multiple regulations and, therefore, fell outside the mandate of the Transport Canada study.

TAXATION, SOCIAL SECURITY There is a series of institutions/practices requiring taxes or social security payments paid based on distances driven in each jurisdiction. The requirement to track distances and to submit reports in a variety of formats to several jurisdictions appears to have a far greater impact on motor carriers than any of the existing differences in the NSC. The largest single problem in this area is the

lack of an agreement on fuel taxes in Canada. There is such an agreement between US states; Alberta is already a member with several other provinces are apparently considering joining.

ECONOMIC REGULATION With the almost complete deregulation of trucking in Canada, there are only a few remaining areas of interjurisdictional differences: three provinces continue to regulate intraprovincial trucking and one province has been regulating (deregulating?) extraprovincial trucking in a way that has caused a good deal of confusion. The impact of these differences is only important to a few carriers.

OTHER TRUCKING REGULATIONS There are many other regulations that, along with all of the above, make up the total regulatory/tax regime controlling trucking. While differences in some of these areas--say the attempt by one province to regulate load brokers, the treatment of owner-operators in another province, or the evolving regulations on periodic motor vehicle inspections in all of Canada--are sometimes singled out by those interviewed as "significant," in total these other trucking regulations are not as important as the topics touched on above.

ENFORCEMENT None of the above regulatory/tax regimes mean much unless they are enforced. Carriers are almost unanimous in their view that there is a problem with enforcement. But just how much of this problem is related to varying levels of enforcement in one jurisdiction versus another is difficult to document. Often, from the carriers perspective, it is the differing levels of enforcement from one enforcement officer to another within the same jurisdiction that is seen as the problem.[10]

Impact of Differences & Multiple Regulations

The carriers interviewed found it difficult to provide numbers as to the actual impact of regulatory differences or multiple regulations--say, higher prices for equipment, supplies or labour; an increase in empty miles; lower load factors because of sub-optimal trucks; or any other efficiency losses. They did provide, however, a subjective ranking of the importance of regulatory differences in several areas.

There are few areas of agreement among all of these rankings. Even within the sample of carriers selected for the Transport Canada study, where there was a degree of homogeneity, the response to regulatory differences depends a great deal on the particular geographic area in which the firm operates and the particular nature of the operation. Whereas aspects of regulatory differences are a significant barrier to one carrier, to another they are unimportant. The result is that the number of regulatory areas where there is a large number of carriers feeling an important impact because of regulatory differences is relatively small.

Carriers were also asked to provide an estimate of the administrative cost required to handle regulations in more than one jurisdiction. Almost all of this relates to the

work required in tracking distances driven and in filing for various tax/social security schemes. The estimates collected do not always measure the same thing and some were made quite casually. Nevertheless, they are worth documenting as they at least provide a first look at one aspect of the cost of interjurisdictional trucking in Canada. At the low end of the scale, carriers operating between provinces with CAVR-registered trucks are paying about $100 per truck more than a carrier operating only within one province or territory. This is the lowest estimate given for the administrative cost of registering under CAVR. At the high end of the scale, one carrier hauling special commodities across Canada, often on a trip permit basis, spends an estimated $4,725 per power unit per year. This is the total administrative cost of handling all aspects of registration, trip permits, fuel tax payments and other more minor administrative chores--prorating sales tax for new vehicles or maintenance, prorating Workers' Compensation payments and ensuring that all stickers, decals and other paraphernalia are on the trucks. (However, it does not include the payment of the tax itself.)

Finally, carriers were asked for the total cost of regulatory differences and/or multiple regulations--that is, how much costs would decline if Canada consisted of one province (with a tax burden identical to that prevailing today). No one could answer the question with any confidence. The four carriers providing answers gave estimates ranging from 0.33 to 2.5 percent of total costs. While strictly speaking the method of choosing the sample of carriers rules out any extrapolation, for those who have to have "a number," these figures could be used to suggest the total cost of regulatory diversity is between $8 and $58 million. This is 0.33-2.5% of the 1990 total domestic interjurisdictional for-hire revenues measured by StatsCan. Adding a bit for private carriage, not much of which crosses provincial/territorial borders, and for the small for-hire carriers omitted from StatsCan's surveys might bring these numbers up to the $10 to $75 million range. This overlooks any "spill over" impacts on intraprovincial or inter-territorial trucking and it overlooks any "spill over" impacts on transborder (Canada-United States) trucking.

Empirical Evidence

Another way of assessing the importance of regulatory differences is the method referenced previously where the authors examine rate levels across the Canada-United States border to assess the impact of institutional barriers. The hypothesis is that differences in regulations and/or multiple regulations lead to higher costs and, further, that these costs will be reflected in higher rates for interjurisdictional traffic. To test this, the following model is used with StatsCan's truck survey data:

$$\text{trucking rates} = F(\text{shipment characteristics, inter or intrajurisdictional})$$

Shipment characteristics are commodity, length of haul and shipment weight. Total shipment revenues divided by tonne-kilometres are used as a proxy for trucking rates. Assuming operational and competitive conditions are similar for domestic

intra and interjurisdictional operations, a rate will be higher for a shipment crossing a domestic border if differences in regulations do, in fact, lead to higher costs.

It is important to clarify the underlying rationale of the specification of the model. Revenues per tonne-kilometre are the outcome of a market transaction between a shipper and a carrier, in a given context. This price reflects all the characteristics of the shipment: weight, length of haul, and also the economic conditions prevailing at the time of the contract on the demand side (eg, modal substitutes) as well as the supply side (eg, the level of costs). A dummy variable in the specification implies that additional factors--beyond the shipment characteristics included--must be taken into consideration for interjurisdictional rates.

Sloss (1970)[11] and McLachlan (1972)[12] first used revenues per ton-mile to test for various explanatory variables (the impact of regulation). They used a linear relationship in their specification. Palmer (1973)[13] argues that a nonlinear relationship is more appropriate on theoretical grounds. Maister (1978)[45] covers the same ground, expecting that improved data and a better specification would yield more meaningful results. However, McRae and Prescott (1980)[15] point out that his statistical model is mis-specified because of a problem of multicollinearity. These early researchers use aggregate data (total revenues divided by total ton-miles for a whole region) which make comparisons of revenue per tonne-kilometre misleading.

McRae and Prescott try to overcome this difficulty in two ways: by using individual shipment data that are then aggregated into commodity groups; and by fitting a double-logarithmic specification as representative of a nonlinear model. Following the previous authors, except Sloss, they also include a dummy variable for provinces (or regions) which do or do not regulate. Their results show the superiority of the individual shipment information used to detect provincial differences.

Following McRae and Prescott, a double logarithmic form of the model is used in this analysis. A better specification would be to use a Box-Cox transformation on each variable and let data dictate the true shape of the general form. However, this possibility does not exist in TSP software. The functional form chosen is:

$$\ln\frac{(revenue)}{(tonne\text{-}km)} = b_o + b_1 \ln(distance) + b_2 \ln(weight) + b_3\ (interjur)$$

Expected signs for the distance and weight variables are negative as trucking rates per tonne-kilometre generally decline for larger shipments moving longer distances. On the other hand, the dummy variable "interjur" which represents the influence of the interjurisdictional market-distinguishing variables not explicitly specified will have a positive sign if interjurisdictional barriers (costs) or other cost-increasing factors exist. The dummy variable will be zero if there is no difference between inter and intrajurisdictional markets and it will be negative if lower costs (or other

aspects of the market) are such that rates are lower for interjurisdictional shipments in comparison to intrajurisdictional ones.

Data on nine large commodity groups from the 1990 survey were obtained:[16]

		# shipments
146	other food preparations	11,240
238	pulpwood chips	5,966
276	sand, gravel and crude stone	4,875
331	lumber and sawn timber	6,974
351	paper for printing	2,282
429	other chemical specialties, industrial	5,380
432	fuel oil	10,230
445	plate, sheet and strip steel	3,547
588	motor vehicle engines, accessories, parts and assemblies	8,693

These commodities account for 35 percent of the domestic tonnages captured by the StatsCan survey (53.4 out of 149.3 million tonne). However, for this test, all shipments weighing less than 4.5 tonne were excluded as truckload shipments are easier to deal with than less-than-truckload shipments (ie, they are more directly related to the cost of operating a truck). The number of such truckload shipments is shown above.

Table 1 contains the estimated coefficients. All coefficients for the distance and weight variables are of the expected sign and statistically significant at the 5 percent confidence level, except commodity 238 where the weight coefficient is positive. As for the dummy variable, 3 of these are not statistically different from zero, 3 are negative and statistically significant at the 5 percent confidence level and 3 are positive and significant at the 0.05 level. The goodness-of-fit results are also reasonable as indicated by the adjusted R^2 for cross-section observations.

A second approach is to estimate the functional form by dropping the dummy variable and comparing the resulting equations with the first ones. This specification assumes both markets (inter and intrajurisdictional) are influenced by the same factors. A test of the difference between these two models consists of comparing the maximized likelihood by means of the likelihood ratio test (LRT) which is given by:

LRT = -2 [(log likelihood from the unconstrained model) - (log likelihood from the constrained model)].

This statistic is distributed approximately chi-square (X^2_k) with given degrees of freedom equal to the number of constrained parameters K. For instance, under the null hypothesis that the coefficient of the variable "interjur" is zero for the product 238 the log likelihood test is 3.94 with one degree of freedom and we can reject this hypothesis at better than the 5 percent confidence level. In other words, there is something more than the specified shipment characteristics influencing inter and intrajurisdictional rates. As shown in the "LRT" column, there are a mixture of

results–that is, sometimes shipment characteristics explain the differences in rates, sometimes there are other factors at work.

Commod -ities	Regression Coefficients				R_A^2	LRT
	constant	distance	weight	interjur		
146	11.811 (217.38)	-0.712 (82.34)	-0.427 (107.41)	0.024* (1.21)	0.646	1.24°
238	7.779 (97.95)	-0.729 (67.11)	0.023 (2.67)	-0.095 (2.81)	0.433	3.94
276	8.872 (110.87)	-0.709 (58.38)	-0.224 (33.63)	1.107 (21.46)	0.445	220.18
331	8.954 (128.54)	-0.701 (69.57)	-0.200 (25.46)	0.659 (24.54)	0.453	288.05
351	11.670 (107.91)	-0.663 (38.13)	-0.502 (59.44)	0.022* (0.53)	0.696	0.14°
429	10.071 (139.94)	-0.419 (33.16)	-0.445 (-61.08)	-0.277 (8.23)	0.546	33.18
432	7.705 (222.44)	-0.549 (86.71)	-0.116 (26.89)	0.321 (19.50)	0.504	30.18
445	10.634 (108.75)	-0.576 (38.17)	-0.458 (63.05)	-0.062* (1.48)	0.601	1.10°
588	11.012 (166.61)	-0.519 (46.56)	-0.441 (76.98)	-0.353 (12.50)	0.522	76.45
Notes	o t statistics are in parentheses o (*) a coefficient not significant at 0.05 level o (o) rejection of the null hypothesis o the critical value for the likelihood ratio test (LRT) is 3.84 for 1 degree of freedom					

TABLE 1 REGRESSION RESULTS

These statistical results, therefore, are inconclusive because of the dispersion in the values for the dummy variable "interjur". That is, there is not enough evidence showing that barriers to trade, whatever the cause (ie, differences in regulations or anything else), exist and have detrimental effects on the flow of goods carried across provincial/territorial borders.

Conclusions and Discussion

It is clear from the results of the discussions with motor carriers that there is an administrative cost and, sometimes, an efficiency loss associated with operating across domestic borders. For particular carriers these impacts may be significant. What is not so clear is how large this impact is for all trucking activity in Canada. Some large carriers operating regionally were quite nonplussed by the whole subject and tended to dismiss the "complaints" of fellow truckers operating in different areas or under different circumstances.

The analysis of StatsCan data provides no conclusive evidence that regulatory diversity is leading to higher interjurisdictional rates. Admittedly, much is left out of this analysis. In particular, if intra and interjurisdictional (and, for that matter, transborder) markets are quite integrated, it is possible that the "burden" of regulatory differences affects all trucking operations. Further, the validity of the assumption that operating conditions for inter and intrajurisdictional carriers are similar is not known. Perhaps different factor prices characterize the intra and interjurisdictional market; perhaps one market is more dominated by owner-operators than another; perhaps the interjurisdictional market is characterized by fewer empty backhauls; perhaps rail competition is more an influence on rates in the interjurisdictional market than the intrajurisdictional one.

The other factor not accounted for in this analysis is the cost of eliminating differences in regulations and/or multiple regulations. This is a large subject that has not been addressed, but one anecdote will show its importance. One element of diversity is different policies on axle loads during spring thaw. Some provinces don't have lower axle loads on major highways in the thaw period; some do; and others have them for secondary highways only. The industry sees this as an example of regulatory diversity and points to the costs (partially loaded trucks on some routes to satisfy the requirements of an intermediary jurisdiction). It would be easy to calculate the cost saving for truckers of an elimination of spring thaw axle loads. But what would be overlooked in the analysis is the particular pavement structure in a particular province and the cost of maintaining this.

Because of these limitations in the analysis and the somewhat limited scope of the survey, this paper is not the final word on whether regulatory differences and/or multiple regulations in Canada amount to barriers to trade. The authors' own opinion--that is, something only partially backed up by the evidence presented here--is that there are unnecessary elements to trucking regulations in Canada. Trucking could be more efficient by eliminating the differences and/or by developing better institutions to handle multiple regulations (the fuel tax situation is the clearest example). Where differences cannot be justified on technical grounds--including technical grounds peculiar to a region--then these differences ought to be eliminated. Where multiple regulations create an administrative burden for truck operations, then the provinces and territories ought to look at changes to institutional procedures.

Notes and References

1 Press release, Committee of Ministers on Internal Trade, Vancouver, June 8, 1993. According to a press release (Jan 20/94), the ministers had requested the chief negotiators to have a draft agreement available by March 31st. The "rules" in this agreement are to include "reciprocal non-discrimination, right of entry and exit, no unnecessary obstacles to trade, reconciliation of standards-related measures and transparency."

2 Nix, F.P., 1994, *Impact of Regulatory Differences on the Motor Carrier Industry.* prepared for Motor Carrier Policy and Programs, Transport Canada, Ottawa.

3 "Canada must arrive at a system by which all laws and regulation applicable to the extra-provincial trucking industry become the responsibility of a central multi-jurisdictional body which will ensure uniformity." Canadian Trucking Association, July 1992, *Submission on the National Transport Act Review, NTA/MVTA Issues*, p 24. In the years leading up to this CTA submission--that is, from deregulation in 1987 to the NTA Review Commission in 1992--there had been a great number of complaints about the lack of uniformity. For example, Gordon Boal (past president of the Alberta Trucking Association) is quoted in *Motor Truck* (June 1990) as saying that the "red tape is so cumbersome and inconsistent from province to province the costs of doing business have gone up by six percent." Much of the "red tape" was associated with the NSC.

4 "A recurring concern in submissions from the trucking industry, its customers and provincial governments is the need for greater harmony among jurisdictions in establishing and enforcing regulations." NTA Review Commission, 1992, *Report*, Vol II, p 44. Recommendation #5 suggests that the federal Minister of Transport appoint a person to chair a group "to resolve expeditiously the inconsistencies of regulation, interpretation and enforcement respecting safety aspects of extraprovincial trucking." (Vol I, p 50) Recommendation #7 suggests that the federal Minister "negotiate with provincial governments to standardize operating and technical specifications affecting the trucking industry's efficiency." (Vol I, p 67)

5 "Lack of uniformity of provincial regulations continued to frustrate both carriers and shippers." National Transportation Agency of Canada, *Annual Review 1992*, p 95. "As an increasing number of NSC standards are implemented, enforcement becomes a more central issue for discussion. Predictably, variations between jurisdictions have arisen which could cause confusion and inefficiencies for extra-provincial carriers. These differences need to be resolved, but do not necessarily threaten the effectiveness of the NSC at this time." Transport Canada, *Report to Parliament*, November 12, 1992.

6 Prentice, B.E., Hildebrand, M.D., 1988, "Transborder Trucking: Institutional Barriers to Canada-U.S. Trade of Agricultural Goods" *Proceedings* CTRF, 23rd annual meeting, Minake Lodge, pp 578-592.

7 Copeland, Brian R., 1993, Interprovincial Barriers to Trade: A Review of the Empirical Evidence from a British Columbia Perspective, paper prepared for the British Columbia Ministry of Economic Development, Small Business and Trade. Victoria.

8 Norrie, K., R. Simeon and M. Krasnick, "Canada as an Customs Union," *Federalism and Economic Union in Canada*, ch 18, vol 59, Research studies for the MacDonald Commission, University of Toronto Press, 1986.

9 In terms of two large areas of regulations--safety and weights and dimensions--the provinces have recently produced the following: (i) Canadian Council of Motor Transport Administrators, 1993, *Report on Regulatory Harmonization*, to the Council of Ministers Responsible for Transportation and Highway Safety, September 23, 1993, Ottawa. (ii) Interjurisdictional Committee on Vehicle Weights and Dimensions. 1993. *Heavy Truck Weight and Dimension Regulations for Interprovincial Operations in Canada Resulting from the Federal-Provincial-Territorial Memorandum of Understanding on Interprovincial Weights and Dimensions*. Transportation Association of Canada. Ottawa. The problem with both of these is that the writers (committees) tend to emphasize all the "uniform" aspects of the regulations (or the attempts to achieve uniformity) and overlook that actual differences that exist.

10 It is not known how much of the "enforcement problems" is related to regulatory diversity (or potential "trade barriers"). Clearly some of it is as the results from the 1993 CVSA road check results show (*Today's Trucking*, Vol 8, no 1, p 42). To pick just one (extreme) example, Québec and Ontario both inspected about the same number of trucks (just under 3,000). In Ontario, 33.9% of these trucks were given an out-of-service rating; in Québec, only 1.4% of the trucks were given such a rating.

11 Sloss, J., 1970, "Regulation of Motor Freight Transportation: A Quantitative Evaluation of Policy", *The Bell Journal of Economics and Management Science*, 1,2, pp 327-366.

12 McLachlan, D.L., 1972, "Canadian Trucking Regulations", *Logistics and Transportation Review*, 8,1, pp 59-81.

13 Palmer, J., 1973, "A Further Analysis of Provincial Trucking Regulations", *The Bell Journal of Economics and Management Science*, 4, 2, pp 655-664.

14 Maister, D.H., 1978, "Regulation and the Level of Trucking Rates in Canada: Additional Evidence", *Transportation Journal*, Winter, pp 49-62.

15 McRae, J.J., Prescott, D.M., 1980, "An Econometric Analysis of the Effects of Regulation on the Canadian Common Carrier Industry", *Studies of Trucking Regulation*, Vol II, Regulation Reference Working Paper No. 3, Economic Council of Canada, Ottawa.

16 During the work for Transport Canada, the question was raised as to whether it was possible to use StatsCan's O/D data to measure differences in rate levels for intra and interjurisdictional traffic as evidence about the importance of "trade barriers." While the scope of the work did not allow this analysis to be performed, Barry Gardner of the Motor Carrier Branch did develop data on nine commodities from the 1990 survey. Michel Boucher analyzed this after the report had been submitted.

The Québec Intercity Bus Industry, Specialization and Route Abandonments: A Preliminary Assessment

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1. Introduction

The Canadian intercity bus industry is actually at a crossroads because intermodal competition for passengers, combined with an increase in consumer income, has led to a slow and progressive abandonment of this form of intercity transportation. However, the Québec industry which also shares the same hardship as the rest of Canadian firms must face two particular sets of difficulties, the first coming from the dismantlement of Voyageur Inc. and its expected side-effects and the second being various initiatives undertaken by the Québec Transport Commission which now allow firms to become more competitive. We contend that these different events could in fact be considered as blessings in disguise, because they offer opportunities for specialization in the industry which were previously constrained by too strict regulations. However, a natural consequence of these changes in the industry is to increase route abandonments in scheduled activities for small communities.

This paper outlines the current process which is going on in the Québec intercity bus industry. It is organized as follows: In section 2, a brief assessment of the existing economic situation is presented with a view to emphasizing the changes which are taking place. Section 3 discusses the actual dynamics of route abandonments which result from actions taken by firms to streamline their activities. Section 4 deals with alternatives which may be considered to maintain scheduled services in small communities.

2. The Industry: An Overview

Over the last ten years, the Québec Transport Commission has gradually modified some elements of the intercity bus industry regulation. These subtle moves, a clear proof that the regulatory agency is endogenous to the industry, have led the latter to go further into specialization. In 1983, there was a first step

toward the liberalization of the regulations respecting charter and tour services [1]. An order in council authorized intercity bus firms holding relevant authorities to offer charter and tour services from and to any point of service it currently served to any destination. It really increased competition among existing firms because, many cities in Québec obtain more than a simple bus carrier when trip activities begin or end at a given point.

A second step, parallel to the application of the new 1986 *Bus Transport Regulation* [2], consisted in rewriting intercity bus permit authorities. As a by-product of this internal activity by the Commission, the regularly scheduled route and the charter services are now considered as two distinct and independent activities. So, an existing firm wishing to offer only charter and tour services or to expand its actual charter operations to new markets may buy the necessary charter operating rights from established firms.

A third step, not at all initiated by the regulatory board, occured with the dismantlement of Voyageur Inc. into five differents regional firms. Intra-provincial routes like Montréal-Hull were then transfered to Voyageur Colonial Inc. which still operates in Ontario and on interprovincial corridors such as those linking Montréal-Ottawa and Montréal-Toronto.

Last, but not least, was the entry of American parcel carriers in the province of Québec. As a matter of fact, United Parcel Service (UPS) [3], and later on, Roadway Parcel Service (RPS) and Federal Express, joined Purolator, now owned by Canada Post, and CanPar and extended their respective services to the whole province when the trucking industry was deregulated in 1988.

2.1 The Demand Side

On the demand side of the industry, two issues must be considered. The first refers to the gradual decline in demand for this transportation service over the years. For the 1974-1990 period, the number of customers dropped from 36.9 million to 17,0 million; when expressed in percentages it means an annual rate of decrease of 4.83. If the 1983-1990 sub-period is then considered, there is an acceleration in the time trend as the annual rate of decrease is 7.85 [4].

Various reasons could be put forward to explain that particular result. A negative or at best a zero income elasticity of demand constitutes the main reason that the intercity bus industry is losing ground over time to various transportation modes. As a matter of fact, the value of time increases with the income. An additional factor comes from the high price elasticity of demand for that particular transportation service. The latter implies the existence of a strong intermodal competition not only from the automobile, but also from the passenger train over

short and medium distances. Oum and Gillen [5] suggest that the price elasticity of demand is about 1.62 at the end of the seventies and is slightly increasing over time. On the other hand, Ridout and Miller [6], using a disaggregate logit functional form, obtain a price elasticity of demand of 2.09.

Secondly, in 1988 the National Transportation Agency of Canada accepted the application filed by Voyageur Colonial Limited that a discount tariff for off-peak periods put in place by Via Rail would reduce Via Rail revenues, would incur a transfer of bus passengers to Via Rail and would "inevitably lead to a requirement for increased subsidies from the Government of Canada" [7]. However, the same federal agency rejected in 1993 a Voyageur Colonial Limited application which argues that an off-peak pricing structure by Via Rail effective since January 1990 would be harmful. The Agency "finds that the off-peak discount fare program of Via has not had a negative impact on the quality and variety of passenger services offered in the provinces of Ontario and Québec" and concludes that "it is not prejudicial to the public interest" [8]. It must be noted that the conclusions of the Agency are implicitly based on a high price elasticity of demand for bus passengers and therefore that price increases by Voyageur Colonial Limited in the nineties partly caused the actual decline observed in the bus industry.

In a study commissioned by the Royal Commission on National Passenger Transportation in Canada, Laferrière [9] shows that the modal substitution index for intercity buses is around 0.75. That high result clearly implies that if there is an increase in the price for intercity busing, the quantity of intercity bus travels decreases. The latter quantity is broken down in the following manner: 75 per cent of the decrease in passengers comes from a diversion, namely customers continue to travel and therefore increase the demands for other transportation modes, car, air and train; the remaining 25 per cent in the decrease is induced, which means that customers stop travelling. It therefore corroborates the argument advanced by the Agency. In other words, the intercity bus industry does damage to itself by increasing its rates in the nineties. There are other modal substitutes which travellers may choose instead of buses.

2.2 The Supply Side

Before continuing this analysis and assessment of the impact of those facts on the industry, some considerations on the production fonction used by bus carriers must be highlighted. Under a traditional regulatory regime, as it was in the United States until 1982 and as it continues to be in Canada, a intercity bus firm generally produces more than one type of outputs. The latter is composed of a mix of regular scheduled routes, charter and tour trips, local transit services, commuting offered to surburban cities, mainly during peak periods, school bus

services and courrier express operations. Empirical American studies, whose results are currently confirmed by the American deregulation, reveal that economies of scale are exhausted at a very small fraction of the total industry output. To put it in a context of a multi-product approach, there are no economies of scope nor product-specific economies [10]. It would therefore be cheaper in Canada to produce a mix of these separately than to produce them jointly. An empirical Canadian study shows that it could happen because the largest intercity bus firms, like the former Voyageur Inc., were operating on the rising right-hand side of their average cost curve [11].

These internal factors which induce the intercity bus industry to become more competitive also have some negative effects on the practices which come from existing regulations. One of them which is worth noting is the supposed cross-subsidization from low-cost routes to high-cost routes. This term designates the arrangement whereby authorization to provide a profitable service is made fairly explicitly conditional to the extension of service to customers unable to meet their costs.

Very few people would disagree that this situation could only be possible where intermodal competition was weak. Moreover, empirical studies, both in Canada and in the United States, raise serious doubts that they could have been important. As a matter of fact, a study undertaken in the United States after the 1982 deregulation concludes, after analyzing 205 intercity firms offering both scheduled and tour services, that "only six per cent of the mileage examined could represent potential cross-subsidization [12]. The exit of the former Voyageur Inc. clearly means that an internal network of routes no longer exists and that the avenue for implementing cross-subsidies is no longer a possibility, if indeed it ever existed. The recent NTA decision on Voyageur Colonial Limited challenged its feasibility in 1993.

On the positive side, a clear increase in specialization is also observed. A by-product of the American deregulation was to segment along certain activities, one of them being the charter and tour service. As this segment of the Canadian industry was not very well developed, accounting for only 12 per cent of activities in 1990, a catching-up effort was long overdue.

More and more bus carriers try to find new niches, and the best opportunities are now either to contract with international travel agencies for high quality services or to work jointly with local travel firms to offer different special services. This adjustment process also sees intercity bus firms reducing their level of regular scheduled activities, some at the margin, others at an inframarginal level. The latter group proceeds by selling their permit authorities to existing firms or to newcomers who generally are school bus operators. It must be

recalled that the only way to enter the industry is to buy permit authorities from firms already in operation. Our interest is to analyze the behaviour of firms which decide to gradually decrease the supply of services.

3. The Dynamics of Route Abandonment

Table I presents, over an eight year period, 1985-1986 to 1992-1993, the various steps undertaken by bus intercity firms when they want to downgrade their actual services. The first possibility consists of making a formal request to the Commission, generally in public hearings, to change its schedules, its routes and its rates and tariffs. It is the usual approach that firms use and the high percentage of approval reveals how flexible and receptive the board can be when evidence brought in sustains the request. A second way to succeed in the reduction of services is to ask the regulatory agency to cancel a given service for which the firm owns the permit authority. Again in public hearings, the bus carrier tries to demonstrate the validity of such a request, mainly by showing how weak the profits are or how high the losses are, when generated by this particular service. Certified financial statements are systematically used by bus carriers to support their arguments. On the other hand, customers or their representatives and different pressure groups react by revealing the adverse impact of this abandonment on their welfare and on that of third parties. Part 2 of Table I shows how unimportant this avenue was until very recently and that the rate of success seems generally inferior to the preceeding approach. A third mean which directly leads to route abandonments is to behave in such a way that the Commission des transports du Québec will itself repeal the permit authority. The last part of Table I reveals its relative importance and especially its variation in percentage over the last five years.

However, the results contained in Table I do not present a real image of the adjustment process which is really taking place in the industry. The real mechanism by which Québec bus carriers proceed is much more subtle and it needs more time than expected to deal with reality. In short, the Québec regulatory regime has not only barriers to entry, but also barriers to exit. As firms can be locked in, the most financially successful ones which can obtain a good value for their permit authorities will sell them and the least financially successful firms which really cannot get out of the industry will gradually reduce the value of some of their operating rights to minimize their losses over the years.

3.1 The Real Adjustment Process: An appraisal

A intercity bus carrier which faces a decline in the demand for its services can modify its actual activities in various ways to maintain or sustain its level of profits. For the sake of the argument, let us focus on its own relations with the

Table I
Different Changes in Activities by Intercity Bus Firms
1985-1986 to 1992-1993

	85/86	86/87	87/88	88/89	89/90	90/91	91/92	92/93
1] Change in Schedules, Routes and Rates								
. Accepted	18	14	14	11	17	7	7	29
. Partly Accepted	0	1	1	3	0	1	2	0
. Retired	0	1	2	4	2	1	1	3
. Rejected	1	2	1	1	0	0	0	0
TOTAL	19	18	18	19	19	9	10	32
2] Discontinuance of Services								
. Accepted	5	5	3	5	2	5	2	10
. Partly Accepted	2	0	1	0	0	0	0	0
. Retired	0	3	2	0	1	2	1	0
. Rejected	1	0	0	0	1	0	1	1
TOTAL	8	10	6	5	4	7	4	11
3] Repeal of Permit Authorities								
. Accepted	-	-	-	7	1	9	8	3
. Partly Accepted	-	-	-	0	0	1	1	0
. Retired	-	-	-	2	0	2	0	0
. Rejected	-	-	-	0	2	2	0	0
TOTAL	-	-	-	9	3	14	9	3

Source: Annual Report of the Commission des Transports du Québec, various years.
- na

regulatory agency. Its first initiative is generally to request a change in its timetable so that actual customers will be served in a more economical way. However, the bus carrier must clearly show that there shall be an effective decrease in its operating costs to compensate for the reduction in consumers' welfare. If the latter are not really reduced with the diminution in services, the regulatory agency will reject its request. The following situation can be used to ascertain that avenue. In 1988, the intercity bus carrier, Autobus du Littoral Inc., [13] tried to change its schedule by invoking eventual losses. The board rejected its request by raising the argument that the usual implicit trade-off was not really effective. The bus carrier did not bring evidence on a future decrease in its costs which shall match immediate negative benefits for travellers (a reduction in their choice set). However, the firm did not easily give up its goals to rationalize its operations, and fourty-three months later, it was able to decrease without any opposition from its customers the number of departures on the corridor from 10 to 8 a week. In 1993, it obtained again that an additional departure be dropped from its weekly schedule. The overall process took 58 months.

A second option available to a bus carrier is a request for discontinuance of existing services on a given corridor. The latter is either partial or complete. The regulatory body approves the request if and only if the losses incurred by this service strongly affect the financial operations of the firm and eventually can lead it to bank-ruptcy. In 1992, a bus owner Camille Mailloux R.D.L. Inc. [14] attempted in a first step to get a decision from the Commission to discontinue for one month and then for some longer periods of the year, the service between two points. In the regulatory jargon, this is called a temporary total discontinuance of service. Later on, he returned to the Commission with a request for a total and permanent discontinuance of service. Requirements for the latter are tougher than the former which only requires evidence that the service is either no longer used by travellers or is only lightly used. As a matter of fact, the regulatory agency requires not only evidence on the drastic decline in demand, but also proof based on certified financial statements that cessation is the only solution, all other alternatives being ruled non-operational or unviable. In the case considered, the saga lasted around 18 months before the Commission finally approved the exit for this particular line.

A third possibility that a bus carrier must undertake to definitively exit from a given service is that the Commission agrees, in a decision, to permanently cease its service and to cancel out the operating right. It must be noted that this situation only represents an extension for the previous case in that now the operating right no longer exists. Once again, in 1991, a bus carrier named Alma Autobus and Taxis Inc. [15] started the process by requesting changes in its scheduled activities, then requested a temporary discontinuance for some months

and finally asked to really give up its operating right. The due process is still the same, in that evidence is related to a declining demand, financial losses and eventual bankruptcy if the exit is not allowed. In this case, the overall process took only 17 months because the distance traveled by customers was short and there existed other bus substitutes.

From the analysis of these different decisions, we can infer that the overall adjustment process that takes place between the bus firm and the regulatory agency is longer when the requesting firm produces more than one output, a situation which helps cross-subsidization in a short period, and when the service is provided to relatively large cities. Otherwise, it goes in much faster because it easily takes less than an half, if not two-thirds, of the time usually required.

A final possibility to exit from a corridor occurs when the regulatory agency repeals *proprio motu* the permit authority. This situation generally occurs when a bus carrier does not produce the standard and normal service as expected by the customers and by the Commission or when it abruptly ceases its operations for different motives, more often than usual, following the rejection by the Commission of its own request.

Because the Commission is generally reluctant to behave like this, it can be said that this is a last resort move. The real meaning of this ultimate solution is explained by the saga that actually faces travellers on the Montréal-Abitibi corridor. In 1991, the bus firm, Autobus Auger Inc., [16] whose operating rights were bought from Voyageur Inc., requested a total complete discontinuance of services in the Abitibi region. However, this important provincial bus carrier wanted to keep its rights linking Montréal to the two main cities of the region. The board approved the request on the evidence brought in and it therefore authorized the firm to cease all its intra-regional operations. But the latter immediately stopped its operations before the deadline specified by the Commission. The board held different public hearings on the situation and repealed all the permit authorities owned by the recalcitrant firm, the intra-regional permits as well as the Montréal-Abitibi corridor. The bus carrier replied by challenging the decision in the Court of Appeal and lost in 1993. Everybody is now back at square one and the problem is not yet resolved because nobody knows which firm will serve the region.

The Commission had no other alternatives but to revoke existing operating rights, because the owner did not act according to by-laws and existing regulations. The recalcitrant operator anticipated the repeal, but only for its intra-regional operating rights. This strategy is generally used by small bus carriers when the Commission does not grant their request for discontinuance of services in small communities. Their losses incurred are very minimal. So what are the

other acceptable solutions for small communities when route abandonments occur?

4. Possible Solutions

A severe decline in demand leads various bus operators to institute cost-cutting measures, among them work-rule changes, renegociation of wages contracts and the discontinuance of some routes they consider to be unprofitable. However, the reduction in services is not instantaneous but takes time because of delays caused by the existing regulation. As the deregulation scenario is really inappropriate for the Québec environment in the near future, only marginal solutions shall be considered[17]. One can be a variant of the hub-and-spoke system that operates in the airline industry. Regional carriers under contract with an important bus firm can provide service by using minibuses, cars, and demand reponse taxis as the demand is insufficient to warrant the traditional intercity buses. Small communities in the country would retain services they can afford to pay. Other innovative approaches to the provision of feeder modes can also be brought forward.

Although the timing is not the most appropriate in Canada, at this moment, the province and the rural cities can provide public subsidies to compensate for losses incurred by carriers to operate in low density areas. Local communities must commit resources to show their "willingness to pay" if they really want their citizens to be linked to the existing network of intercity buses. If not, they must acknowledge that every member of the community will find his own personal answer, the automobile.

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MANAGEMENT TRAINING NEEDS FOR THE TRUCKING INDUSTRY

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The trucking industry, a demand-driven industry, is changing in order to meet the demands of its customers. These changes also bring along obvious training needs. This paper outlines some of the findings of a study performed by Peat Marwick Stevenson & Kellogg for the Canadian Trucking Research Institute. The study dealt with the management training needs of the trucking industry.

The trucking industry is a labour-intensive industry and as such it needs to pay special attention to its human resources. As is often said, the trucking industry is a people industry. Some of its productivity and growth in the future will pass through its human resources. The other part of the equation is, of course, the equipment/technology component. Human resources adjustment cannot, however, be done in isolation of the outside environment. To summarize the "déjà-vu", the following outlines some of the factors making up the outside environment:

- Customer-driven globalization of the markets:
- Trend in cost reduction at all Levels:
- Quick response/JIT
- Technology plays a major role
- Need for a game plan and proper identification of market(s)
- Partnership and strategic alliances
- Where does trucking add value?
- Total Quality Management
- Cost and performance measurements

As part of the project, a series of workshops and focus groups were conducted across Canada. More than 50 participants took part in these discussions. One of the result of these workshops/focus groups was a listing of relevant management functions or tasks in the trucking industry. Following is a listing of these functions/tasks:

Asset Management	Budgeting and Cost Control
Business Planning	Communicating
Costing	Customer Service Management
Delegating	Financial Planning
Human Resources Planning	Information Systems/Technology Labour
Relations	Leadership
Marketing Planning	Motivating
Operations Management	Performance Measurement
Problem Solving	Quality Management
Sales Management	Setting Goals and Objectives
Strategic Planning	Structuring the Organization
Work Scheduling	

Obviously, the complexity of the above tasks increase with the size of the organization. It is fair to say however, that because most trucking companies are small and medium size businesses, the management of these companies is highly concentrated and the tasks are often performed by one or two individuals. Even in larger trucking corporations, we have witnessed recently a shrinking of the mid-management group in an effort to reduce management layers and become more hands-on. To use a new popular qualifier, trucking executives now have to be Renaissance Persons.

Management functions/tasks often represent a continuum not easily divided into discrete entities. Also, some of the requirements represent special skills, others knowledge, and others personality traits (e.g.leadership). The workshops/focus groups did, nevertheless, try to identify the functions in order of importance. The five tasks that ranked the highest in order of importance were as follows:

- Customer Service/Quality
- Quality Management
- Costing
- Leadership
- Strategic Planning and Logistics

Based on the findings of the workshops and focus groups, and recognizing the complementary nature of many of the above functions, specific management training in trucking was identified as follows:

1. **Customer Service/Quality**

   - Understanding customer's needs
   - Identifying the attributes of the interface with the customers
   - Determine how important these attributes are for each customer

- Setting service objectives and policies
- Refining business processes to deliver the target service
- Measuring and Monitoring service performance
- Managing culture change
- Training, motivating people to deliver quality service

2. Quality Management

- Quality Programs and TQM programs exist.

The Canadian Trucking Association established in 1993, with the financial assistance of Industry Canada, a Canadian Trucking Quality Institute to assist trucking companies in adopting and implementing TQM programs.

3. Costing, Cost Control and Budgets

Costing is now becoming a science and it was recognized that some of the segments of the trucking industry need better training for properly costing their business. In the TL segment, costing is usually less complicated due to the nature of the business. For the Bulk Segment many moves are done under annual contracts. Thus, training for costing has to recognize the diversity of the business.

4. Leadership Skills

All group discussions identified leadership as a critical function in the industry. More specifically leadership needs were perceived the following way:

- Developing and articulating the vision of the company
- Defining the mission statement
- Promoting recognition and reward systems to encourage employees
- Encouraging team leadership, empowerment
- Communication skills

5. Strategic Planning and Logistics

Some of the trucking industry's customers have adopted an integrated logistics strategy. Consequently, to be successful motor carriers must

understand these changes and be part of it.

Specifically training in this area should deal with the following:

- Principles of logistics
- Supply chain management
- Changing shipper and consignee strategies

Obviously some organisations already provide some training in the fields above. The area with the more pressing need is on costing.

In closing, it is important that training and educational institutions/organizations provide a competitive package to the motor carrier industry in view of its importance in the freight distribution. The difficulty of course resides in the segmentation of the industry and the size of the market. On the latter point, although there are a potential of thousands of middle and senior managers who could take training in any of the five mentioned areas, very few have the time and access for doing so. In this respect, the Information Highway offers some potential to a market as fragmented and geographically dispersed as trucking management people.

GETTING AHEAD OF THE ISSUES: THE IMPLICATIONS OF TODAY'S DEVELOPMENTS FOR THE SHAPE OF THINGS TO COME IN CANADIAN TRANSPORTATION[1]

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Introduction

This paper sets out the major factors expected to influence the development of the Canadian transportation over the next decade. It also outlines some likely national and sectoral responses to those influences. The purpose of the paper is to provide a basis for the discussion of developments in the transportation industry and the consequent challenges and opportunities that will exist. Some of these will affect the CTRF itself.

Transportation, as an integral part of Canadian society, has been undergoing significant change. As with society generally, there is every reason to believe that the rate of change will be sustained if not accelerate. Conclusion of the North American Free Trade Agreement (NAFTA) and the Uruguay Round of the General Agreement on Tariffs and Trade (GATT) are obvious symbols of the influence of the forces at work. These forces have important implications for Canadian transportation. Their influence on the development of the transportation system are of concern to carriers, to public decision makers and to users of transportation services.

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[1]. This paper is based on a paper prepared for the Transportation Association of Canada's Task Force on Transportation, Society and the Economy. I wish to acknowledge the valuable comments of the Task Force on that paper. However, the views expressed are not attributable to members of the Task Force and all errors and omissions are mine alone.

Many inextricably interwoven influences exist. Sorting out their individual effects is difficult. For the purpose of this paper, it is also not very fruitful. The important overall effect is paramount; that is the need to achieve improved efficiency. The growth of global competitiveness has led to the acceptance of greater reliance on market competitive forces to generate domestic efficiency. Similarly, the pressures caused by budget deficits are leading to the acceptance of greater reliance on user-pay policies which will enhance efficiency in supply and use.

The most important influences are derived from forces much wider than the transportation industry or of Canada. The growth of global competitiveness is an example.

The approach in the paper is to outline the broad overriding factors first and then to identify their implications for the transportation sector. No attempt has been made to place the implications in an order of importance. Arguably, the most significant is the priority given to the needs of users of transportation. The paper concludes with some comments on the information requirements of public and private sector decision makers.

I. The Major Influences

It is common for change to be the product of pressures and opportunities. The pressures for change demand innovation to avoid adverse consequences. The opportunities are means to improve performance. The major influences on the Canadian economy can be viewed in these categories. Global competitiveness and the restraints on government expenditures require some changes in public and private policies. At the same time, changes in the population and economy will require new investments. Fortunately, technological and conceptual innovations are providing the capability of doing more with less, of being more efficient. The elements in each of these major influences and the ramifications from them are complex and numerous.

1. ***Global competitiveness.*** Many factors account for the increase in global competitiveness. These include the reductions of trade barriers under GATT and regional trade agreements, increased communications and transportation efficiency, and the increased value and transportability of many goods. All organizations are having to respond to the increased need for efficiency as the effects of competition spread through the economy. The effects are felt by governments whether national or local and by corporations whether large or small. Responses of government include the provision of services more efficiently and the creation of a more supportive environment for industry in its

pursuit of efficiency and competitiveness.

The transportation industry continues to experience greater competition. Intermodal, intramodal and market competition continue to exert strong pressure on the performance of carriers.

2. *The continental economy.* The development of North American free trade under the FTA and NAFTA is a part of the wider globalization of competition. However, the trade agreements have particular significance for the transportation sector because of the implied changing balance of east-west and north-south trade patterns. The most rapidly growing markets are north-south with some substitution of north-south for east-west movements.

Free trade will result in more integration of the North American economy. A consequence will be greater importance for the compatibility and harmonization of policies affecting competitiveness.

3. *Restraints on government expenditures.* Efficiency in public expenditures is necessitated by the more globally competitive environment. At the same time, restraints on government expenditures are caused by public policies which have inflated budget deficits excessively. The policies and practices of the past cannot be sustained.

4. *Changes in the economy.* Anticipating changes in the global economy and their implications for the Canadian economy is fraught with dangers. Notwithstanding cyclical variations, the global economy will continue to expand. It will be led in the foreseeable future by developments in Asia. Opportunities for substantial growth over time are present also in Mexico, in South America and in Eastern Europe and the states of the former Soviet Union.

While the challenges and opportunities on a global scale engender optimism, the fortunes for Canada are uncertain. How far economic growth in other countries will enable an expansion of Canadian exports or result in tighter markets for them is an issue. What seems most likely is that Canada is moving from a period characterized by growth to one during which regional shifts and restructuring will be more prominent than growth. Unemployment rates are likely to remain relatively high. The population will also age. These conditions and the pressure for social programs will place governments under tight financial constraints.

The changes in the economy will give rise to requirements for more public infrastructure and services in the regions of growth. New ways will be needed

to finance at least part of the infrastructure.

Not all sectors of the economy will enjoy the same levels of prosperity. It is difficult to forecast particular structural changes that will take place. However, the implications for the transportation industry can be related to the broad nature of the users that the modes serve. The railway industry is the most at risk in the new environment because of its dependence on a relatively narrow base of commodities and shippers. This is notwithstanding the emergence of a substantial volume of intermodal traffic. World trade conditions will be important to the railways and to their shippers. For coal, grain, potash and sulphur shippers the balance between the expansion of world consumption and the development of new sources of supply will be critical. For forest products, the varied effects of environmental concerns may adversely affect traffic. The highway sector, on the other hand, will be affected more by the overall growth and restructuring in the economy. Pressures will continue to be exerted on passenger transport facilities by the mobility of Canadians and the growth of tourism.

5. *Technological and conceptual innovation.* Technological and conceptual innovation often go hand in hand. However, the role of conceptual innovation in its various forms is easily underestimated. Included under conceptual innovation are methods of achieving desired objectives, for example, efficiency through total quality management, and organizational changes such as deregulation and out-sourcing. The beneficial effects of conceptual innovation are often less easily duplicated than those of technology alone.

Specific mention is appropriate of the influence of developments in information systems, often referred to as telematics, the combined innovation of communications and computing. Innovation in information systems are not only enabling previous activities to be conducted more efficiently, they are also enabling systems and organizations to be redesigned. Change in information technology may provide the most important opportunities for change in the transportation industry. Examples are in the development of integrated logistics management, the progress of trade facilitation and the application of new methods of road pricing and financing.

It is important to note that successful innovations often are adapted more widely and have wider ramifications than initially expected. The demonstration and competitive effects of innovation are dramatic. This has been true of the adoption of container transport, of just-in-time inventory management and is becoming true of information technology. The adoption of new methods of paying for roads could be wider than commonly expected.

6. *Safety and the environment.* There will be more emphasis in the future than in the past on the safety and environmental consequences of transport. The heightened concern for these conditions is evident in the report of the Royal Commission on National Passenger Transportation. The policy measures which might be taken and their effects on the modes of transport remain uncertain. Advances in technology will affect the benefits and costs of alternate policies.

II. National and Sectoral Responses

Many circumstances influence the particular response of individual countries to the broad influences outlined above. Some general patterns of response are evident even among countries of widely different political persuasion. In Canada, the dominant patterns of change seem likely irrespective of the political parties in power. The expected responses are consistent with continental and global trends.

1. *Refocusing on core activities.* Under the threat of new constraints and competitive pressures, most organizations are having to reassess their resource allocations. To be competitive, they focus their resources on areas of advantage. A result is that productivity is raised and marginal activities are dropped.

This general trend has special significance in the transport industry. Carriers are assessing the value of low density parts of their networks. The trend creates opportunities for new enterprises of which the short-line railways are an example. In logistics activities new opportunities are arising for third party suppliers.

2. *Reinventing government.* Governments are seeking ways to be more efficient. Reexamination of government policies and practices are resulting in changes to the role of government and the means of achieving government objectives. In the short run, many changes are associated with down-sizing government.

a) Reduction in the civil service: The size of the civil service is expected to be reduced. This is necessitated by current budget constraints but it is also enabled by changes in organizations and by technology which are enabling the work force to be more efficient. Such down-sizing places considerable pressures on the time of individuals, especially during the process of change. It may also result in reducing the functions to be performed by government through privatization and devolution in their various forms. (Related issues are in subsection 6. on horizontal organization structures.)

b) Changing role: The perceived need for government to be involved in the provision of certain goods or services changes over time. The drive for greater innovation and dynamic efficiency is resulting in a reduced role for government and greater reliance on the private sector. Sometimes, the role of government is changed. For example, the deregulation of aviation did not remove issues related to airline competition although many governments acted temporarily as though it had. There are some aspects of the economy for which a greater role for government is needed. This is true in the areas of environmental protection, public health and safety. The mechanisms to achieve desired standards are still evolving.

c) Delivery mechanisms: Efficiency in the achievement of policy objectives is being pursued by changing mechanisms. The acceptance of different mechanisms is widespread, from transport to social programs. New approaches in transport include the setting of standards while allowing carriers the choice of the means for their achievement, the use of competitive tendering and innovation in funding public highways.

3. ***Reliance on market forces.*** The need for increased responsiveness to changing conditions is leading to greater reliance on market forces. This takes various forms.

a) Regulatory reform: The special entry and pricing restrictions in certain industries such as transportation are being reduced. Most change has already been realised. However, further deregulation will occur in highway transportation. The deregulated industries remain subject to the general provisions of competition policy. The railway and the telephone industries which own infrastructure have been and will likely continue to be subject to special regulations to facilitate competition.

b) Exposure to foreign competition; The effects of global competition on most industries will continue to increase. Canadian transport, already largely open to foreign competition will continue to be exposed to more competition. A result will be more emphasis on international harmonization of policy and technical standards.

c) User pay: The implementation of user-pay policies will increase. User pay is attractive and acceptable to the taxpayer because of the budget deficit. It is also a means of improving economic efficiency because of the associated discipline imposed on suppliers and users of facilities and services. More direct user-pay practices will result in greater pressure for accountability. User-pay policies and practices will be a major component

of upcoming infrastructure issues.

4. *Public infrastructure policy will be important.* The need to maintain an adequate infrastructure and to expand it in certain regions will give rise to many issues. The relevance of user-pay has already been mentioned. User-pay is being made feasible by telematics in a wide range of new applications. Many new technological and policy issues will be associated with the application of user charges. The technology, economics and politics of user pay will be major issues of wide interest

a) User-pay: A result of budget and efficiency pressures will be more interest in users paying at least for improvements to the infrastructure system. "Pay for More" aptly captures the possible policy in a mature economy. How this will be done and how far it should go will be important issues. Attitudes towards road pricing and other user charges may change as rapidly in coming years as did attitudes towards deregulation about a decade ago.

b) Cost allocation: The fuller application of user charges inevitably raises many questions about the appropriate basis on which to levy the charges. The prolonged efforts of Transport Canada to introduce user charges for marine services and facilities is evidence of some of the controversy which will arise. Cost causality by users is a critical issue. Highway cost allocation studies will be of even greater interest in this environment.

c) Investments in alternate modes: The need to invest in the mode of transport that can serve users' needs most efficiently has long been recognised as necessary. However, jurisdictional issues have inhibited progress. Resolving issues so that investment can take place in the most efficient mode will be important.

d) National infrastructure issues: Infrastructure is likely to be a national issue. The rationalization of the railway network will raise issues of modal substitution and of the shape of a national railway system. The national highway and infrastructure programs in the U.S. may raise demands for comparable programs here.

e) The role of uneconomic Canadian infrastructure in a continental economy: The maintenance of uneconomic infrastructure is not an issue unique to Canada. Many reasons can exist for such infrastructure. However, Canada's proximity to the U.S. makes the duplication of plant for national reasons particularly significant. The greater continentalization

of trade and transport will likely increase the need to face up to whether, or how much, duplication is warranted.

5. ***Devolution and privatization of public agencies.*** There are several reasons for the changing role of public agencies involved in the provision of transportation facilities and services.

a) Loss of a public service role: Changing economic and social conditions and the effects of pervasive competition have combined to erode the previous rationale for Crown corporations such as the former Air Canada. The privatization of CN North America is expected at some time.

b: Responsiveness to local conditions: The growth of global competition has made responsiveness to competitive forces more important. Even when the forces are global, responses, in the diverse conditions existing in Canada, are most effective when they are local. The case for decentralization of responsibility from Ottawa will continue to result in privatization or devolution, as seen in airports and ports.

c) Opportunities to involve the private sector: The pursuit of efficiency may result in other shifts to the private sector even when ultimate responsibility for a good or service rests with the government. The use of contractual arrangements in the highway sector (including construction, operation and maintenance) is a good way of introducing competition and private funding.

6. ***Horizontal organization structures.*** In addition to changes in the roles of public and private organizations, changes are taking place in the structure of those organizations. As a means of improving performance many organizations are adopting more horizontal organization structures. There are fewer levels of management. Managers have more and wider responsibilities.

7. ***Well educated, flexible labour necessary.*** As work forces decrease in size, the level of skills and the flexibility of employees is increasing. Decision making responsibilities are also more widely spread through many organizations. A range of labour/management issues arise as a consequence. The wider involvement of employees in decision making may have implications for the involvement of unions and other employee representatives in various transport undertakings. Achieving change will be important but difficult in an environment such as ports because of the role of casual labour.

8. ***User needs remain the primary policy objective.*** In theory, transportation policy has always been designed to serve the needs of users. In practice, however, many policies have had the effect of protecting the incumbents in the transport industry. The importance of a fully competitive transport environment, comparable to that in other sectors of the economy, has been increased by competition in users markets and in international transport markets. The interest of users in access to competitive transport services will likely be a major factor in shaping the development of each of the transport modes. It has yet to have the impact in international liner shipping that it has had in other modes in Canada. However, users must recognize that it is essential for the efficiency of services that carriers earn an adequate return on capital in the long run. This does not guarantee the viability of individual firms.

9. ***Direct subsidies for unprofitable public-interest services.*** The advantages of direct subsidies for unremunerative services to be sustained in the public interest have been recognised for many years. However, the policy has still not been implemented fully; for example, some provinces still expect bus lines to practice cross subsidization. Direct subsidies will become more necessary as carriers are less able to sustain cross subsidy and as overall efficiency is needed in the economy.

Benefits can be obtained, also, by contracting out for the provision of unremunerative services. Bids may be requested for the provision of services irrespective of the mode of transport used. More contracting out of services is likely.

Distortions are also recognised if one of competitive modes is subsidized, as occurs with the subsidization of grain transportation by rail under the Western Grain Transportation Act. Resolution of the long-standing issues in grain transportation may be seen this century!

10. ***Transport is a part of service sector systems.*** Traditionally, transport has been viewed as a terminal-to-terminal service or at best as a door-to-door service. Increasingly, transport is viewed as a part of wider systems. This has some relevance for passenger transport as the packaging of travel has been tied in with accommodation and other vacation arrangements. However, it has greatest relevance for freight transport. Shippers are increasingly managing transport with other logistics costs to achieve integrated control of the processes involved in providing time and place utility. There are three specific trends evident.

a) The buyers of freight transport are logistics managers: As transport becomes a part of integrated logistics systems so the interests of managers change.

b) Reliable, time-dependent services are more important than modal services: Service attributes of transport have become more important as transport has been integrated into modern systems, such as just-in-time logistics. The reliability of transport has become more important. Service attributes rather than the mode of transport used are important. Carriers increasingly define their services in terms of the service level provided rather than the mode of transport used. Shippers worry about the results, not the methods.

c) Carriers must market services as integrated or compatible parts of logistics services: Carriers are interested in the ways that they can best utilize their physical assets and expertise to serve the logistical requirements of shippers. The extent to which carriers integrate logistics services with transport services varies among the modes; there is more integration in the highway than the rail mode. It varies, also, among the companies in a mode.

11. ***Intermodal services.*** Technological developments, especially containerization and telematics, have facilitated the development of intermodal freight transport. The trend to greater integration of the modes of transport will continue. Intermodal yards will become more prominent as distribution hubs in continental transportation systems.

Achieving better integration of passenger services will need more attention in the future.

12. ***Traffic is more international.*** The importance of north-south trade and of overseas trade will be stimulated by NAFTA and GATT. Carriers are responding to this reality in their organization structures and in their practices.

Pressures will exist to enable users to benefit from efficient international services and for carriers to participate freely in those markets. These pressures will have implications for international airline agreements and the protective policies of the U.S. in maritime transport.

13. ***International harmonization is important.*** The increased importance of international transport implies that all conditions related to the provision of international services will become more important. Greater emphasis will need

to be given to the international harmonization of transport regulations and conditions, especially with the U.S. The effects of tax levels and regimes will continue to need scrutiny. Trade facilitation through improved border procedures, especially by Canada Customs, will get more attention. EDI will allow the re-engineering of import and export procedures so that international movements will become closer to the simplicity of domestic movements. Shippers, carriers and government agencies will have to deal with the challenges that arise from the use of EDI.

14. ***Changes continue in industry structure modally.*** In spite of common conditions affecting each of the modes, modal attributes will continue to give rise to distinctive modal issues. Each of the modes has its distinctive attributes. The airline industry is moving to a more global structure. The role of the two major Canadian carriers in the global system is yet to be determined. The pattern of global change in the airlines contrasts strongly with the distinctive issues associated with the Canadian railway industry. Issues associated with the efficiency of railway operations, the extent of an essential railway network, and the means to preserve competitive services will be among the most controversial national freight transportation issues. It may be that Canada will follow the emerging pattern in Europe with competing carriers operating over publicly provided right of way. More short-line railways under provincial jurisdiction are likely. The changes will result in more railway companies in Canada. The major issues in the highway industry will be the organization and financing of infrastructure. The bus industry will likely be deregulated. In the maritime industry, the most serious issues will be related to infrastructure policy. The Great Lakes and St. Lawrence systems will likely continue to face uneconomically low tonnages. The issues for Canadian ports will be associated with their operation in a competitive North American regime. Direct and indirect subsidies to ports may raise difficult issues among Canadian and American ports. In international shipping, there will be increased pressures for an end to the price setting practices of conferences.

15. ***Changes in the corporate composition of transport.*** The evolving structure of the transport industry is associated with a changing mix of corporations. A wider diversity of corporations is likely to exist in the future than in the past. In the trucking industry, some firms are successfully combining transport with other logistics services. The future of the railway industry is particularly uncertain. Private-sector infrastructure providers may be new types of transport enterprises.

III. Implications for Decision Makers

Substantial change can be expected to characterize the transport sector as it responds to the various influences outlined above. Doing things in new ways will have to be supported by excellent information. Research and development results and up-to-date information on applications will be highly valued. The scope of interest will be wide, triggered by increased need for harmonization of regulations and technologies with other countries.

Many issues will arise as the influences outlined cause reevaluation of previous policies. Organizations such as the CTRF and the Transportation Association of Canada (TAC) may play important roles by providing information and acting as a forum in which the issues can be debated and policy consensus evolved.

The increased role of international trade and the greater linkage of transport with other logistics activities will result in even greater synergy between trade and transport. Trade issues and developments will affect Canadian transport requirements more than formerly.

Global developments will be of more importance to Canadian transport managers. Matters related to trade may affect the demand for transport in Canada. Also, knowledge of technologies and concepts developed or applied to improve transport performance elsewhere will be sought more eagerly. Currently, for example, knowledge of the technical, economic and political experience with road financing and pricing systems is of interest to the development of new highway policies. The reorganization of the railways in Europe may have relevance to railway issues in Canada.

Canada's international competitiveness will be a major issue and driving force. This will provide a strong inducement to evolve practices and policies which are better integrated across levels of government and modes of transport. It will strengthen interest in cooperative arrangements among governments and between the public and private sectors.

Re-inventing and Rationalizing the Freight Transportation Policy Role of Government

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INTRODUCTION

Several developments and a variety of factors have made redundant much of the traditional freight transportation policy role of Canadian governments. In its place, needs have emerged for differing and more comprehensive approaches to transportation policy development which more fully recognize the role of transportation policy as part of broader government approaches to meeting economic and social objectives.

Globalization of trade, the continentalization of logistics management, and the restructuring of most goods producing industries have had a profound effect on the nature and standards of freight transportation service demand. Concurrent changes in transportation regulation have served to intensify competition in the transportation sector and expose carriers much more directly to market forces. With the exception of safety issues, government's role as a regulator of transportation has diminished, while its role as a facilitator is achieving greater prominence.

* The views expressed are those of the author and not necessarily those of the Ministry, nor of his colleagues, whose constructive criticism is gratefully acknowledged.

Traditional transportation policy analysis and development processes, directed by officials working within established government structures and with the usual data sources, have been oriented towards dealing with industries subject to economic regulation. Administrators have found themselves ill equipped to respond to recent "cries for help" from the transportation industry, or to respond to social and environmental concerns as they gain a higher profile on the public policy agenda. Furthermore, the need to cope has arisen at a time of diminishing public resources, so that the natural response of adding capacity to the policy analysis and development process has not been an option.

This paper will discuss the effects these broad changes are having on the transportation policy analysis and development role within government, and it will identify some of the responses necessary to accommodate them, as well as the mechanisms and data necessary to provide sound and practical policy advice. The author draws on experience with the Research Directorate of the National Transportation Act Review Commission (NTARC) and with the Ministry of Transportation, Ontario.

Traditional Freight Transportation Policy Role

Traditionally, governments have approached freight transportation policy from a modal and carrier perspective and orientation. While, in both the U.S. and Canada, the legislative intent has gradually taken a broader approach and one that acknowledges the role of market forces and the needs of shippers, much of government's policy making and regulatory structure has been focused on monitoring and controlling carrier behaviour in the marketplace.

In Canada, the National Transportation Act of 1967 (NTA1967) made massive strides in acknowledging the role of competition between modes and it relaxed rate regulation of the carriers. Indeed, this Act, founded on the McPherson Commission Report, acknowledged the options then available to shippers, and it was an appropriate reflection of the marketplace of the time. The federal government did however, through its regulatory body, continue to monitor railway rates and administer process for rate filing. In trucking, the failure to proclaim Part III of NTA1967, resulted in several provinces continuing stringent regulatory regimes regarding carrier pricing and most of them to control market entry very tightly. The interpretation of "public necessity and convenience" entry tests by regulators tended to focus on the interest of existing licensed carriers, rather than that of users. Further, that approach tended to colour policy analysis of governments as well. Little consideration was given to the consequent effects of trucking regulation on other modes, or on the growth of private trucking during the 1970's and 1980's.

Another key characteristic in this period was a continuing focus within Canadian governments on specific modes. Regulators and policy departments functioned on strict modal lines with little if any dialogue between them. Regulatory and policy initiatives were seldom the product of multi-modal analysis, but were developed and implemented as a result of the perceived situation in a specific mode. Contrary or competing needs of transportation modes became apparent, if they were noticed at all, only at very senior levels within most government structure.

A further characteristic was an interventionist approach by governments into the role of each mode through deficit producing crown corporations (e.g. Canadian National, Air Canada, Ontario Northland, BC Rail), direct subsidies, and the provision of infrastructure and services without thought to adequate cost recovery. The broader role of transportation in the economy appeared to be reserved for an almost mystical consideration of transportation's role in regional economic development (NTARC Vol II p. 142). Perceived needs were then addressed through one of the above mechanisms, or through the notion that carriers should cross-subsidize the cost of serving unprofitable markets with profits made elsewhere.

Policy analysis and development occurred largely from an introspective, isolationist perspective. The domestic market was viewed in isolation from the U.S. With respect to trucking, individual provinces saw little need for harmony or uniformity with neighbouring jurisdictions. On the contrary, some regulators and bureaucrats appeared to take pride in doing a "better job" of controlling activity than their neighbouring counterparts. In many governments, little consideration was given to the effect of policy decisions in one mode on carriers of competing modes, active in the same markets.

It was considered acceptable to pass on the costs of the regulatory schemes and any resulting inefficiency to the ultimate consumer of transportation service, without regard for any effect that those costs might have on them or the economy at large. Very little attention was focused on this subject, and as long as our economy could absorb such inefficiencies, and our main trading partner embraced a somewhat similar approach to transportation regulation, it was easy to ignore.

Attention was very slowly drawn to this issue in the late 1970's, as the U.S. was obliged to focus on transportation regulation due to the impending financial collapse of its railways, and a parallel examination in Canada prompted by the Regulation Reference initiative of the federal government.

It is remarkable how much our focus in transportation policy considerations has shifted as a result of a dramatically changed business and trading environment. The remainder of this paper will be devoted to discussing those changes and the extent to which governments have kept pace in structuring themselves to address transportation policy and issues relevantly.

Changed Environment

Much has been said about the role of the Canada U.S. Free Trade Agreement and its successor the North American Free Trade Agreement in changing the trading practices and ultimately the goods production and distribution industries in North America. It is the view of this author that those trade agreements served primarily to accelerate trends in trade and goods distribution which had been influencing market behaviour for many years.

The increasing globalization of trade, both in commodities and manufactured goods, is broadly acknowledged. Indeed, there are relatively few Canadian made goods offered to consumers at retail for which one cannot find a competitive product from a U.S. or offshore source. While we have always imported, initially from Europe and the U.S. and expanding to the Pacific rim in the 1960's and 70's, we have never before had such a wide range of trading partners. In addition, our economy has never before been as closely tied to the U.S. both in terms of trade and those business institutions which conduct and facilitate trading activity.

As multi-national corporations have grown, they have increasingly considered North America to be a homogenous market. Canada is now seen by many goods producers to require little more product differentiation than California or New England (Globe & Mail). Similarly, many production facilities in Canada now produce and distribute continent wide. There is nothing particularly original about this. The automotive manufacturers have been doing this for decades under terms of the Canada U.S. Auto Pact. However, the concept has now spread throughout goods producing industry so that even small local manufacturers in niche markets find survival dictating that they expand their trading horizons. That is the key difference. We no longer have local markets, satisfied by local producers. This has had a significant impact on the growth and development of the North American transportation industry. It has been obliged to continentalize in step with its customers.

Also obliged to continentalize has been the practice of logistics management, the successor to distribution and before that traffic management. North American goods producers are steadily centralizing logistics functions at a single continental

location. Centralized planning and control serve to optimize distribution efficiency and facilitate meeting customer requirements and measuring results. Many companies are embracing the practice of outsourcing major portions of their logistics needs to third party operators. This serves to further centralize goods transportation purchasing decisions into the hands of fewer and fewer purchasers, each dealing on a continent wide basis. The probability is that these purchasers will gradually focus on large carriers serving broad geographic areas to meet their transportation needs.

A further consequence of plants dedicated to limited product lines and centralized logistics has been a shift away from regional warehouses carrying full inventories, and a trend toward direct shipment from factory to customer. The new generation of superstores require frequent, efficient replenishment of high volume items (PMS&K 1992). For Canadian distribution this has resulted in more "direct to customer" cross border shipping and a lower incidence of national redistribution from warehouses located in Ontario and Quebec.

Another change has occurred during the past two decades as the nature and mix of freight commodities has changed with shifting demands and industrial practices. While bulk freight continues to dominate many western Canadian freight transportation markets, the volumes of such traffic in eastern Canada have declined as mines have closed, plastics have replaced steel, and remaining traffic is mode competitive. In addition, recycling programs have resulted in shifting the origins of raw materials, and they are influencing the selection of plant locations. These trends have resulted in a significant change in the role of rail transportation in eastern Canada. Without the former volume of bulk traffic to share overhead costs, remaining business is at best only marginally profitable.

Service standards and their maintenance have become a driving force in the freight transportation marketplace. Competition is intense and relentless.

One final added dimension to the new transportation marketplace is public concern about a wide range of social issues. Primary among these are safety and environmental concerns. Ministers responsible for transportation receive a steady stream of correspondence from a public concerned about sharing highways with trucks, and the effect on the environment of fuel used to support freight transportation. For some interest groups such issues are central to their raison d'être. Their effective use of the press to further raise public awareness creates pressure within governments for prompt analysis and response.

Freight Transportation Policy Response

The National Transportation Act 1987 (NTA1987) acknowledged the need for improved efficiency in freight transportation to support Canadian industry in being competitive in both domestic and foreign markets. Effectively, through opening the freight transportation market to competition, it obliged carriers to become more responsive and shippers to become more discriminating in their carrier selection. In the case of rail transportation, it forced competition through regulatory mechanisms wherever natural intramodal competition was absent.

The intention was to allow market forces to prevail, with minimal if any intervention by government, in the belief that this would lead to an effective and efficient transportation system. It was believed, not unreasonably, that the U.S. experience with deregulation was sufficient example of the success of this approach. Two things were overlooked. First, was the fact that U.S. carriers with seven or eight years experience were well advanced in the process of becoming highly efficient and capable of functioning in unprotected markets. Indeed, those U.S. carriers which had not adapted by 1988 had either withdrawn from the market, or had been swallowed by their more enterprising competitors. Second, with respect to rail, the U.S. Staggers Act sought to ensure the financial health of the railways by releasing them from regulatory constraints rather than imposing a regime to regulate competitive options for shippers, as does the NTA1987.

The consequence was that in transborder markets the leaner, more efficient U.S. carriers tended to dominate in both the rail and the truck modes. The effects were not immediately apparent, but U.S. truckers moved quickly to enter transborder and in some cases domestic Canadian markets. U.S. railways, aided in at least one instance by the Canadian competitive access provisions, moved quickly to seize the longest possible portion of the haul in transborder movements. As traffic diminished in 1990, as a consequence of the recession, and Canadian carrier costs on transborder moves continued to be adversely affected by a strong Canadian dollar, domestic truckers showed signs of severe stress. The decline in railway financial performance commenced at the same time, although public concern was slower to crystallize, perhaps because the railways reaction was less dramatic than the truckers.

Blockades by truckers in 1990 served to disrupt industrial activity, particularly in Ontario and Quebec, and as a consequence governments moved very quickly to address the issue. A series of seven studies were commissioned by Transport Canada to examine perceived problems of the industry, with the focus being on carrier and owner operator complaints of disparity between Canadian and U.S.

cost inputs, and taxation and inequity in matters of enforcement. A wrap up or synopsis of these studies was prepared by Heads et al in 1991. A more qualitative comparison of the Ontario trucking industry and that of neighbouring states was prepared for the Ontario Government by Deloitte Touche.

This research was necessary because governments to that point had taken very little account of what was happening in the truck freight transportation marketplace since 1987. Perhaps, Governments had underestimated the degree of regulatory change, and the period of adjustment required by industry to learn to function in a new environment. The former mechanisms of entry management had been abandoned, and no effective mechanism of monitoring the industry replaced it. The National Transportation Agency performed national ongoing monitoring based on surveys and other available sources, and it published annual reports as required by NTA1987. These reports formed the best available data, but due to a lack of timely or detailed information provided only a very broad perspective on the industry. Statistics Canada data on financial performance of the trucking industry at that time lagged at least two years behind, and it was of little assistance. No information existed to evaluate the specific industry complaints raised at the time of the blockades.

The federal studies showed that the operating costs of Canadian transborder carriers were indeed higher than those of their U.S. competitors at the then prevailing value of the Canadian dollar - 86 cents U.S. Indeed, the effect of the value of the Canadian dollar relative to the U.S. on competitiveness was one of the more interesting discoveries of this exercise. The Ontario study performed by Deloitte Touche identified some significant differences in carrier management and market orientation between U.S. and Ontario carriers which had hitherto not been acknowledged.

It is important to note that while the output of these studies was something of a revelation to government, they were little more than confirmation of the obvious to the more progressive carriers who had quietly figured things out for themselves. Several of them had already shifted portions of their transborder activity to a U.S. base, and they were busy emulating the more effective management practices of their U.S. based competitors.

The result of government awakening to the problems of the transborder trucking industry were some tax relief measures. In Ontario, there was also a government response to trucking industry educational needs, focusing initially on owner operators, and to the need for the Ontario industry to assess itself, develop a vision for its future, and strategies to compete successfully within a continental market.

In rail, the realization of problems and their understanding by government has been much slower. While evidence of poor financial performance has been available for some time, and it was well documented by NTARC research, there has been little reaction from government, and the railways themselves have been slow to analyze the problems and to institute internal remedial action and strategies to achieve reforms. As the truckers did initially, the railways are inclined to invoke the hackneyed complaint about the lack of a "level playing field" for which they blame government. Studies focus on tiresome comparisons of U.S. and Canadian tax regimes, and they attempt to quantify the cost implications of the very differing means by which railways and truckers pay for transportation infrastructure. Little, if anything, has been done to perform analysis similar to the Deloitte Touche trucking study. CN North America was reported to have performed a productivity comparison of several North American railways in 1991, but has been very shy about sharing whatever it learned. Attempts by the Ontario Government to proceed with an in depth analysis of the rail industry in that province, leading to a shared vision of the future, are being met with reticence by the railways to share meaningful information. While the railways may have a very clear understanding of their circumstances and how to address them, beyond general statements by chief executives, very little has been shared with governments, customers or the public. Without more specific information, it is very difficult to evaluate whether some of the suggested remedies (merger, downsizing, revised labour agreements) will address their financial difficulties appropriately.

What Have We Learned, And Where Do We Go From Here?

The experience of the past several years shows that government has been ill equipped to understand in a timely and comprehensive way, exactly what is transpiring in freight transportation markets. As a consequence, it has had difficulty in responding appropriately to carrier complaints, and to balance legitimate needs of carriers for equality of opportunity with the needs of shippers for efficient transportation. Similarly, segments of the transportation industry have been slow to recognize that government is not necessarily the chief impediment to commercial success. All industry, as well as individual Canadians, would prefer lower taxes, better public services, and fewer regulatory impediments. Furthermore, "playing fields" are seldom level in all respects which is why the rules of most games call for teams to change ends at half time. Indeed, there may be a competitive advantage to choosing to move the ball uphill, if the wind and/or the sun are at your back.

Certainly, we all need to better understand and monitor the marketplace. We need better and more timely information, and we need to interpret the information we receive much more effectively. Statistics Canada has made improvements in the timeliness of trucking industry data. However, we must recognize the limitations of financial performance data and aggregate industry figures, as well as acknowledge the time lag in publishing data and the fact that change can occur rapidly.

Judging the condition of an industry, solely by financial performance, at a specific point in time, is likely to be as successful as assessing the weather, solely by reading the temperature. Trying to assess the current status of an industry, based solely on last year's financial performance, is similar to assessing today's weather, based on the temperature last year. Some analysts (and lobbyists) go further. Based on last year's financial performance (temperature), they will forecast for next year.

Furthermore, aggregate industry figures do nothing to inform us about the fortunes of specific companies. Financial performance reported for the trucking industry can be skewed significantly by a single large exceptional performer (NTARC Vol II, p 37). Similarly, the fortunes of the industry or specific segments can change dramatically between the reporting period and the time data is published.

As an example, in January 1993, the then most current financial performance data reported by Statistics Canada showed the trucking industry continuing in severe financial difficulty. Its situation was considered critical enough, based on 1991 aggregate data, to warrant further government attention in Ontario. However, a quick telephone survey of senior executives of a very small sample of Ontario carriers revealed that none of those contacted had been in a loss position in 1992. On the contrary, one carrier reported that 1992 had been its best year ever and another that the same year had seen its best financial performance in the previous five years. While most acknowledged extreme difficulty in the years 1990 and 1991 they were quick to point out the manner in which they had responded to changing market conditions and competitive pressure and the mechanisms they had employed to restructure their enterprises and focus on market opportunity. The upbeat tone from this informal and unscientific data gathering was sufficient to draw a reasoned, if tentative, conclusion that the industry was well on its way to recovery. Subsequent information has proved that assessment to be correct, whereas, reliance on dated and skewed published information may have led to unnecessary government intervention.

What government should learn from this is that aggregate industry data should be viewed with caution, and that published information should be verified by some empirical research. It should be recognized also that governments do not have a

responsibility to ensure the financial success of an entire industry through the application of crude instruments, such as taxation and regulation, when individual companies within those industries are being quite successful in the prevailing environment. What may be needed is for government to assist poorer performers to recognize the reasons for their failings and facilitate restructuring and refocussing of their resources on available opportunities. This is best achieved through programs oriented toward education and consultation, rather than by manipulation of taxation and public policy.

Governments also need to recognize the implications of marketplace continentalization. Often, we refer to the "Canadian railway industry" or the "Ontario trucking industry" without really reflecting or considering what we mean by those terms. Since governments are called on to be responsive to "their" industry, we should attempt to define those terms within a continental perspective. A narrow definition of the Ontario trucking industry might restrict it to those companies owned by Ontario residents. A broader definition might include all carriers who maintain terminals and provide employment in the province. The broadest might consider the Ontario trucking industry to include any carrier providing service to a shipper or receiver located in the province.

It is not the purpose of this paper to defend any one of those definitions. However, if we recognize continentalism in manufacturing and retailing, we should be prepared to do the same in transportation and adopt similar strategies to ensure that investment, regardless of origin, and employment occur within our jurisdictions.

The primary concern of government should be that our goods producing and trading industries have access to an efficient, competitive transportation system. We should next ensure that we have an environment which encourages the individual carriers to invest and employ within our jurisdictions. Finally, we should ensure that our locally domiciled entrepreneurs have fair and reasonable access to do business in other jurisdictions. We should recognize that at times locally domiciled carriers may be displaced by more efficient, more effective, or perhaps, simply more fortunate entrepreneurs from other jurisdictions. Examples of this exist in Ontario, not only in trucking, but in rail, with the potential operation of the Algoma Central Railway by the Wisconsin Central.

A further objective should be to integrate freight transportation policy with our broader economic and social policy objectives. Our government institutions, federally and provincially, are not yet structured to achieve that. A first step, which Ontario has achieved, is a modal integration of transportation policy analysis and development. Next as issues arise, we must achieve greater synergy among government ministries and departments in addressing issues. In Ontario,

we are working on this, but we need to improve our processes of staff level consultation in the early stages of issue analysis. Finally, we need to fine tune our consultative mechanisms, not just with shippers and carriers, but with the broader public which shares the use of our transportation infrastructure, and which monitors society's progress in addressing safety and environmental issues.

In 1993, the Ministry of Transportation in Ontario, brought these considerations to bear on the issue of allowing longer 16.2 metre (53 foot) semi-trailers and 25 metre overall double trailer combinations. Shippers were concerned about competitive access to markets; truckers with productivity improvement and uniformity of equipment among jurisdictions; the railways with competitive equity, and the public with safety and the environment. The economic issues were dealt with in a comprehensive consultant study (PMS&K 1993). Once that work was completed, it formed the basis, along with safety and environmental analysis for consultation with interested groups and with other ministries. A final check on broader public perceptions were obtained through a series of focus group discussions.

This approach proved effective in achieving a decision by government to implement changes in an environment in which all parties had experienced the opportunity for input and to influence the final outcome. Through consultations, it was acknowledged that the need for Ontario industry to be competitive with that in neighbouring jurisdictions could not be ignored. While absolute consensus was not achieved, all parties developed a broader understanding of the issue and most could take credit for having modified the outcome. Government was able to feel comfortable that the final decision addressed economic and social considerations, and that safety had not been compromised.

To achieve these results consistently, government transportation ministries and departments, in addition to improving data collection, need to adopt a multi-modal, multidisciplinary approach to policy analysis and development. Regular communication should be fostered, not only with carriers and shippers, but with other groups having an interest in transportation service and infrastructure, and with the public at large. This requires a depth and breadth of expertise which has not always been found within transportation ministries and departments. To develop it during times of restraint and retrenchment, is challenging; to fail to do so, may have very negative consequences.

ENDNOTES

(NTARC Vol II) Competition in Transportation, Policy and Legislation in Review - the report of the National Transportation Act Review Commission, March 1993.

(Globe & Mail) Head Office Flexes Its Might - January 18, 1994 p.1 This articles deals with many aspects of the continentalization of North American industry and the diminishing role of Canadian branch head offices in directing national corporate activity.

(PMS&K 1992) Canadian Shippers' Needs Assessment - Appendix B of this report prepared for NTARC provides detailed commentary on emerging practices in logistics management.

(PMS&K 1993) Economic Impact of Introducing 53' Semi-trailers and 25 metre B-trains in Ontario, January 1993.

DE L'ÉTAT PROVIDENCE À L'ÉTAT PARTENAIRE, COMMENT RÉINVENTER LES TRANSPORTS, À L'AUBE DU XXI[E] SIÈCLE.

Introduction

Si nos ancêtres avaient pu voyager dans le futur et survoler notre époque, l'évolution de notre société et du rôle de l'État les aurait probablement beaucoup étonnés. Ils n'auraient sans doute pas compris comment nous pouvons être à la fois si riches... et si pauvres.

Notre richesse nous a tout d'abord été donnée par la science. Les découvertes médicales, par exemple, nous ont assuré une meilleure santé et ont prolongé notre espérance de vie.

Des esprits inventifs ont également appliqué les découvertes scientifiques pour révolutionner les méthodes de production et améliorer notre vie quotidienne. Les progrès techniques nous ont apporté un niveau de confort inégalé ainsi qu'une abondance de biens inimaginable, il y a seulement 200 ans. En voyant nos automobiles, nos téléviseurs et nos lave-vaisselle, nos ancêtres nous auraient trouvé bien gâtés.

Sur le plan socio-économique, ils auraient aussi trouvé nos gouvernements bien généreux... du moins à une certaine époque. Bénéficiant de la richesse collective, l'État a stimulé, à sa façon la modernisation de la société.

Et qui aurait pu reprocher à un gouvernement de vouloir développer les réseaux routiers, de lancer le pays dans l'électrification massive et de donner à la population un réseau d'éducation et de santé modernes, ainsi qu'une sécurité minimale du revenu?

La modernisation de la société canadienne a donc demandé des investissements majeurs, en santé, en éducation, pour le soutien de l'industrie ou le développement de la culture.

Devant tant d'abondance, nos ancêtres auraient regardé le Parlement et auraient dit : «Voilà la Providence!» Jusqu'au jour où leur voyage dans le temps les aurait amené dans les années 1990, et que le ministre des Finances leur aurait expliqué l'ampleur du déficit national!

De l'émerveillement, ils seraient passés au stade de l'incompréhension la plus complète.

Mais rapidement, aussi, ils auraient constaté que l'État providence est en pleine mutation.

Fini le temps où l'on peut tout attendre de l'État. Bienvenue l'époque où le gouvernement central fait sa part, l'entreprise privée, les autres paliers de gouvernement ainsi que les citoyens faisant aussi leur bout de chemin.

De pourvoyeur qu'il était, l'État devient un partenaire.

I - Les transports : l'État qui assume tout

L'évolution des transports au Canada et au Québec reflète celle de la société en général [1].

Si, à notre tour, nous allions dans le temps et remontions jusqu'à à l'époque de nos ancêtres, nous retrouverions un immense pays où le transport est avant tout fluvial. C'est en 1665 que la première route est construite en Nouvelle-France : elle est dans la région de Montréal et a 24 km de long.

En 1734, on inaugurait le premier service de transport en commun entre Québec et Montréal. C'était un service de diligence qui empruntait le Chemin du Roy, sur la rive nord du Saint-Laurent. Les voyageurs mettaient 4 jours et demi pour franchir 290 km.

L'ouverture du Chemin du Roy marquait le point de départ du réseau routier provincial.

Sous le régime français, il n'y avait pas de corporation municipale et c'est le gouvernement qui veillait à l'aménagement des rues dans les villes. Ailleurs, seigneurs et propriétaires ouvraient et entretenaient leurs chemins. Ils organisaient des corvées mettant à contribution les populations locales.

Le régime anglais était plus décentralisateur, mais en l'absence d'institutions municipales, il était difficile de mettre en oeuvre une politique de voirie.

Même avec la création d'un réseau de corporations municipales et de districts municipaux dans les années 1850, le gouvernement du Bas-Canada a été incapable de faire assumer par les municipalités l'amélioration des chemins ruraux. Les autorités municipales étaient réfractaires à la levée d'impôts pour la construction de chemins et s'en remettaient encore à une organisation du travail basée sur la corvée.

C'est durant ces années que les gouvernements se sont associés à l'entreprise privée pour développer un autre mode de transport : le chemin de fer.

Par ailleurs, l'avènement d'un nouveau véhicule, l'automobile, demandait que des routes soient aménagées. Le gouvernement fédéral allait donc presser les provinces pour qu'elles créent des réseaux routiers carrossables.

Au début des années 1910, on constatait encore que les municipalités du Québec avaient du mal à s'organiser pour entretenir leurs chemins. Face à la menace d'une intervention du fédéral, le gouvernement provincial pris l'initiative et en 1914, on créait le ministère de la Voirie du Québec.

Situation assez unique en Amérique du Nord, l'État québécois devenait ainsi le principal maître d'oeuvre de tout le transport routier, situation qui allait durer jusqu'aux années 90.

La modernisation de la société québécoise a été accompagnée par un développement spectaculaire de son réseau routier dans les années 60 et 70, dans le but d'appuyer le développement économique et social. Et le gouvernement était à l'origine de tous les grands projets.

En 1972, le ministère de la Voirie était fusionné au ministère des Transports et progressivement, la vocation du nouveau ministère allait changer.

Une fois créé le réseau routier supérieur du Québec, le problème de l'entretien est devenu plus important que celui du développement. Par ailleurs, la présence du gouvernement dans les autres secteurs que le transport routier, allait faire du Ministère autre chose qu'un «ministère des routes».

Le transport en commun, le transport scolaire, le maritime, l'aérien et le ferroviaire nécessitaient l'intervention de plus en plus importante du gouvernement québécois. Le ministère se diversifiait, en même temps qu'apparaissait la nécessité de s'appuyer sur la recherche et le développement pour être en mesure de «faire plus avec moins».

Car à la fin des années 80, après deux récessions et une augmentation croissante des dépenses, le Ministère et tout le gouvernement se retrouvaient devant un problème criant de rareté des ressources budgétaires. Il devenait nécessaire de réduire la taille de l'appareil gouvernemental et de chercher de nouvelles formes de financement des services au citoyen.

L'État devenait justement plus sensible aux demandes des payeurs de taxe pour des services répondant mieux à leurs besoins ce qui, dans bien des cas, passait par la décentralisation et la régionalisation des activités.

Il y a deux ans, le ministère des Transports du Québec se retrouvait donc à la croisée des chemins et devait faire des choix impliquant ses objectifs et son organisation.

Le ministère qui avait tout géré au Québec en matière de transports devait maintenant rationaliser ses activités, se rapprocher du citoyen et envisager de nouveaux moyens de financer opérations régulières et développement.

L'État providence allait prendre le virage vers l'État partenaire.

II - La rationalisation du ministère des Transports

Des décisions prises à l'extérieur du Ministère allaient favoriser le changement de cap.

À la fin de 1990, le gouvernement du Québec décidait de transférer aux municipalités la responsabilité de 33 000 km de routes locales, soit environ la moitié du réseau routier de la province. Le gouvernement central remettait ainsi au gouvernement municipal, avec compensation, ce qu'il avait assumé un peu malgré lui au début du siècle.

L'organisation du ministère des Transports s'en trouvait profondément affectée. On ne pouvait se départir de la moitié du réseau routier, sans modifier la structure qui gérait ces routes.

Le gouvernement québécois s'engageait par ailleurs dans un important processus de rationalisation de ses activités. L'un des objectifs était de réduire la taille de l'appareil gouvernemental. L'un des moyens pour y arriver était de diminuer les effectifs globaux de 12 % et le nombre de gestionnaires de 20 %.

Pour le ministère des Transports cela voulait dire, dans un premier temps, l'abolition de près de 900 postes permanents. Si l'on ajoutait à cela la réduction de 500 postes permanents et de 1250 postes occasionnels en raison du transfert de la voirie locale, le ministère voyait ses effectifs totaux réduits de plus de 2 600 postes. L'impact sur l'organisation était inévitable...

Mais au-delà du transfert de la voirie locale et de la rationalisation décrétée par le gouvernement, le ministère des Transports avait entrepris une mutation profonde. L'un des Géants du gouvernement du Québec commençait à changer de peau et à se refaire une âme.

Rien de mieux, tout d'abord, qu'un bon examen de conscience. Au mois d'août 1990, on entreprenait un exercice de planification stratégique dont les résultats se sont concrétisés en 1992 avec, notamment, l'élaboration d'une vision ministérielle.

On y retrouvait un énoncé de mission, la définition d'une culture organisationnelle basée sur la responsabilisation des agents de première ligne, ainsi que des indications claires de ce que serait l'orientation du ministère des Transports pour les prochaines années. En conclusion de la Vision ministérielle on retrouvait une liste de choix stratégiques traduisant les priorités d'action du Ministère pour trois ans.

Ces choix stratégiques permettaient de réaligner le ministère vers le futur. Parler de «maintien et de remise en état du patrimoine routier» signifiait que la priorité allait à la protection de nos acquis plutôt qu'au développement de nouvelles routes. Cela correspondait à la réalité économique et aux besoins des usagers.

Par ailleurs, faire le choix du «développement et de l'intégration des modes et des systèmes de transport», indiquait bien que le ministère était engagé dans une démarche de transport multimodale tournée vers l'intégration, donc vers l'intermodalité.

Le Géant avait donc une nouvelle «vision». Il fallait maintenant que son corps retrouve une nouvelle souplesse lui permettant d'être plus efficace tout en rejoignant mieux les citoyens se trouvant aux quatre coins du Québec.

Pour être plus efficace, il faut être plus fort là où ça compte et plus simple là où ça décide.

Les activités du Ministère étaient regroupées selon cinq grandes fonctions. Avec la nouvelle organisation, il n'y en a plus que trois. Les activités de développement technologique sont regroupées, les activités de planification sont concentrées et le tout est intégré dans une seule direction générale de la planification et de la technologie, dont je suis le sous-ministre responsable.

Les services à la gestion sont également consolidés et regroupés dans une seule direction générale.

Quant aux opérations, c'est-à-dire l'action du ministère des Transports sur le territoire québécois, elles constituent la troisième grande fonction, décentralisée comme jamais dans toutes les régions du Québec.

Cette présence en région est caractérisée par la responsabilisation maximale de directions territoriales. Ces directions interviennent au niveau de tous les modes de transport, pas seulement au niveau de la voirie, et sont des guichets uniques où les partenaires du Ministère peuvent s'adresser pour obtenir services et informations.

Et plus que jamais, le Ministère est à l'écoute des municipalités, commissions scolaires, entrepreneurs en déneigement ou en construction, groupes d'intérêts, etc., un service étant responsable dans chacune des directions territoriales, des relations avec les partenaires.

Notre Géant est maintenant doté d'une structure plus souple et de «bras territoriaux» lui permettant d'intervenir plus efficacement, partout sur le territoire. Son oreille est bien tendue vers les besoins des citoyens et son coeur bat au rythme des préoccupations régionales.

Des politiques élaborées au fil des dernières années lui permettent également d'être un «Géant amical».

Une politique en environnement fait en sorte que les projets du Ministère sont tous évalués en fonction d'un plus grand respect du milieu.

Une politique en aménagement du territoire permet de planifier les actions du Ministère en fonction d'un ensemble de besoins dans une région. Ce sera d'autant plus vrai que des plans de transport régionaux détermineront en grand partie les choix que Transports Québec posera au niveau d'un territoire ou d'un autre.

Finalement, une politique sur la sécurité dans les transports fera de notre Géant un être vigilant, et de bon conseil, pour ce qui est de la prévention des accidents.

III - Réinventer les transports, mode par mode

Dans un pays vaste comme le Canada, c'est un euphémisme que d'affirmer de l'importance des transports. L'histoire de ce pays est jalonnée par les traversées océaniques des découvreurs, par les voyages vers l'ouest des explorateurs et par les grands projets de développement dont le chemin de fer, d'un océan à l'autre, n'est pas le moindre.

Les transports furent au coeur des rêves des pionniers et ont été un outil indispensable pour les bâtisseurs. Aujourd'hui, les industriels ne pourraient se passer de réseaux de transports performants, tout comme les simples citoyens ont besoin de routes ou de tranports en commun pour aller au travail ou à l'école, recevoir des soins de santé ou visiter les amis.

Mais le monde évolue et les temps changent... Les exploits du passé, une fois racontés dans les livres d'histoire servent tout au plus d'inspiration pour les générations actuelles et futures. Même le présent, éphémère par définition, doit être un tremplin pour aller plus loin... puisqu'il est question de transport.

L'an dernier, l'Association des transports du Canada suggérait une nouvelle vision, pour que l'industrie canadienne des transports puisse passer avec succès le tournant du siècle. Ce faisant, l'ATC lançait presqu'un cri d'alarme : dans un contexte de globalisation des marchés, le Canada n'a d'autre choix que d'améliorer la compétitivité de ses transports [2].

Pour l'association, notre pays doit poursuivre de nouvelles orientations dans les domaines de la réglementation et de la fiscalité des transports. Des décisions doivent être prises en matière d'investissements, de productivité de la main-d'oeuvre, d'éducation, de formation et à bien d'autres égards.

Je pense qu'il faut également réinventer les transports, mode par mode, en n'oubliant jamais que l'État doit être avant tout un partenaire.

Si les gouvernements peuvent favoriser, stimuler et mettre en oeuvre des réformes, ils doivent se garder de tout faire eux-mêmes et d'assumer plus que leur juste part, dans le fonctionnement des modes et des réseaux de transports. C'était le sens de la vague de déréglementations que nous avons

connue depuis quelques années, et c'est la voie qui doit demeurer celle des décideurs publics en matière de transport.

On utilise le mot «rationalisation» quand il est question de l'État. C'est un terme que le secteur privé a compris bien avant, semble-t-il, que les gouvernements ne l'apprennent. Si l'on ajoute la «compétitivité» à la rationalisation, on a les ingrédients qui ont sans doute inspiré les dirigeants **des deux grandes compagnies nationales de chemin de fer.**

La fusion en une seule administration de toutes les activités ferroviaires pour tout l'est du Canada est inévitable, me semble-t-il. On pourrait ainsi rationaliser un réseau national de chemin de fer qui a fait l'histoire mais qui risque aussi de s'y retrouver à l'état de souvenir, si l'industrie ferroviaire ne fait pas les bons aiguillages.

Sur le plan régional, le Québec a entrepris de favoriser **les Chemins de fer d'intérêt local, les CFIL.** Ces chemins de fer sont la propriété d'intérêts privés et constituent une solution intéressante pour le maintien des services, sur les lignes qui ne sont plus rentables pour les grandes compagnies.

Le rôle du gouvernement a été de faire adopter la réglementation permettant la création de CFIL. Par la suite, nous sommes convaincus qu'ils pourront être utiles et rentables.

Le transport maritime fait aussi partie de nos traditions et dans ce cas, le changement de cap s'est amorcé dans les années 80. À la veille du XXI^{e} siècle, on parle moins de modes de transport et de plus de en plus de «chaînes de transports».

L'intermodalité répond aux besoins de systèmes de production et de distribution des biens révolutionnés par la globalisation des marchés. Quand la matière première est en Amérique du sud, l'usine au Canada et les clients en Europe ou en Asie, la multimodalité s'impose et la conjonction des modes devient la règle pour de nombreux expéditeurs, qui sont eux-mêmes en concurrence avec manufacturiers étrangers.

Toute l'industrie doit s'adapter à ces changements, et l'on peut comprendre que les camionneurs, par exemple, craignent la montée de l'intermodal. Il est possible de trouver un équilibre et de concilier, à long terme, les intérêts des expéditeurs et ceux des transporteurs de tous les modes.

Il ne faut pas oublier que dans le domaine de l'intermodalité, le Canada bénéficie d'avantages géographiques : ses ports sont situés plus près des continents voisins, que la plupart de leurs concurrents et l'ensemble Saint-

Laurent – Grands-Lacs peut amener un navire jusqu'au Midwest américain. Ce qu'il reste à assurer, c'est la performance des infrastructures et des services, particulièrement dans le domaine du maritime et du ferroviaire.

À cet égard, un enjeu important est la révision en profondeur de l'organisation du travail dans les ports canadiens, toute la structure de gestion pouvant être remise en question. Ici encore, le rôle de l'État est de réglementer, la responsabilité finale des réformes demeurant entre les mains des autorités locales.

Deux aspects de la gestion des ports méritent une attention particulière.

Le premier, c'est bien sûr la gestion par une autorité locale, qui pourrait être faite à la manière américaine, ou encore sur le modèle d'autonomie de gestion des grands aéroports canadiens.

Quant au second aspect, il concerne les relations de travail. Il m'apparaît évident qu'il faille trouver un nouveau modèle, plus adapté à la nouvelle réalité économique mondiale. Ces nouvelles règles du jeu devront reconnaître l'importance des «chaînes de transport», devenues cruciales pour l'économie canadienne.

Le transport aérien a connu énormément de turbulence durant les dernières années. Et les perturbations engendrées par la déréglementation du début des années 80 nous réservent encore des surprises.

Si l'on regarde vers le futur, on peut déjà prédire l'arrivée de méga-transporteurs aériens, résultats de regroupements multinationaux et même intercontinentaux. Les alliances stratégiques qui se forment actuellement en sont une indication claire.

Quant à la concurrence, je crois qu'elle demeurera le principal outil de régulation du marché national et qu'elle continuera de s'exercer de plusieurs façons, notamment par l'élargissement d'ententes bilatérales Canada–États-Unis.

Sur le plan régional, la concurrence s'exercera par l'émergence de petits transporteurs qui assureront un service pouvant répondre aux besoins de clientèles locales.

Si le transport aérien est un secteur d'où l'État s'est progressivement retiré, les gouvernements doivent par contre continuer de jouer un rôle social à l'égard des communautés isolées.

Depuis 10 ans, grâce à une entente fédérale-provinciale, le Québec a aménagé pas moins d'une douzaine d'aéroports dans le nord de son territoire. Des communautés pratiquement dépourvues de moyens d'atteindre rapidement certains points de services, bénéficient ainsi d'une voie d'entrée et de sortie des personnes et des marchandises qui leur est devenue essentielle.

Parlant de **transport des personnes**, le XXI[e] siècle devra être celui du transport en commun. Nos réseaux routiers se fatiguent et leur réfection coûtent des milliards de dollars. Nos centre-ville sont encombrés, les bouchons de circulation usant la patience des banlieusards et la productivité des entreprises de transport.

Notre environnement montre également des signes d'essouflement, la pollution de l'air, et ses coûts afférents sur la santé, étant devenus inacceptables pour une grande majorité de citoyens.

Nous devons saluer les efforts des grands constructeurs d'automobiles pour nous offrir des voitures qui émettent moins de monoxyde de carbone. Mais la solution de l'avenir pour un transport interurbain rapide et confortable et des déplacements urbains efficaces et non-polluants, est le transport en commun, train, autobus, métro ou train de banlieue.

Après avoir conquis le Japon, puis l'Europe, le train à grande vitesse est attendu en Amérique. Un jour ou l'autre, il sera en service au Canada. Les études en cours nous démontrent qu'il ramènera dans le giron du transport collectif, une part non négligeable des automobilistes.

Parmi les grandes villes du Québec, celles de Montréal et Québec ont réussi à arrêter l'hémorragie des passagers qui quittaient l'autobus et le métro pour utiliser l'automobile. Les sociétés de transport ont pu remporter ces victoires grâce à de vigoureux programmes de relance. Elles ont été aidées par le gouvernement du Québec qui a favorisé, par exemple, la modernisation des trains de banlieue à Montréal et la mise en place de voies réservées pour les autobus, l'une des mesures les plus efficaces, si l'on considère le nombre de dollars investis.

Pour ce qui est finalement du **réseau routier**, le gouvernement québécois veut accentuer son rôle de partenaire.

Après avoir vécu le transfert de la voirie locale, les municipalités du Québec et le ministère des Transports sont demeurés des partenaires. Chaque niveau de gouvernement assume la responsabilité d'une partie importante du réseau routier, le Ministère assurant un soutien dans le cas de certains travaux techniquement plus complexes.

Transports Québec demeure donc le maître-d'oeuvre du développement et surtout de l'entretien, du réseau routier supérieur. Deux types de partenariat sont appelés à se développer à cet égard.

Tout d'abord le gouvernement recherche de nouvelles façons de financer la conservation et le développement des infrastructures routières.

L'État serait ainsi le partenaire de l'entreprise privée, dans des activités ayant une importance socio-économique cruciale.

L'autre domaine où le partenariat est déjà une réalité est la recherche et le développement.

Le ministère des Transports du Québec compte beaucoup sur la recherche scientifique et le transfert technologique pour améliorer notamment la qualité des chaussées, des ouvrages d'art et des systèmes de transport en commun. L'objectif est évidemment d'économiser sur les coûts de construction et d'entretien des infrastructures routières et d'avoir des véhicules de transport en commun plus performants, moins polluants et mieux adaptés aux besoins des usagers.

Grâce au **béton à hautes performances** développé au Québec, on peut construire des ponts et des viaducs deux fois plus résistants et ayant une durée de 25 à 30 pour cent plus longue qu'avec du béton conventionnel.

L'utilisation à Québec d'un **orniéreur de laboratoire**, le premier appareil du genre en Amérique du Nord, a permis la mise au point d'un enrobé bitumineux tellement résistant, que les camions poids lourds ne l'ont pas altéré, en trois ans d'usage, sur le boulevard le plus achalandé de Montréal.

Ce sont là des exemples très concrets des fruits de la recherche et du développement dans le domaine routier. En participant à des programmes interprovinciaux comme le C-SHARP et en choisissant des partenaires qualifiés dans le milieu universitaire et dans l'entreprise privée, le ministère des Transports est en mesure de faire progresser les connaissances et les techniques.

Conclusion : De l'État providence à l'État partenaire, réinventer les transports...

N'y a-t-il pas un sage qui a dit un jour que «c'est dans l'adversité que l'on atteint la grandeur»? Aussi étrange que cela puisse paraître, ce que nous pouvions faire dans l'abondance peut être aussi bien fait, sinon mieux, avec des ressources limitées.

C'est du moins le défi que doit relever l'État, en cette fin de XX^{e} siècle marqué par la lutte aux déficits de toutes natures.

L'État providence ne se peut plus. Nous n'avons plus les moyens de nous le payer. Des impératifs sociaux, comme le soutien aux plus démunis, des choix de société, comme celui d'un système de santé universel, voilà ce qui ressemble le plus à la providence que nous pouvons nous offrir. Et certains y verront, avec raison, plus de justice sociale que de générosité.

Pour le reste, l'État doit devenir l'un des acteurs de notre théâtre socio-économique. Un acteur de premier plan, certes, mais tout de même un, parmi d'autres.

C'est pourquoi, à la veille d'entrer dans un siècle nouveau, nous parlerons de «partenaire». Il y a d'ailleurs dans ce mot la notion d'équipe, donc de «force à plusieurs». L'État lancera un nouveau programme avec l'aide de l'industrie, créera des emplois avec des corps intermédiaires ou gérera des services en collaboration avec des citoyens.

Les grands ensembles, santé, éducation, justice demeureront la responsabilité des gouvernements. Mais de plus en plus, l'État devant vivre selon ses moyens, il déléguera à d'autres de grandes portions de ses activités.

De la rareté des ressources, peut également jaillir la créativité. La nécessité de suivre le train du progrès nous oblige d'ailleurs à retrousser nos manches et à avoir des idées. Ce n'est pas incompatible avec le partenariat. Ne dit-on pas que deux, ou trois têtes valent mieux qu'une? Nous avons moins de ressources qu'auparavant? Bonne raison pour innover! En n'oubliant jamais que le premier objectif est le service au citoyen.

La même façon de voir s'applique à notre monde, celui des transports.

Si nos organismes sont lourds et inefficaces, nous devons avoir l'humilité de le reconnaître et nous avons le devoir de les réformer.

Dans notre planification, nous devons choisir nos politiques et nos projets en fonction du meilleur rendement pour chacun des dollars que nous dépensons, le rendement étant évalué en terme de service au citoyen. Des outils comme la planification stratégique, les plans de transport, la recherche et le développement permettront d'optimiser notre efficience.

Dans la gestion de chacun des modes de transport l'État devra rechercher cette efficience et être prêt à jouer un rôle nouveau, celui de partenaire. Le gouvernement a le mandat de légiférer, donc d'encadrer l'activité socio-économique et non de jouer le jeu à la place des joueurs. Quant au mandat d'administrer, il s'agit plus de «soutenir» que de «faire à la place de».

Si l'industrie des transports est vigoureuse, compétitive, elle pourra bien souvent se passer de l'État pour vivre et offrir les services que l'on attend d'elle. C'est le cas de presque tous les modes de transport, ferroviaire, maritime, aérien et routier.

Il restera au gouvernement à être toujours présent quand il s'agira de planifier les grands systèmes de transports, ou au moment d'offrir des services publics, comme le transport des personnes et la desserte des régions éloignées. Et encore... Des formules de partenariat existent avec les sociétés de transport et certains transporteurs privés. Il sera certainement possible d'en développer, par ailleurs, lorsqu'il s'agira de conserver le patrimoine routier et de développer les nouvelles routes correspondant aux nouveaux besoins.

Réinventer les transports veut dire tout d'abord revoir notre façon de gérer les transports, à la façon d'un partenaire plutôt que comme un grand entrepreneur.

Réinventer les transports signifie également encourager les nouvelles façons d'assurer la circulation des personnes et des marchandises, que ce soit grâce à l'intermodalité, la remise en valeur du transport fluvial ou la stimulation du transport en commun urbain et interurbain.

Réinventer les transports ne nous amènera pas nécessairement à concevoir des véhicules ressemblant à des fusées et fonctionnant avec des carburants révolutionnaires.

Il s'agira tout simplement d'avoir une vision d'avenir, inspirée par les besoins nouveaux et balisée par les ressources que nous aurons... et le courage de nous engager dans le chemin qu'elle nous tracera.

Et vous savez, il n'est pas interdit de rêver...

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(1) L'explication historique développée au début de la partie I est fortement inspirée d'un rapport d'intervention présenté à l'École nationale d'administration publique par M. Raymond Landry, en juin 1992. Le titre de ce document est Proposition pour l'allocation de l'aide financière gouvernementale aux municipalités pour l'amélioration de la voirie locale.

(2) La «nouvelle vision des transports au Canada», telle qu'élaborée par l'Association des transports du Canada, a été expliquée notamment dans un dossier publié par cet organisme en septembre 1993. Il est possible d'en obtenir une ou plusieurs copies, en s'adressant à M. John Hartman, secrétaire du Conseil des transports multimodaux de l'ATC.

Public-Private Partnerships - The Way of the Future or Just Another Buzz Word?

by Sylvie Lefebvre, Senior Manager, Price Waterhouse
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Summary

Public-Private partnerships are becoming common place around the world for funding transportation infrastructure. Public-Private Partnerships are cooperate ventures between governments and the Private sector for owning, building, or/and operating facilities. Some widely publicized projects in Canada and the United States include the Fixed Link project in PEI, Terminal 3 at Pearson International Airport and the Caltrans toll road projects in California. Other projects around the world include the Channel Tunnel project between France and the U.K.

Some key advantages of Public-Private Partnership agreements include: lower financing costs (although governments can often borrow at lower rates); ability to finance large projects in a shorter time frame; ability to link design with operational concerns; and the set up of user charges with potentially less political backlash. Also, the development of Public-Private partnerships can foster the development of an industry which can then be potentially exported to other countries.

Some disadvantages may include the possibility of the private consortium going bankrupt, the difficulty for governments to return on their decisions, the need for public debate on the Public-Private Partnership mandate, the perception, right or wrong, that the private sector will earn profits on the back of the taxpayers, and the difficulty for the private consortium to take the risk on what can be a very lengthy environmental approval process.

The concept of Public-Private partnerships has been gaining momentum in Canada. In 1993, Ontario set up the Ontario transportation Capital Corporation and the B.C. government established the Transportation

Financing Authority (although the Authority has yet to endorse the concept of Public-Private partnerships). The financing of the Northumberland Strait Crossing partnership was completed successfully. Also in 1993, the Federal Government cancelled the partnership to redevelop Terminals 1 and 2 of Lester B. Pearson International Airport. Governments are considering Public-Partnership options for a number of projects in Canada including the upgrading of the Lion's Gate Bridge across the Burrard Inlet in Vancouver.

For a Public-Private partnership to work well, the public must be educated as to the benefits and costs associated with the arrangement. The government needs to explain the economic rationale for going that route. The government must also set out guidelines to protect the public's interest and ensure that the profits to be earned by the private investors are not unreasonable.

Introduction

Public-Private partnerships are being branded as the new way for governments to finance public infrastructure. There are many Public-Private partnership options with some of the more commons including Build-Own-Operate, Build-Operate-Transfer, Build-Operate-Own-Transfer, Buy-Build-Operate and Lease-Develop-Operate. Which option is best for a particular project depends on the project characteristics.

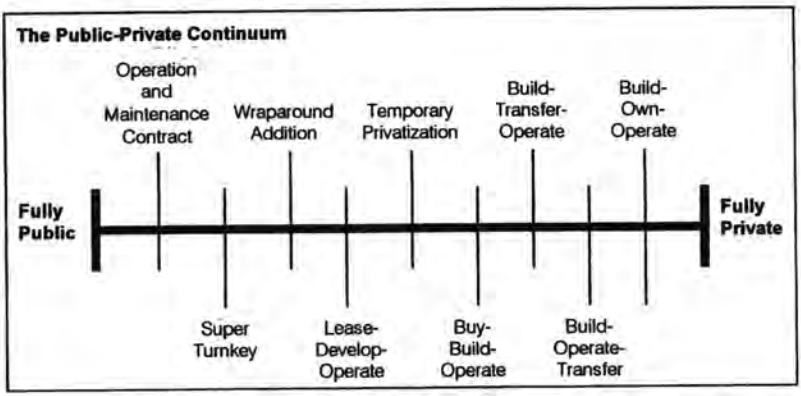
What it means and what is at stake

Public-private partnerships are cooperative ventures between government and private entities to develop or improve public purpose infrastructure. For each venture, the structure will depend on which partner opts to share the following responsibilities:

- project initiation and planning;
- design;
- financing;
- construction
- ownership
- operation; and
- revenue collection

Under a fully publicly funded and operated project, the public sector holds all responsibilities and shares all risks. Similarly, the private sector holds all risks and responsibilities in a private sector project.

Public-private partnerships are anything in between and the various options are presented in the chart below:



Note: For further details on the definition of each option, see Appendix A.

Source: A Guide to Public-Private Partnerships in Infrastructure, Bridging the Gap Between Infrastructure Needs and Public Resources, 1994 Edition, Prepared by Price Waterhouse.

Some of the key advantages from these agreements may include:

- lower financing costs (although governments can often borrow at a lower rate);
- ability to finance large infrastructure projects in a short time frame, thereby creating more wealth earlier through the economic spin-offs and tax revenues;
- ability to link the design of a project with the operational concerns;
- earlier adoption of technological innovations like electronic tolling for projects operated and designed by the private rather than the public sector;
- the ability to increase/set user charges with limited public backlash;
- the development of Canadian companies with experience in building and operating infrastructure projects, experience which can then be exported to other countries; and
- the set-up of user charges which may better address demand management issues and reduce needs for infrastructure development.

There are however, some pitfalls which one must guard against. These may include:

- possibility of the private consortium going bankrupt, leaving the public sector with the problem of completing the project;
- cost of changing one's mind; these agreements require the government's commitment that the project will proceed as planned especially once contracts have been signed;
- difficulty for the private sector to take the risk on the environmental front, and the many approvals that may be required;
- requirement for an open process for selecting bidders; and
- perception, right or wrong, that the private sector can earn large profits at the expense of taxpayers.

What is happening in Canada in terms of public-private partnerships

The year 1993 saw a number of major developments relating to Public-Partnerships in Canada. These include:

- The Northumberland Strait Crossing partnership (the PEI Fixed Link project) successfully obtained financing of almost $700 million.

- The Ontario government created four new capital corporations to facilitate infrastructure financing, including facilitation of public-private partnerships. By year's end, one of these corporations, the Ontario Transportation Capital Corporation was evaluating bids for a public-private partnership to finance and build Highway 407, a $1 billion project. During 1993, the Government of British Columbia created a Transportation Financing Authority, also to facilitate financing of infrastructure such as the Lion's Gate Crossing and the Vancouver Island Highway.

- A number of Canadian public and private sector organizations created the Canadian Council for Public-Private Partnerships, a nonpartisan, nonprofit organization dedicated to the application of innovative approaches to the financing and delivery of public services and projects.

- The partnership to redevelop Terminals 1 and 2 of Lester B. Pearson International Airport was cancelled by the new federal government, highlighting the need for openness and public consultation in all aspects of public-private partnership transactions. In the case of the Pearson terminals, too much was done behind closed doors. The government never explained to the public the need for the terminals and the contracting strategy. The process for selecting the successful bidder, while rigorous, was also not adequately exposed to the public.

The cancelling of Terminals 1 and 2 contrasts with the successful construction of Terminal 3 in 1991. This finance-build-transfer-leaseback arrangement for development of a new 29 gate terminal with parking and hotel is well known to all Canadians. The construction costs were around $700 million and all parties agree that Terminal 3 is a good example of a successful Public-Private partnership. The project was built in 33 months (not seven years as was initially planned by Transport Canada) and 29 gates were built (instead of the original plan of 17).

What is Happening Outside Canada

Public-Private partnerships in highway and transportation infrastructure are being used all around the world. Public Works Financing, a trade journal on the issue of Public-private partnerships, estimates that there are about 300 transportation projects involving public-private partnerships around the world. Together these represent an aggregated construction value of almost $200 billion. Of these, about 75 projects worth about US$40 billion have been funded in the past decade, including the Channel Tunnel project of about US$15 billion. The following describes some of these projects:

- The private sector, in cooperation with the public sector are building and financing four toll road projects in California. In 1993, two of these projects, State Route 91 Express Lane (the SR91 project) and the San Joaquin Hills Transportation Corridor obtained their financing:

  - The SR91 project will be a ten mile long private and fully automated toll road - the four lanes are in the middle of a highly congested highway. The private operator will build and operate the road at a cost of about US$ 125 million and it will operate it for 35 years. The State of California will not regulate

the prices of the tolls but it has set a maximum rate of return on total capital employed.

- The San Joaquin Hills Transportation Corridor is a $1.4 billion dollar project for the operation of a new six lane, divided, 15 mile road in Orange County, California.

Members of the conglomerate involved in the projects include: Peter Kiewit Son's Inc., Cofiroute Corp. a subsidiary of a large French toll builder company, and Granite Construction.

- The Dulles Toll Road extension in Virginia is another recent U.S. example of Public-Private partnerships. This project represents construction costs of about US$ 330 million. The project consists of a 40 year franchise to build-own-operate a 14.7 mile, four lane private extension of the existing state-owned Dulles tollroad.

- Build-operate-Transfer Projects have also been built and are being proposed in Australia, notably around Sydney.

- Major public-Private partnerships underway in Europe include the Lyon Northern Ring Road in France, the Marseilles Road Tunnel also in France and various toll motorways and tunnels in the U.K. and Germany.

- In Mexico, the private sector is building a toll motorway linking Mexico City and Guadalajara (200 mile road, project cost of US$ 1.2 billion). At least ten other toll road projects have been completed or are under development.

- Other countries which have initiated other projects involving public-private partnerships include: Hong Kong (including various toll tunnels), Indonesia and Malaysia.

The Lion's Gate Project - a Case Study

The Lion's Gate Bridge across the Burrard Inlet in Vancouver will require significant maintenance by 1998. By that time, the entire deck will likely require replacement, perhaps in the form of a new, wider deck, or the bridge itself might be replaced with a new link.

There are many issues particular to this project including the environmental issues relating to going through Stanley Park, the fact that Lion's Gate is a City Landmark, consideration for High Occupancy

Vehicles, and the need to have crossings and approaches which are compatible with the existing traffic systems on the north and south shores.

Nine options for the new Link have been identified so far, addressing three variables:

- the type of crossing (bridge or tunnel);
- the width (number of lanes); and
- the location of the crossing (existing site or one of at least two alternative sites that would remove the access from Stanley Park).

The costs of these options range from about $100 million (rebuilding the existing bridge) to about $1 billion (a new mid-harbour crossing away from Stanley Park).

A key question being addressed by the provincial government is: "How should the Link be financed?". Basically, there are three alternatives:

1. The government finances the Link through the Consolidated Revenue Fund (CRF).

2. The government finances the Link through the recently-formed British Columbia Transportation Financing Authority (TFA) and structures the financing as project financing, with limited or no recourse to the CRF.

3. A private developer finances the Link.

Any of these alternatives could include using tolls to raise revenue for the project, or continuing to allow "free" use of the Link.

The relative merits of each alternative are briefly described below:

CRF Financing: This is the traditional approach taken by governments - financing projects through tax revenues and general obligation bonds. The cost of financing the Link through the CRF would appear to be lower than the other options, particularly for a province such as B.C. with a very strong credit rating. However, under CRF financing, the government will retain the bulk of the project risks including traffic and construction risks.

Project Financing by the Government: This form of financing the Link could be more expensive than the CRF approach because the financier would insist on an increased return to compensate for the risk being assumed, since he or she would be fully dependent on the project cash flows and would not have a recourse to the CRF. The purchase of bonds would assume many of the project risks associated with the Link, particularly traffic risk.

Project Financing by a Private Developer: Under this approach, a private developer would finance, design, build and operate the new Link, probably through a "Build-Operate-Transfer" structure. The developer would recover its investment through the Link's revenue stream over a long-term lease period, probably 25 to 50 years, and the Link would be transferred to the government for a nominal amount at the end of the lease period. This form of financing would appear to be more expensive than CRF financing because most or all project risks would be passed on to the developer. The financing cost. "spread" over that of government bonds, would probably be anywhere from 100 to 300 basis points, depending on the specific risks being assumed by the developer.

The key point when reviewing financing options is to understand that there is no "free lunch" for the taxpayer. If CRF financing is used, the taxpayer assumes most of the project risks, whereas if either of the other two approaches is used, the financing cost might be higher, but significant risks are passed to the private sector - either the purchasers of bonds, a developer or both. Either of these approaches is a "public-private partnership" in that the public and private sectors both share the risks.

The option of private developer financing however, could yield benefits outside strictly financing costs. These may include: building the bridge quicker thereby generating tax and potentially toll revenues sooner, developing Canadian expertise in building and operating major infrastructure facilities, and the ability to set user fees with limited backlash (although private sector involvement may not include tolls).

Conclusions

Public-Private partnerships are here to stay. However, there are many options that are available and the specific option that makes sense will depend on the project characteristic. No matter what option is chosen, there needs to be attention put on the public process so that the

experience of Pearsons Terminal 1 and 2 does not get repeated. Part of the process must include educating the public on the economic rationale for the Public-Private approach, i.e. that the project just could not be publicly funded. Governments must also explain to the public how they plan on protecting essential public interests and prevent the private sector to earn unreasonable profits from any Public-Private ventures.

Appendix A - Structuring the Public-Private Partnerships

The structural options available to public-private relationships encompass the full spectrum from fully public to fully private. Organized in order of increasing private involvement and risk-bearing, the options include:

- **Operation and Maintenance Contract**. A private partner operates a publicly-owned facility under contract with the sponsoring government. Private operation of a facility can result in improved service and efficiency.

- **Super-Turnkey Development**. A private partner designs and constructs a facility to meet performance objectives defined by the public sector. Upon completion, the private sector is reimbursed by the public sector for construction and begins operating the facility under contract. Super-turnkey development may place some financial risk on the private sector, but private-sector investment is generally limited. This model can be used where the public sector maintains a strong interest in ownership of the facility, but seeks to benefit from private construction and operation.

- **Wraparound Addition**. A private developer finances and constructs an addition at an existing public facility. The private developer operates both the existing facility and the addition for either a specified period of time, or until the developer recovers the investment plus a reasonable return. The SR91 Project in California, in which private toll lanes are being added to a congested freeway, is similar to the Wraparound Addition model.

- **Lease-Develop-Operate (LDO)**. A private developer is given a long-term lease to operate and expand an existing facility. The private developer agrees to invest in facility improvements, and can recover the investment plus a reasonable return over the term of the lease. Public ownership avoids potential legal problems associated with private ownership of a publicly-financed facility.

- **Temporary Privatization**. An existing public facility is transferred to a private partner that renovates or expands the facility. The private developer then owns and operates the facility for either a specified period of time, or until the developer recovers the investment plus a reasonable return. This model can be useful when public resources are constrained and existing public facilities,

such as deteriorating bridges, require extensive renovation or expansion.

- **Buy-Build-Operate (BBO).** An existing public facility is transferred to a private partner that renovates or expands the facility, and then owns and operates the facility in perpetuity. The BBO model is similar to temporary privatization, but provides for permanent private ownership.

- **Build-Transfer-Operate (BTO).** A private developer finances and builds a facility and, upon completion, transfers legal ownership to the sponsoring government agency. The government then leases the facility back to the private developer under a long-term lease, during which the developer operates the facility and has the opportunity to recover its investment and a reasonable return through user fees and commercial enterprises. This arrangement is similar to the build-operate-transfer model described on the following page, but can avoid some of the legal, regulatory, and tort liability issues that can arise from private ownership of transportation infrastructure.

- **Build-Operate-Transfer (BOT).** A private developer receives a franchise to finance, build, operate, and collect user fees on a facility for a specified period of time, after which ownership of the facility is transferred to the public sector. This structure is serving as the model for Pearson Airport and the fixed link to Prince Edward Island.

- **Build-Own-Operate (BOO).** A private developer finances, builds, owns, and operates a facility in perpetuity. The developer may be subject to regulatory constraints on operations and, in some cases, pricing. The long-term right to operate the facility provides the developer with significant financial incentive for capital investment in the facility. BAA (formerly the British Airports Authority) owns and operates Heathrow Airport under this arrangement.

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Geographical, Organisational and Social Implications of Teleworking

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1.0 LITERATURE REVIEW

1.1 Definition of teleworking (TW)

The term telecommuting was originally defined as the ability of people to "perform their work using communication and computer technologies, at locations much closer to their home than is the case now" (Nilles *et al.*, 1976:4). This definition was interpreted by much of the media to imply working solely at home, somewhat similar to Toffler's (1980) idea of an 'electronic cottage'. The concept of telecommuting has recently been extended to mean any form of work which uses information technology to communicate and/or transmit completed work back to a central place. It can include a lap-top computer whilst travelling or even holding meetings with the use of videoconferencing techniques. (A more appropriate term for this activity would however be the more general term of teleworking (TW) which includes work based from satellite centres). TW within the context of this research is defined as work which occurs at home or at a satellite centre, where that person normally maintains contact with their employing organisation through the use of telecommunications equipment.

1.2 The Impetus for Teleworking

Technology

The introduction of telecommunications into society has greatly reduced the problems of distance and has enabled firms to become locationally footloose. Gordon (1986) and Rathbone (1992) remark on how the improved technology has played an enabling role in the decentralisation of office employment and in the rise of teleworking (TW) in particular. Personal computers became available in the late 1970s and early 1980s and, along with improved quality of hardware (including fax, modem and multi-channel phone lines), encouraged the growth of work at home schemes (PC Magazine, 1994).

Organisation

Reduced amount of profits, increasing inflation and increased global competition stimulated organisations to seek other ways to increase their profits and/or reduce costs. A main way of reducing employment costs is therefore the use of temporary workers, sub-contractors, part-time work and in recent times the use of TW techniques. This source of labour is more flexible not only in its contractual terms (where they can be hired for specific periods of time to accommodate increased demand), but also in financial terms where the organisation is not obliged to provide the same job security, benefits or wages as permanently salaried employees (Atkinson, 1985). Organisations are also faced with increased demands from employees and customers to offer a more flexible service and work arrangements - TW provides an opportunity to comply with these desires.

Society

Accompanied by the move towards flexible economic activity, has been a considerable change in society. Reduced socio-cultural and institutional barriers have enabled women to achieve greater access to the labour market (Huws, 1991; Christensen, 1987). This is of significance since a dual-income family has become an economic necessity to keep pace with rising living standards (Ramsower, 1985). Family structure has been further modified by the rising occurrence of divorce and separation to produce large numbers of single parent families and financial circumstances have pressured the lone parent to seek employment opportunities. Small businesses also contribute to the growth of home-based work, and again it is the remarkable growth of female entrepreneurs which is a driving force in this area (Christensen, 1987).

1.3 Organisational Implications of Teleworking

Benefits for the Organisation

From the organisational perspective, a number of benefits can arise from enabling employees to TW. These include improved recruiting abilities and retention of key personnel who might otherwise have to be excluded from the labour force due to physical disabilities or family commitments. Teleworkers (TWs) often exhibit an increased productivity level of between 10 and 20%, and this is a critical issue for organisations in the current environment of intense competition. Organisations can achieve reduced real estate by having two TWs share the same office space, but scheduling their attendance in the office with the other's teleworking days. Gordon (1985) notes that a firm can achieve 20% savings in office space from using TWs in this way. Labour cost reduction can be achieved by using labour in lower cost locations, such as the Caribbean or Hong Kong, and also by designating their telecommuters as independent contractors, thus moving the burdens of pension, social security benefits and no sick leave pay onto the shoulders of the individual. This activity however has attracted confrontation with labour unions.

Costs for the Organisation

Costs for the organisation remain mainly at the level of perceived difficulties attributed to managing 'absent' employees. Some managers have expressed the fear that they may lose control over their subordinates by no longer having visual contact. Supervisors are required to alter their managerial approach from one of 'visual' checks on the individual to one of management by results. A manager's salary has been thought to be linked to the amount of decision-making responsibilities that they have, the amount of workers supervised, and some perceive that wages are correlated with the amount of physical space that their department takes up in the office. Where a supervisor no longer has a certain number of subordinates present in the office, some may feel that their status has diminished and that their promotional prospects may be jeopardised. Corporate culture is seen as being more easily transferred when the person is within the building and participating in informal gatherings (Olson, 1988). Thus, TW is seen as diminishing the strength of loyalty that an employee may have for the organisation (Holcomb, 1991).

1.4 Social Implications of Teleworking

Benefits for the teleworker

Benefits for the individual focus on improved flexibility of their work and home life, and reduced work-related expenses. TWs are given more autonomy over the scheduling of their work and this provides freedom to carry out personal appointments, domestic duties, parenting responsibilities and so forth at more convenient times during the day. Many employees actually work during the night or early hours of the morning (Huws, 1991) and therefore tend to have quicker access to the company computer. Working in a relatively distraction free environment often means that workers suffer less stress than their office counterparts, and are often more productive as a consequence (Qvortrup, 1992). Whether working directly from home or working at satellite centres, workers can take advantage of the reduced transportation times and lower fuel costs. TWs also do not have to rise earlier than necessary, to dress and to face the long commute to work, which can be considered as wasted time (Holcomb, 1991; Bacon, 1989). The purchase of electronic equipment for the home, or even the designation of the home as a small business, can offer tax deduction benefits for many people (Holcomb, 1991). Traditional work schedules of 9 to 5 work, often leaving a person very tired, have led to insufficient time spent with the family. Flexitime, part-time work and job-sharing enable the parent (normally the female) to have the satisfaction of having adult company, being intellectually stimulated and being a source of income in the family, whilst still being able to participate with their children. TW is viewed by Zedeck and Mosier (1990) as an important element of developing a stable family background.

Costs for the Teleworker

The most frequently cited disadvantage of TW is the feeling of isolation from society that can result from remaining at home, and thus having little professional or social contacts (Qvortrup, 1992; Filipczak, 1992). Coupled with the lack of professional contacts is the feeling that promotional prospects are reduced for telecommuters, because they are not physically visible (Holcomb, 1991). Telecommuters feel that because their home is also their workplace, the two spheres of life merge, so that they begin to feel that they are neither 'at work' nor 'at home'. Attempts to provide a solution to these feelings include the introduction of satellite centres and the strong support for part-time telecommuters, who still are required to come to the office about twice weekly. Feminist observers consider that TW is the 'chaining' of women to the computer terminal, and there is no difference than the historical sweatshops of the textile industry. This stems from the dominance of women in clerical work (97%), and this category is subject to the routine and monotonous side of TW (Holcomb, 1991; Huws, 1991). Much of this work is often piece work, i.e. paid by the amount produced, in which workers have little control over the rates paid, or the amount of work received. For the parent (often the female in the partnership), being at home can be extremely stressful when trying to care for young children and trying to work (Filipczak, 1992; Holcomb, 1991). TW should therefore not be viewed as a substitute for day care, because often telecommuters have the same day-care costs as workers at a central office (Filipczak, 1992). When individuals initially start to work from home, they are often unused to the absence of the nine to five regime, and often 'burn-out' from working long into the small hours (Holcomb, 1991). Many suffer from fatigue, and do not attribute this to the lengthy hours of work.

1.5 Geographical Implications of Telecommunications

Changing Urban Morphology and Function

The use of alternate work sites, whether at home, at a neighbourhood centre or satellite office, not only further modifies the geography of employment opportunities, but also has repercussions for the morphology and function of the city. The current impact of improved telecommunications, represents a serious challenge to the 'traditional' urban form of a central business district offering employment opportunities and social facilities at a nodal point for the surrounding labour market (Bourne, 1989).

Implications for Transportation

The implications of a multi-nucleated city and the use of the home as the prime workplace are significant issues for those concerned with the provision of utility infrastructure, urban planners, architects and transportation analysts. The market for utilities, transportation and services for employees during their journey to and from work and during lunch hours, would no longer be focused on the central

city. In a society 'networked by telecommunications', there would be demand for such facilities in suburban centres, requiring possibly new or improved fibre optic cables to facilitate information transfer for example, or widening of highways and provision of parking spaces (Moss, 1987).

An analysis of the impact of TW on transportation demand was performed by Pendyala *et al.*, (1991). Their research concluded that in addition to a savings of 40 miles per day, TWs avoided peak times in which to carry out other errands, and also used minor roads to reach local areas. Thus TWs tended to make trips which involved less freeway use but increased use of non-primary routes. Other studies by Kitamura *et al.*, (1990) and Mokhtarian (1988) support these travel reduction estimates.

Government intervention could be extremely influential in directing the growth of TW projects if they gave tax relief for firms who advocated TW, or even subsidies for those who located satellite centres in economically depressed areas (Gordon, 1988). There are numerous environmental laws concerning air quality, e.g. the Clean Air Act of 1990, and the Intermodal Surface Transportation Efficiency Act of 1991 (ISTEA), which indirectly or directly encourage the adoption of TW. For example, the State of Washington passed legislation providing a 20% bonus to organisations for using TW to reduce trips (U.S. Department of Transportation, 1993).

2.0 METHODOLOGY

This paper provides a statistical analysis of data which were collected in a pilot study of people in North America involved in TW, either at home or based at a 'satellite' office. Previous studies have suffered from a number of limitations which this research aims to overcome. Many studies have been company specific and thus the data obtained are proprietary in character. Other studies have been restricted by gender, occupation or even examining the change that TWs have experienced with no reference to a baseline of workers at the conventional office. This research provides data from TWs, co-workers and supervisors in organisations in Canada and the United States

2.1 Objectives of the Research

Objectives of the major research project include:

1. Analyse whether teleworkers and co-workers differ in their responses to attitudinal variables, and in socio-demographic characteristics and whether these are statistically significant.
2. Analyse whether groups internal to the sample of teleworkers and co-workers differ. These subgroups include:

a. employment status, i.e. employee, independent contractor, business owner.
b. telecommuting status, i.e. whether from home or at a satellite centre.
c. Permanency status, i.e. part-time or full-time worker.
d. Hours of telecommuting per week.

e. gender f. age g. education
3. From the above, determine the variables which distinguish the groups. This will determine whether the 2 metatheories of teleworkers is supported (see Gerson and Kraut, 1988).
4. Determine the geographical implications of TW, including whether transportation problems are significant influences on a person's decision to TW. If so, what is the impact in terms of reduced distance and time, and how will the use of the car be affected. From this analysis, an interpretation of the potential for the transportation system will be suggested.
5. Identify the strengths and weaknesses of TW from the perspective of the organisation, the teleworkers and their counterparts.

2.2 Research methods

These objectives were achieved through the use of questionnaire surveys with TWs, co-workers, managers and representatives of the organisation responsible for supervising the TW project. A total of 76 TWs, 60 co-workers and 40 managers have been involved in this study, of which 30 people have participated in a diary of 7 days in order to obtain more qualitative evidence of the change in work and home life between TWs and traditional office workers. This comprehensive study is currently underway, and the results shall be presented at the 1994 conference

The preliminary results provided in this paper represent data obtained from a pilot test of the questionnaire related to telecommuters. This pilot study was carried out in late January and early February of 1994. Obviously, the results of the pilot study do not accurately reflect the condition of telecommuters, and provide a poor basis of change as there are no comparative results obtained from co-workers. However, they provide some indication of reasons why people TW, potential problems facing the organisation, and implications for the transportation system.
The pilot study suffers from several limitations:
1. The sample size of 15 individuals is too small to provide statistical significance for the tests used in this project, and also too small to represent confidently typical TW situations.
2. Many of the participants were Calgarians, identified in the media, whilst some were obtained by a 'snowballing' technique, i.e. once one telecommuter was identified, he/she was asked whether they could provide the names of other telecommuters.
3. The sample exhibits a strong gender bias in favour of women (10 women to 5 men), and therefore may over-represent the experience of females.

Thus, this paper presents a preliminary description of a pilot study pertaining to teleworkers. Of 68 questionnaires that were distributed between September 1993 and January 1994, only 15 were returned. This poor response rate reflects a number of problems in deriving an adequate sample of teleworkers. First, there is no official 'directory' of teleworkers. Second, many of the organisations which are reported in

the media have exemplary programs which have been frequently surveyed - they do not want to over survey their employees or participate in research to which they have no benefit.

The low figures participating in the pilot study reflect the problem encountered in using one organisation to pre-test all the questionnaire structures to be used, i.e. managers, teleworkers and co-workers. Many of the people in this organisation, were not officially TW, but simply took work home at night or over the weekend to complete there instead of staying to do overtime at the office. Some participants found many of the questions to be inapplicable and thus alternative sources were used in January. These were obtained from organisations which had only one or two participants. and also The Calgary Herald reported several people who TW in the Calgary region and these were contacted to test the questionnaire for ambiguities. The decision not to involve the main participants in the pilot study was based on the desire not to 'tire' them of completing a lengthy survey twice. Above all, I did not want to over-survey the participants and reduce the chance of obtaining accurate answers.

3.0 RESULTS

The descriptive results from the pilot study have been subdivided into 4 sections. These include first, a demographic and employment characteristic analysis, and second a study of TW characteristics. A third section involves some of the social implications of TW and the level of support that a teleworker receives. Geographical implications constitute the fourth and concluding section.

3.1 Demographic/Employment Characteristics

The mean length of employment for the 15 individuals with their respective organisations is 81 months, while the mean length of TW experience is 23.3 months. Only 1 individual had any TW experience prior to their present arrangements, and had teleworked for 18 months. Of the 15 participants in the pilot study, 11 were employees, 2 were independent contractors and 2 people were responsible for running their own business. All of the 15 telecommuted from home. Nine individuals worked on a full-time basis, with 6 working part-time. Most telecommuting appears to be done on a part-time basis with 11 individuals working less than 20 hours (Figure 1). Only 2 people work more than 40 hours, considered to be 'full-time telecommuters'.

Figure 1 Hours spent teleworking

Value Label	Frequency	Percentage
Under 10 hours	6	40.0
10-19 hours	5	33.3
20-29 hours	2	13.3
30-39 hours	0	0.0
More than 40 Hours	2	13.3
Total	15	100.00

All respondents still have face-to-face meetings with their immediate superior, but for full-time teleworkers in particular these are infrequent (Figure 2). This figure shows that the most common frequency for face-to-face meetings is once a week or infrequently (other category). The purpose of the meetings are typically to go over progress, catch up on business and receive new projects.

Figure 2 Frequency of Face-to-face Meetings

Value Label	Frequency	Percentage
Daily	2	13.3
2-3 Times A Week	3	20.0
Once a Week	4	26.7
Monthly	2	13.3
Other-infrequently	4	26.7
Total	15	100.00

For 13 of the 15 respondents, face-to-face meetings are supplemented by electronic media when they TW. Technology used for meetings is fairly standard and simple equipment, for example 66.7% of teleworkers have meetings using the phone at least 2-3 times a week, electronic mail is used by 72.7% of people at least 2-3 times a week. Audio conferencing and bulletin boards are used only by a few participants (Figure 3). The technologies of computer conferencing, video-conferencing and videophone were not used by any of the respondents

Figure 3 Technology Used for Electronic Meetings

Value Label	Phone	Audio-conferencing	E-Mail	Bulletin Boards
Daily	3		4	1
2-3 Times A Week	5		4	
Once a Week	2		1	
Every two weeks	1	4	1	
Monthly	1		1	
Total	15	4	11	1

Despite working at home from an average of 10-19 hours per week, 40% of respondents still go into the office at least 4 times a week, whilst 20% do not go into the office at all during the week or go there infrequently. The purpose of these visits is typically to attend regularly scheduled meetings (66%) and to receive work instructions (40%). Visits to the central office are typically not for the purpose of sharing a job position (only 13% or 2 people job-share), to fulfil a designated number of hours or to carry out social visits (20% or 3 people).

Participants in this research are, as expected, heavily involved in the manipulation and processing of information. Job tasks range from word processing, a communications expert through to senior scientist, lawyers and product designer.

Almost all (13 of 15) of the respondents are between the ages of 30 and 40, possibly reflecting the criteria of experience required or that many are at the stage where they have a young family. There is a gender bias in the sample as 10 of the respondents are female. Eleven respondents were married or had a common law spouse, with 9 people having children under the age of 16. It appears that most children are looked after either at an educational establishment, e.g. kindergarten or day-care. One individual actually has a nanny at the home to look after the children when she is working (both at home and at the office). Child care costs have correspondingly increased for this person, otherwise costs have shown no change. Only rarely (1 person) are the children cared for by the teleworker themselves.

Teleworkers typically have some form of undergraduate or post graduate education. Seventy three percent have attained a Masters degree or higher level of education. This is reflected in the modal gross income of between $50-59,999. Typical gross family income is between $100-109,999, with an average of 2 wage earners per family, supporting a family size of 3.1 persons. Most individuals are salaried but some, such as independent contractors and business owners receive hourly or piece rates reflecting the differing contractual status.

3.2 Teleworking Program Characteristics

The decision to TW was the responsibility of the individual for 8 of the respondents and a combination between personal and organisational decision for the remaining 7 people. The dominant reasons stimulating the decision to TW were time with the family (40% of respondents), to achieve greater flexibility (40%) and reduce distractions (33.3%). Other reasons included to reduce commuting times (20%), the arrival of a baby (2 people) whilst one person was physically challenged and found it easier to work from home, with another person choosing to work from home to care for a dependent person (Figure 4). From the organisational perspective, reasons for implementing TW were seen as a cost cutting measure (6.7% of responses) and an experiment to decentralise (20%). Others wanted to be more receptive to the demands from their employees for more flexibility (20%).

Sources of equipment were mainly provided from equipment already located in the office (50%) though in some cases new equipment was provided (46.7%). Others provided additional phone lines for the person's home, and many teleworkers supplemented this with their own equipment (46.7%). With regards to payments of costs incurred from TW, 60% of employees typically take the burden of payments, but the organisation contributed to the remaining participants. The organisation however takes more responsibility for repair of the equipment used at home (79% of respondents stated that the organisation either paid the majority of the repair costs of shared the costs equally with their employees).

Figure 4 Personal Reasons for choosing to telework

Reason	Frequency	% Responses	% of Cases
Time with the family	6	22.2	40.0
Improve Flexibility	6	22.2	40.0
Reduce Distractions/stress	5	18.5	33.3
Reduce Commute	3	11.1	20.0
Arrival of baby	2	7.4	13.3
Physically challenged	1	3.7	6.7
Look after person at home	1	3.7	6.7
Other	3	11.1	20.0
Total	27	100.0	180.0

Problems of difficult technology, having to purchase equipment, limited emotional support from the organisation or family were found to be minor or no problems accompanying their TW experience for between 60-80% of respondents (See Figure 5). All felt that TW did not conflict with domestic duties, and that their partner (where applicable) provided support for the teleworker. Equipment was also found to be sufficient for their needs and did not become obsolete for their tasks.

Figure 5 Disadvantages of Teleworking

Reason	Significant Problem	Minor Problem	No Problem
Difficult technology		2 (14.3%)	12 (85.7%)
Have to buy equipment		5 (33.3%)	10 (66.7%)
Social Isolation	1 (6.7%)	7 (46.7%)	7 (46.7%)
Lack professional contacts	1 (6.7%)	9 (60.0%)	5 (33.3%)
Lack managerial support	1 (6.7%)	3 (20.0%)	11 (73.3%)
lack emotional support(from organisation)		1 (6.7%)	14 (93.3%)
lack emotional support (family)		1 (6.7%)	13 (92.9%)
low pay for routine work		2 (14.3%)	12 (85.7%)
Limited to certain tasks	1(6.7%)	2 (13.3%)	12 (80.0%)
Promotion inhibited	1(6.7%)	6 (40.0%)	8 (53.3%)
Interferes with domestic duties		6 (40.0%)	9 (60.0%)
Partner dislikes teleworking		2 (13.3%)	13 (86.7%)
Teleworking is stressful	1 (6.7%)	2 (13.3%)	12 (80%)
Children interfere	2 (13.3%)	3 (21.4%)	8 (57.1%)
Face-to-face contacts required	5 (33.3%)	5 (33.3%)	5 (33.3%)
Equipment is obsolete		2 (13.3%)	13 (86.7%)
Total	13	58	164

N.B. Percentages are based on valid respondents. Some questions have missing values

More significant problems can be grouped into two topics - those pertaining to personal/social disadvantages and those on an organisational level. For the individual, social isolation was seen as a significant problem for one individual and a minor problem for 7 persons. The problem of children interfering with their work at home, is a significant limitation for 2 respondents. At the organisational level, the lack of professional contacts that resulted from TW was seen as a significant or minor problem for 66.7% of the respondents. Twenty six percent of the teleworkers also felt that the lack of managerial support from their supervisors was also a

problem. Three persons considered that TW resulted in them being limited to certain task as home but the remaining 80% found that this was not a limitation. TW was also seen as a significant problem to promotion, and could be stressful by only one respondent. The most significant problems of TW is that despite the use of telecommunication technology for conversation, it could not replace face-to-face contacts that were required for 33% of the respondents to carry out their work. It is suggested that perhaps the introduction of videophones might overcome this limitation.

Stimulants to the adoption of TW include a desire to reduce distractions, increase flexibility, reduce the amount of commuting and also to look after someone at home. Benefits of TW are seen strongly in the form of increased autonomy over work scheduling and time management (by at least 80% of respondents -see Figure 6). All the respondents stated that they enjoy the isolation to work which TW provides. Most also found that they have flexibility to carry out personal errands (86.7% agree that this is a benefit of TW). Most respondents (66%) felt that TW enabled them time to carry out domestic duties, but 3 respondents disagreed that this was a benefit of TW. For most of the participants, owning equipment used for TW was not applicable but for those who expressed an opinion as many people agreed as did disagree that this was a benefit (20%).

Figure 6 Advantages of Teleworking

Reason	Strongly agree	Agree	Not applicable	Disagree	Strongly Disagree
Increased autonomy over time	11 (73.3%)	2 (13.3%)	2 (13.3%)		
Increased autonomy over work	8 (53.3%)	4 (26.7%)	3 (20.0%)		
Enjoy Isolation to work	9 (60.0%)	6 (40.0%)			
Flexitime for Personal errands	6 (40%)	7 (46.7%)	2 (13.3%)		
Allows time for domestic duties	2 (13.3%)	8 (53.3%)	2 (13.3%)	2 (13.3%)	1 (6.7%)
Tax benefits for equipment		3 (20%)	9 (60%)	1 (6.7%)	2 (13.3%)
Tax benefits for establishing own business		4 (26.7%)	9 (60.0%)	2 (13.3%)	
Reduced commuting time	5 (33.3%)	6 (40%)	4(26.7%)		
Financial savings	4 (28.6%)	3 (21.4%)	4 (28.6%)	3 (21.4%)	
Increased computer availability	3 (20%)	2 (13.3%)	5 (33.3%)	2 (13.3%)	3 (20%)
Increased computer response	1(6.7%)	1 (6.7%)	7 (46.7%)	4 (26.7%)	2 (13.3%)

N.B. Percentages are based on valid respondents. Some questions have missing values

Eleven of the TW (73.3%) agreed that reduced commuting times were a benefit of TW, but 4 felt that this issue was inapplicable as they go into the office frequently. 50% felt that they were able to achieve financial savings by working at home, with 20% disagreeing that this was an advantage - apparently expenditures are the same as when they work at the office. Perhaps this is because of the frequency with which they attend office meetings. Average savings were calculated and teleworkers estimate that they save $13 on gas, and a further $8 on transportation related expenses. (For one person, costs increased as they had moved 600 kms away from their workplace). TW also estimate that they save $10 on clothes, $12.33 for food and dry cleaning expenses of $2 per week. TW also benefit from time savings including a reduced commute time of 2 hours 25 minutes per week, and obtain an average of 5.3 hours with their family.

Since the 15 participants had been TW, 4 had been promoted and only one person of the sample thought that their promotion prospects had been hindered by working at home. It appears that TW has not affected the 'visibility' of the individuals, or that managerial style is based on results oriented supervision. Two persons considered that their gender had influenced their promotional chances, one of whom was male whose organisation had a policy of positive discrimination in favour of women.

Despite any apparent problems of isolation, or the need for face-to-face contacts, the decision to continue to TW was unanimous, but this was preferred on a part-time basis. Apparently people still want to come into the office and meet with their fellow workers. Reasons for continuing to TW are mainly that TW suits many people's lifestyle requirements, enabling them flexibility to carry out no-work related tasks and leisure pursuits. Eighty percent of people preferred to continue their 'mixed' arrangement of work at home part-time and at the office, but 3 persons expressed a desire to work at a satellite office which would be located closer to their home, thus reducing commuting times and the associated stress.

3.3 Social/Individual

A key argument against full-time TW is the problem of social isolation. Not only is contact seen as important for personal development and inter-personal contacts, but also for career advancement through professional contacts. For 80% of the respondents, social contacts had been maintained throughout their TW experience. However, frequency of contact had decreased for 47% of TW. Only 2 respondents felt that the reduced number of contacts was a disadvantage and that they were isolated by working at home, none felt that they wanted to discontinue their working at home arrangements because of this.

It has been suggested that the perceived success of an individual TW is reflected in their attitudes towards family and support received from them, their career aspirations and also equality between the sexes. All valid respondents (i.e. those who completed this section on attitudinal characteristics) agreed that they share family income equally, but some are neutral or disagree regarding the sharing of

household chores (35%). All valid respondents supported the notion of gender equality on the topics of access to education, employment, wage and promotional prospects. Most also stated that they believed in career advancement, but 20% were neutral or disagreed on this issue. Family life was important for 92.9% of respondents and most received support towards the individual working at home and also child care issues (at least 64% supported these issues). No teleworker stated that their partner demanded that domestic chores had to be completed prior to starting work at home. Nearly all the respondents (92.9%) stated that they were satisfied with working at home, but not all the parents in the sample were satisfied with looking after their family whilst TW - forty percent expressed neutrality or dissatisfaction on this topic. Explanation for these feelings could be in the form of either that they felt they still did not have enough time to care for them, or that demands from children interfered with their work, causing displeasure. A surprising result were the responses to the statement 'telecommuting is stressful'. Generally people considered that TW was not stressful, or were neutral this idea, but 2 respondents agreed that TW was stressful - possibly this is a result of 'juggling' roles, having to schedule their resources accordingly. Most respondents stated that they were either neutral or did not need contact with other people while they worked, and several did not consider themselves to be extrovert in character or neutral to the description (64.2%). Perhaps successful TW is a function of this reduced need for contact and social activity.

3.4 Geographic Implications

Levels of car ownership, as expected are very high with only one person not having a car (another not responding to the question). But not all individuals rely on their car for the commute to work. One person uses the bus, 3 people use the transit or subway, and for the two individuals who live more than 2,500 kms from their place of work, the only feasible mode of transportation is the plane! These latter two persons did not calculate their commute time since they did not travel between their work place on a regular basis. For the remaining 13 participants, 53% live within 25 kms of their workplace, taking an average of 75 minutes for the return journey. Note, that there are 3 'extreme' cases of telecommuters - those whose place of residence is more than 100 kms from their workplace (Figure 7). For 2 individuals, their commute when working at the office takes 120 minutes and 240 minutes respectively.

Figure 7 Distance from Work-Place

Distance	Frequency
Less than 25 kms	8
Between 26 and 50 kms	3
Between 51 and 75 kms	1
Between 76 and 100 kms	0
More than 100 kms	3

TW were asked when they usually used their automobile and for what purpose. As expected, travelling to work is concentrated between 7-9 a.m. (9 out of

the 10 valid respondents) and between 3 and 6 p.m. The time taken to perform these journeys is 57 minutes. For other travel purposes, the use of the car is distributed throughout the day. TWs are able to visit the store from 9 a.m. through to 3 p.m. during what is a 'normal' work day. An average of 72 minutes is spent using the car for travelling for shopping purposes. For those in the sample who were parents, 4 were required to either drop off or pick up their child at school, and obviously the time this is carried out is restricted largely to the school's scheduled hours. TW does not offer any added flexibility in this mode. The time spent performing school related trips averages 70 minutes. But TW is more significant in affording the individual more flexibility in the use of their car for leisure related purposes. Excluding time spent during the evening, 3 individuals reported being able to use their car between 7 a.m. and 3 p.m. Visiting friends and relatives is also possible during the day for 2 people. For one person who worked at their home business, use of the car had increased as they were now running errands for the business that had not occurred previously. One respondent stated that "I try to either 'walk' my errands or arrange to avoid rush hour".

TWs compared their car usage when TW with when they worked full time at the central office, and it was found that 26% consider that usage of the car had decreased or decreased greatly for the purpose of travelling to work. For most of the respondents (46%) car usage had not changed, perhaps due to the fact that most come into the office at some time during the week anyway. For 2 individuals, TW had been accompanied by an increase in the time spent travelling to work as their option to TW had been accompanied in a change of residence and a longer commute.

For the majority of respondents, there had been no change in the time spent using the car for the purposes of shopping, school, leisure or visiting (Figure 8). It is apparent that the frequency of these trips were not affected by any kind of improved time flexibility that TW offered. It is possible that trips identified previously as occurring during the day were carried out by people who worked only on a part time basis and carried out those trips regardless of their working arrangements.

Figure 8 Changing Automobile Usage as a Consequence of Teleworking

Purpose	Increased Greatly	Increased	No Change	Decreased	Decreased Greatly
Travelling to work	1	1	7	2	2
Shopping	1		9	1	
School			8		
Leisure			9	1	
Long distance leisure			9	1	
Visiting			9	1	
Other	1	3			

Some questions on the survey were specifically focused on whether traffic congestion was influential in a person's decision to TW. This was due to the preponderance of legislation and interest expressed in TW as a traffic demand management tool in the USA (US Department of Transportation, 1993) and even in

Calgary (Calgary GOPLAN, 1993). Forty percent of respondents replied that they felt traffic congestion was a problem when they worked full-time at the central office, but only 13% (2 respondents) stated that these problems were an influence on their decision to TW. One of these respondents stated that they would in fact return to working at the office if these transportation problems were resolved. Three of the 15 teleworkers considered that TW was a means of substituting travel.

4.0 INTERPRETATION

Very limited information has been presented which gives only an indication of possible trends to be confirmed in the main study, results of which are forthcoming and will be presented at the CTRF conference.

Typically, teleworkers are between 30 and 40 years of age, in professional occupations which is reflected in their educational attainments and income levels. Many have chosen to TW because it provides them with a lifestyle which is more suited to their needs and they can be more productive in the quieter environment. Transportation is an influence on a person's decision to TW, but within this sample it was relatively minor. For some people, transportation costs and commuting times are reduced, but this is dependent obviously on the number of times that the person is required to go into the office to meet with their supervisor or pick up instructions. If these visits can be reduced in frequency, then there is potential for the average TW to save a drive of 50 kms and save 75 minutes doing so. This time could then be spent on other purposes. TW enables an individual to schedule appointments and social visits during the day, but in this sample it is apparent that these visits are carried out regardless of when the person is TW-here these people may only be working on a part-time basis. If trips like these are carried out, then actual usage of the automobile has not been reduced, there simply has been a shift to other purposes at different times throughout the day. Hopefully, the main study can illicit stronger evidence on this issue.

Problems that have been encountered by the individuals in this sample are relatively 'minor' in character, but at an organisational level, more support from managers is required and some feel out of touch with professional contacts. Some people still feel that their home life is interfering with their work at home, and TW should not be seen entirely in terms of stress reduction - for some the increased organisation of their schedule or demands from the family can result in tension. There are few technical difficulties encountered by the TW, but this may be partly because of the limited technology that they are using - most use a phone, electronic mail, a modem and computer. More advanced technologies such as the videophone and videoconferencing are not used by respondents in this pilot study. Even the use of telecommunication technology was not felt to replace the need for face-to-face contacts and overcome problems of social isolation.

All respondents however still want to TW, even is it is on a part-time basis. Most want to continue to do so because of the benefits of greater flexibility to carry out their own errands, and spend time with the family, and also the greater autonomy

that they have been given over their work. Work is easier to complete in the distraction free environment removed from contact with other workers. These benefits seem to dominate the decision to TW above any financial savings that may have accrued or any conscious effort to avoid the commute to work. TW from these results thus reflects a move for greater power by the individual to choose their style of work and reduce previous organisational rigidities of the 9 to 5 work day.

5.0 CONCLUSIONS

A brief literature review of the issues pertinent to TW has been presented here, along with preliminary descriptive results from a pilot study of teleworkers. The results indicate that teleworkers are characterised as professionals in their 30's, earning high income and typically employees of an organisation. Many have chosen to TW to suit their lifestyle options, but despite regular meetings at their supervisor's office, many still have problems of lack of support and social isolation. They have benefitted from improved autonomy and an environment reduced of the distractions in a traditional office. The geographical consequences of TW are uncertain given the small sample size - it seems to indicate that reductions in travel will not occur unless teleworkers are removed of the constraint of attending meetings at the central office. Most teleworkers remain in locations close to their employers but the potential of reduced mileage and time spent commuting to work and back exists. A more geographically dispersed group of teleworkers emerged from this study-those who live over 100 kms away from their normal place of work. In this instance, telecommunications technology has indeed removed the frictions of distance.

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URBAN TRANSPORT OF SENIORS IN WINNIPEG

by Jonathan Heads *

With the aging of the Canadian population, there is increasing concern for seniors in all areas of economic and social activity.[1] The problems which have been highlighted include the need for mobility of seniors within the communities in which they live. In order to provide a more comprehensive data base on the urban mobility of seniors, the Seniors Directorate of the Province of Manitoba commissioned research in 1992/93 with the University of Manitoba Transport Institute.

The research was in three parts. Phase 1 was an inventory of transport services available for seniors in Winnipeg. Phase 2 was a questionnaire survey, documenting the current travel patterns and transport needs of seniors within Winnipeg; this is the subject of the present paper. Phase 3 compared urban transport services for seniors in Winnipeg with cities of similar size in Canada, United States and several European countries. The research studies were completed and delivered to the Seniors Directorate in February, 1993.

1. SURVEY METHODOLOGY

The field work for the survey was conducted mainly in December, 1992 and interviews were carried out with 150 seniors citizens resident in Winnipeg. Names and addresses of a stratified random sample of seniors citizens resident in Winnipeg were purchased from the Manitoba Health Services Commission (MHSC).[2] This sample was specified to reflect the age and sex composition of the general population of persons aged 65 and over who live in Winnipeg. The sample was made up of 150 respondents - 37 men aged 65 - 74; 21 men aged 75 - 84; 5 men aged 85 or more; 48 women aged 65 - 74; 29 women aged 75 - 84; and 10 women aged 85 or more. A larger sample of seniors may have been desirable, but financial considerations played a role in determining the sample size. Subsequent analysis of the data seems to show that the size of the sample is generally adequate, but readers can judge this for themselves.

The prospective respondents were sent a letter, which informed them of the study, asked for their participation, and indicated that they would be telephoned in the near future. Respondents were for the most part contacted by telephone a few days after they received the letters from the researchers. Where telephone answering machines were available, messages were left asking prospective respondents to call the offices

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of the Transport Institute. If no answer was received, call-backs were made at different times of the day to a maximum of five calls per respondent.

The sample size, stratified by age and sex, was achieved, but it was necessary to contact a total of 290 people in order to obtain the required 150 interviews. Of the 140 persons not successfully interviewed, 97 individuals refused to participate in the study. Many senior citizens were suspicious of strangers contacting them by telephone, although the letters which had been sent in advance did much to allay these suspicions. Of the other 43 contacts where interviews did not proceed, slightly half (24) were due to failure to contact the respondents even after five telephone calls. The balance of non-interviews (19) were due to causes typical of any survey and not specific to the senior population, such as changes of address and temporary absences from Winnipeg.

Other problems in survey administration are noted for the information of future researchers. Respondents not fluent in English were interviewed in a language in which they were fluent. There were only four respondents in this category - two in German, one in Cantonese and one in Vietnamese; although the sample included respondents whose first language was French, they agreed to be interviewed in English. When telephone contact was impossible, a few in-person visits were made. These were not productive - it was found that the respondent had moved, that there was no answer at the door, or that the respondent refused the interview. On some occasions, it was not possible to conduct an interview directly with a respondent on the telephone, because of the respondent's ill health or hearing problems. The method used to overcome this barrier was either to do the survey by mail or to communicate by telephone through an intermediary, usually a relative of the respondent.

The survey form is not reproduced with the present paper. There were 11 questions asking for data and the responses form the subject of the discussion below. Age and sex were already known prior to contacting the respondents, but the questionnaire contained 6 questions to confirm this data and to obtain information on marital status, work status, housing and annual household income.

2. URBAN TRANSPORT PATTERNS OF SENIORS IN WINNIPEG

Over the course of a year, seniors travel within Winnipeg for medical visits, shopping, and visits with friends and relatives. To a lesser extent, they travel for hair appointments, social/recreation reasons and to go to church or other religious institutions. Roughly one in five seniors travels to carry out voluntary work. Paid employment, education and other reasons are relatively unimportant.[3]

The percentage of respondents who travelled for each purpose are shown in Table 1 together with a sex and age breakdown. This table shows whether or not travel was undertaken for each activity in the course of the last year.

Table 1: Purposes for Travel in Winnipeg						
	% of respondents who travel for each purpose					
	All	Male	Female	Age-Groups		
				65-74	75-84	85+
Medical	97	95	98	96	96	100
Paid employment	5	10	1	7	2	nil
Volunteer work	21	19	22	31	10	nil
Education	5	6	3	6	4	nil
Shopping	89	90	87	94	88	60
Social/recreation	67	76	60	72	70	27
Visits with friends and relatives	83	90	78	87	84	60
Hair appointments	71	75	68	76	72	33
Church	57	62	54	61	54	47
Other	6	5	7	6	4	13
Average number of travel purposes	5.0	5.3	4.8	5.4	4.8	3.4

The average Winnipeg senior made trips within the city for 5.0 different purposes over the last year. Six main reasons were given for these trips - medical visits, shopping, visits with friends and relatives, hair appointments, social/recreation reasons and church. Other reasons were much less frequently mentioned.

Male seniors tend to travel slightly more than female seniors in Winnipeg, but this is partly because male seniors tend to be younger than female seniors and travel declines in the higher age-groups of the senior population. Relatively more males than females made visits for social/recreation reasons and to visit with friends and relatives, while the small number of seniors in paid employment were predominantly men. Seniors in the youngest age-group 65-74 had the highest number of reasons for travel within Winnipeg. However, this only changed slightly in the age-group 75-84 and did not fall markedly until the oldest age group 85+.

Turning to frequency of travel of seniors in Winnipeg, it is not surprising to find that shopping trips are the most frequent. Of the seniors interviewed, almost three-quarters made a shopping trip at least once a week. Visits to friends and relatives also occurred with high frequency and almost half the respondents made a visit of this type at least once a week. Although many seniors did not attend a church or

religious institution, the majority of those who did attend were there on a weekly basis.

Table 2: Frequency of Travel in Winnipeg			
	% of respondents who travel for each purpose		
	Medical	Shopping	Social/recreation
Almost every day	1	19	10
Once or twice a week	7	54	26
Once or twice a month	31	12	18
Once or twice every three months	29	3	7
Once or twice a year	29	1	6
Never	3	11	33
Total	100	100	100
	Friends/relatives	Hair	Church
Almost every day	5	nil	3
Once or twice a week	41	6	37
Once or twice a month	23	28	11
Once or twice every three months	11	34	3
Once or twice a year	3	3	3
Never	17	29	43
Total	100	100	100

Travel for social/recreation purposes occurred a little less frequently - roughly one-third of respondents travelled for this purpose once a week or more, one-third with less frequency and one-third not at all. Inevitably, hair appointments did not usually occur on a weekly basis, but mainly on a frequency ranging from twice a month to once a quarter. Although practically all seniors made a medical visit during the course of the year, the frequency of these visits was low.

A breakdown is not shown for the minor purposes for senior travel. Very few seniors were in paid employment; of the seven respondents who worked, four were in daily employment and three in part-time work once or twice a week. The seniors pursuing education courses mainly attended once a week. Volunteer work was performed mainly once a week or once or twice a month.

An attempt is now made to quantify the different travel purposes in terms of the number of trips they generate for seniors. The approach is slightly arbitrary, as it is assumed that each trip made almost every day generates twenty trips per month; that once or twice a week generates 6 trips per month (except for church, which was taken as 4 trips per month); once or twice a month 1.5 trips per month; once or twice every three months 0.5 trips per month; and once or twice a year 0.1 trips per month.[4] In addition, this approach does not allow for the fact that trips for different purposes would tend to be of different length. For example, a visit to a doctor's office is likely to involve the senior in greater mileage than a shopping trip.

Table 3 shows the average number of journeys made per month by the Winnipeg seniors interviewed in the survey. The first column shows the average number of journeys per month for all respondents including those who made no trips at all. The second column gives the average number of journeys for participants in each activity and excludes those who made no trips at all in each activity.

Table 3: Average Number of Trips per Month

	All Respondents	All Participants
Medical	1.2	1.3
Shopping	7.3	8.2
Social/recreation	3.9	5.8
Friends/relatives	3.8	4.6
Hair	0.9	1.3
Church	2.3	4.0
Volunteer work	1.0	5.0
Paid employment	0.7	13.2
Education	0.4	7.9
Total	21.5	n/a

Table 3 needs to be interpreted with some care because of the element of subjectivity in calculating the average number of trips per month. It is estimated that the average senior made 21.5 trips per month within Winnipeg. Taking the month as four weeks rather than a calendar month, this would mean that the average senior makes a trip every three days out of four. Shopping accounts for one-third of these trips; social/recreation and friends/relatives account for a further one-third of the trips; of the remaining trips, visits to church are the most important. As already mentioned, more seniors make medical visits in the course of a year than visits for any other single purpose; however, the frequency of medical visits is relatively low, so that this ranks fairly modestly in the number of trips required.

3. MEANS OF TRANSPORT USED BY SENIORS FOR TRAVEL IN WINNIPEG

Seniors were asked what was their primary transport mode for each purpose; with the wisdom of hindsight, the question should have included secondary means of transport.

Seniors make most of their trips in Winnipeg by private automobile. For the six main purposes of travel, use of the automobile varies from a low of 58% of trips for medical purposes and hair appointments to a high of 83% for visits to friends and relatives. The senior generally drives himself/herself, but transportation in a car driven by family members is also important, particularly in visiting friends and relatives. Except for visits to church and other religious institutions, friends do not often drive seniors on trips within the city.

The conventional bus service of Winnipeg Transit is quite important for seniors, apart from visits to church and to friends and relatives. Although the sample size was very small for educational trips, Winnipeg Transit was also important here.

Trips where the mode of transport was walking are probably understated. This is usual in most urban transport surveys, as people have a higher propensity to forget journeys made on foot. Nevertheless, walking was quite important in trips for hair appointments, church visits and shopping.

Handi-Transit is Winnipeg's name for para-transit services to meet the needs of travellers with disabilities. However, this accounted for relatively few trips and only achieved any significant impact in medical visits. This was also true of other forms of transport, including taxis.

Detailed figures for the six main transport purposes are shown in Table 4, where the percentage calculations are based on numbers of participants for each purpose (i.e., omitting those who did not make trips for each purpose).

Table 4: Means of Transport in Winnipeg			
	% of participants who travel for each purpose		
	Medical	Shopping	Social/recreation
Drive myself	35	47	51
Family members drive	21	24	24
Friends drive	2	2	6
Winnipeg Transit bus	20	9	11
Handi Transit	7	1	2
Walk	8	14	4
Other	7	3	2
Total	100	100	100
	Friends/relatives	Hair	Church
Drive myself	44	42	44
Family members drive	37	15	21
Friends drive	2	1	13
Winnipeg Transit bus	5	14	2
Handi-Transit	2	1	--
Walk	8	25	17
Other	2	2	2
Total	100	100	100

4. ATTITUDES OF SENIORS TO WINNIPEG TRANSIT SERVICES

This section summarizes the attitudes of seniors in Winnipeg towards two forms of public transit - regular bus service and the para-transit service known as Handi-Transit provided for seniors and other members of the community who are unable to access the regular bus services.

a) Winnipeg Transit Regular Bus Service

Winnipeg seniors were asked whether they ever used the regular bus services of Winnipeg Transit. Of the 150 respondents interviewed in the survey, 96 used bus services on a regular or an occasional basis. These users accounted for 64% of all Winnipeg seniors interviewed. (This is, of course, much higher than the instances where Winnipeg Transit was used as the main means of transport for various trip purposes, as shown in Table 4 of the preceding section.)

Of the seniors who said that they used Winnipeg Transit, 86 respondents were willing to comment on the features of the service provided. Five statements of a positive nature were read to each respondent and the respondent was ask to indicate whether or not this feature was considered important.

On the basis of the responses, the greatest attractions of bus service to seniors were avoiding the problems of driving and parking a car. The financial savings from travelling by bus were also appreciated. However, seniors were equally divided as to whether is was important or unimportant that the bus offered particularly greater convenience in winter or that the bus was "better for the environment". Respondents were also offered the opportunity to identify other positive features of bus transport not specifically enumerated in the questionnaire. The average respondent offered one additional comment. These related mainly to the helpfulness of the driver and the good quality of the service provided.

Respondents were given a list of ten negative attributes of the bus service and were asked to rate these as important or not important. Negative views on bus service were expressed much less frequently than positive views. The most important problem for seniors using Winnipeg Transit was the difficulty caused by winter weather, including walking to the bus stop and waiting at the bus stop. While winter weather is an inevitable fact of life in Winnipeg, these problems are particularly severe for seniors and raise the issue of a possible need to provide more alternative transport to regular bus service in the winter than in the summer.

Of the other negative aspects of regular bus service, approximately one quarter of seniors have problems with parcels on the bus step and a fear of falling if they are moving on a bus which is in motion. Concerns were relatively few on the cost of the bus fare, the need for the right change to pay the fare, and understanding bus schedules giving times and routes. Only a small proportion of seniors appeared to need an escort when they used the bus.

Respondents were also given the opportunity to offer any other negative comments on the bus service. Negative comments averaged slightly less than one per respondent. The two most common complaints related to inadequate clearing of snow and ice on sidewalks and areas around bus stops and the behaviour of fellow passengers, such as failing to vacate the courtesy seats at the front of the bus. There were some complaints about quality of service and even lack of courtesy on the part of bus drivers, but these negative comments were far outweighed by the positive comments already recorded above.

Although every type of service obviously has its problem areas, the overall assessment of seniors is quite favourable toward the regular bus service in Winnipeg. Two issues are noted for future consideration. Firstly, there are particular difficulties for seniors in walking on snow covered or icy sidewalks. Secondly, consideration could be given to increased provision of para-transit services in winter and the

possibility of authorizing some seniors "for winter use only", if they are able to cope with regular bus transport outside the winter months.

b) Winnipeg Handi-Transit

Handi-Transit takes clients, who are unable to use regular bus service, from origin to destination in customized vans. The service is available not only to seniors but to all travellers with disabilities. Of the seniors interviewed in the survey, 12% used Handi-Transit. This sample size is so small that it is embarrassing to attempt any statistical analysis. However, because of the virtual unanimity of the views recorded, the results are presented as qualified information from a small sample.

How does utilization of Handi-Transit compare with the number of seniors who have mobility problems? The survey throws some light on this issue, although it does not give a definitive answer. The entire survey population was asked if difficulties were experienced in performing three tasks - walk a city block; get in and out of a car; and go up and down a flight of stairs. Responses to the three questions were reasonably similar and 86% of seniors said they could perform the tasks. Of the remainder, 9% could perform the tasks but only "with the aid of a device". However, in many cases, the device used was fairly straightforward - a cane for walking, assistance from other people in getting in and out of a car, and heavy reliance on the banister in coping with stairs. The remaining 5% of seniors do have serious mobility problems, in many cases because they are confined to wheelchairs.

As indicated earlier the survey showed that 12% of the sample were presently qualified to use Handi-Transit. This would be broadly consistent with the data summarized above on the mobility problems of the senior population of Winnipeg. The survey found three persons not yet eligible for Handi-Transit but in the process of applying and four persons who believed that they were eligible but had not yet applied. There did not seem to be any evidence to suggest that the availability of Handi-Transit was inadequate for the demands being made on the service.

While it is dangerous to comment on small samples, the results are sufficiently unanimous to be of interest. Seniors were very favourably impressed with the Handi-Transit drivers - cheerful, friendly, and helpful in assisting clients in and out of the vehicles. Handi-Transit was also appreciated as affordable and allowing seniors to avoid asking family and friends for transport.

Seven negative statements on Handi-Transit were read to the users. Approximately one-third of respondents commented on difficulties in advance booking requirements and delay in vehicle arrivals, but there were negligible complaints on the vehicles themselves, the rejection of trips as non-priority, or circuitous routing. There was one major complaint, shared by four-fifths of the respondents. This related to difficulty in making contact though Handi-Transit's telephone lines. Transport Institute staff made a limited check on these complaints by random telephone calls to Handi-Transit. The problem was severe in the morning with busy signals and long

delays on hold waiting for the operator. However, by noon the delays had virtually disappeared. The explanation is, for example, that noon on Monday is the cut-off time for Wednesday booking and only Thursday and later bookings can be made after Monday noon. Since this survey was conducted, Handi-Transit has made considerable attempts to reduce these telephone delays.

5. GAPS IN WINNIPEG'S TRANSPORT SERVICES FOR SENIORS

The survey tried to examine unmet urban transport needs of Winnipeg's seniors. Rather surprisingly, 89% of the respondents indicated that all the travel they wanted to make was available to them. This even included a number of individuals who appeared to travel outside the home very infrequently, but did not have any desire to increase their amount of urban travel.

Of the respondents who did not find all their travel needs met, about half were able to use regular bus service, but this was not easily available to the destinations they wished to reach in the city for shopping or recreational purposes. The remainder expressed a need for Handi-Transit service and this included several respondents who were in the process of applying for this.

Respondents were asked whether they changed their urban traffic patterns during the winter. Half of the respondents said that their travel arrangements were affected by winter and half that they were not. The main modifications to travel patterns consisted of staying at home more frequently, switching from car to bus, delaying trips on days when weather conditions were very bad, and taking greater care in using the existing modes of travel.

Seniors were asked if they had any recommendations to make concerning transport services available for senior citizens. Two-thirds of the respondents did not offer any recommendations, with the remaining one-third putting forward ideas for improvements. These ideas focused mainly on special bus services for seniors, sometimes requesting door-to-door service. Miscellaneous suggestions ranged over many areas, but the only specific suggestion made by more than two respondents was the need for additional bus shelters, preferably heated.

6. CONCLUSIONS

While it always possible to improve any transport services, the results of this survey, together with Phases 1 and 3 of the study, would not suggest that senior transport services in Winnipeg were in any state of crisis. Like other citizens of Winnipeg or any large urban centre in Canada, the most popular means for seniors to make their trips in Winnipeg is by private automobile, either driving themselves or driven by family members. The regular bus service provided by Winnipeg Transit is also important and, while seniors identified problems in using the bus, the general reaction

to the quality of service and the courtesy shown by bus drivers was reassuring. Most seniors (89%) indicated that they were able to make all the travel trips they wanted to make within the city.

The para-transit services provided by Winnipeg's Handi-Transit are used by roughly 12% of seniors in Winnipeg. From an examination of factors impeding mobility of seniors, it appears that this level of service is adequate and the people who need the service are able to obtain access. It is rare for service requests to be rejected as non-priority. Handi-Transit users have positive attitudes towards the service provided and several seniors would be housebound if it were not available. There was one major negative feature of the system, namely the difficulties in making telephone contact with Handi-Transit.

Some transport issues relating to seniors are addressed in too narrow a context (but this is true of every transport problem). For example, while the survey was being analyzed, the Winnipeg Free Press of February 17, 1993 reported in very strong terms on Winnipeg's "Sidewalks icy nightmare" and "elderly, disabled effectively locked in for winter". Costs and benefits of clearing snow-covered and icy sidewalks need to be assessed in a total context, including the isolation otherwise inflicted on seniors in winter and the medical expenses and suffering caused by winter accidents.

ENDNOTES

1. The age distribution of Winnipeg and Manitoba residents is shown below from the 1991 Census (Statistics Canada 93-310). Seniors aged 65+ accounted for 12.88% of the population. The table also shows forecasts available only for Manitoba as a whole, made by Statistics Canada in 1989 on the basis of the 1986 Census. Statistics Canada used four projection scenarios, based on different assumptions on fertility and net immigration; the table below averages these four scenarios. As would be expected, the forecasts for 1991 correspond closely to the actual figures available from the census.

	Age Distribution - % of total population			
	65-74	75-84	85+	65+
Winnipeg, 1991	7.37	4.22	1.29	12.88
Manitoba, 1991	7.57	4.47	1.39	13.43
Forecasts for Manitoba only - Statistics Canada 91-520 (1989)				
1991	7.55	4.51	1.41	13.47
1996	7.41	4.81	1.71	13.93
2001	7.03	5.04	2.05	14.12
2006	6.97	5.05	2.28	14.30
2011	7.61	4.88	2.50	14.99

2. The researchers had originally feared considerable delay in obtaining this information from MHSC, although in fact the delay did not turn out to be excessive. Before contacting MHSC, an attempt was made to contact seniors though random telephone phonings. While there were no high expectations of success from this approach, this proved to be time-consuming beyond our wildest fears and completely ineffective. It was soon abandoned and we document this failure only as information for future researchers in this area.

3. Respondents were explicitly asked if, during the course of a year, they travelled for each of the reasons listed in Table 1. They were also given the opportunity to indicate other activities, but very few of these were mentioned.

4. For greater clarity, the calculations in respect of social/recreation are as follows:

10% (almost every day)	x 20 = 200
26% (once or twice a week)	x 6 = 156
18% (once or twice a month)	x 1.5 = 27
7% (once or twice every three months)	x 0.5 = 3.5
6% (once or twice a year)	x 0.1 = 0.6
33% (never)	x 0 = 0
100%	387.1

Dividing 387.1 by 100 gives an average number of trips per respondent of 3.9. Dividing 387.1 by 67 (i.e., excluding the "never" respondents) gives an average number of trips per participant of 5.8.

CREATING OPPORTUNITY INCREASES DEMAND

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Introduction

Increased accessibility will create greater opportunities to travel for persons with disabilities, thereby increasing the demand for service and creating further opportunities for travel related industries. Moreover, improvements of the socio-economic characteristics of persons with disabilities coupled with the increased accessibility of the transportation network also contributes to an increased travel demand by persons with disabilities. Changes in the industry can be in response to demand-pull or in compliance with regulation-push. Various legislation and programs currently in place which influence and assist the implementation of accessible transportation will be highlighted. This paper will also look at demographics of travellers with disabilities using Statistics Canada information and other relevant data, drawing on the experience of the paratransit operations in Canada to illustrate what can happen through increased service.

Persons with disabilities should be able to access all modes of transportation while travelling in Canada. When a trip consists of several modes of transportation and that trip is accessible, it can be termed a "seamless trip". Being able to travel from door to door without encountering any setbacks or obstacles is the goal of all travellers, but is especially relevant for persons with disabilities. A transportation network is like a chain: it is only as strong as its weakest link.

Profile

Canada is a great place to live. Persons with disabilities are wheezing, tapping and rolling their way into their rightful place of dignity and independence within the Canadian fabric.

The continuum of their evolution can be divided into three areas, or three time periods, which are demarcated by distinct social attitudes:

> the era when person with disabilities were pitied and looked after ("the warehouse");
>
> the current era, in which persons with disabilities are discovering their own identity and society is discovering their abilities as they grow together ("the greenhouse"); and
>
> the approaching era of empowerment and autonomy ("the open house").

The "warehouse" period represented an era where the majority of persons with disabilities lived in residential institutions. This institutional model was based on the belief that they were incapacitated. Initiated by the catalyst of the Vietnam War and its aftermath, the era of the "greenhouse" is now thriving. The traumatized and newly-disabled veterans provided the models from which society as a whole has benefitted. These veterans refused to accept or tolerate the traditional way in which society related to its members with disabilities. Canada's proximity to the United States means that Canadians with disabilities benefitted from this accelerated progress. The advancement of rehabilitative medicine and the provision of government social services have contributed to a vast improvement in the quality of life for persons with disabilities and to their greater integration into mainstream society.

Since the beginning of the "Decade of the Disabled" in 1981, the Parliament of Canada has planted numerous seeds of change in the "greenhouse" by issuing a number of reports focusing attention on the aspirations of persons with disabilities. These reports have covered the spectrum of human interest from recreation and education to employment and transportation.

A number of Acts of Parliament have continued this trend. The *Canadian Human Rights Act*, the *Charter of Rights and Freedoms* and the *National Transportation Act, 1987*, contain guarantees of protection and the promotion of freedoms. These are founded in the evolutionized status of persons with disabilities, which has fostered their strong desire for the blooming of independence and integration. Two important corollaries of these principles are the right to self-determination and the dignity of risk.

The movement towards integration and demedicalization implies personal choice, user control over ongoing support services, and equal access to the rights and responsibilities accorded to all Canadians.

In the 1991 post-census *Health and Activity Limitation Survey* (HALS) conducted by Statistics Canada, 4.2 million citizens or 15.5% of the Canadian population reported some level of disability. This compares to the 1986 HALS figures of 3.3 million or 13.2% of the Canadian population. This would translate to an increase of approximately 900,000 people. For these people, accessible transportation is a necessity and a right. With accessible transportation, people can become integrated into the community. It becomes possible to travel to and from school, a place of employment, or medical and recreational facilities. Through accessible transportation, persons with disabilities can participate more effectively and fully in community life. It should be noted, however, that not all persons with disabilities have trouble using transportation services.

The Hickling Corporation conducted a study in 1992, based on the 1986 HALS data, in order to develop some projections concerning the increase in number of persons with a transportation disability. Persons with a "transportation disability" are defined in this study prepared for Transport Canada's Transportation Development Centre as "individuals who, because of their health problems or condition, are unable to use transportation services, or use transportation services with more difficulty than those in the general population". A projection of interest from this study was:

- For 1990, of over 3.0 million adult (15 years and older) Canadians with disabilities, 1.9 million (9% of the general adult population) have transportation disabilities. By the year 2000, the number of persons with transportation disabilities will increase to 2.3 million.

There are many possible reasons for this higher incidence of disability as observed in the HALS data. One probable cause is the fact that people now seem to be more willing to identify themselves as having a disability because of the reduction of the social stigma attached to it. However, in more recent times, as attitudes about people with disabilities have changed and as services for persons with disabilities have increased, people are now more comfortable and have realized that it can be to their benefit to identify themselves as having a disability. In doing so they are able to take advantage of some mobility enhancing services, such as parking for the disabled, bus lowering for easier access to city buses, and Paratransit services.

Another possible reason for the increased number is the aging population. The incidence of disability increases significantly with age. According to 1991 HALS data, 65.5% of all Canadians with disabilities are younger than 65. However, the incidence of disability is higher for persons 65 years of age and older: 7% of children under the age of 15 are reported to have a disability while this rate rises to 45% among people aged 65 and older. The HALS data also found that

the severity of a disability also increases with age. Among children with disabilities under the age of 15, 3% are reported to have a severe disability while the rate is 32% for those 65 and over.

> **Seniors grow into disabilities; people with disabilities grow old with them.**
>
> A. Aitkens, One Voice Seniors Network, Ottawa[1]

During the coming decades, the 65 and over population in Canada will grow at a very rapid pace. According to Statistics Canada's population projection, one in five Canadians will be 65 years of age or older by the year 2021, and one in four of these will be over the age of 80. Mr. Aitkens, quoted above, continued:

> **We believe that all aspects of Canadian society must confront the reality that we have an aging population. The demographic projections show that while the population of today looks a bit like a pear when you set out, with a smaller, older generation and a very large baby boom, that over the next 20 years that pear will turn to an apple and 20 years after that it will be an upside down pear. We will have a much greater proportion of older people than we have younger people. Not just proportions, but also numbers. The sheer number of those people is staggering.[2]**

Progression of Infrastructure

Paratransit experiences show how infrastructure must progress in several areas at the same time in order to create easy access to travel. For example, when Paratransit was introduced, its use was originally expected to be minimal. It was found that once people had the ability to travel to their destinations with relative ease and were confident about the reliability of the system, they started to travel with greater frequency.

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[1] The Road to Accessibility - An Inquiry into Canadian Motor Coach Services

[2] *ibid.*

The experience of the Paratransit service in the Ottawa-Carleton area (Para Transpo) can be used as an example. In 1987, the number of bookings were 324,223, whereas the number of passengers were 314,274. By 1993, the number of bookings and passengers grew to 739,957 and 706,067 respectively. The difference between bookings and passengers are "no shows". In a span of six years, the number of passengers and bookings have more than doubled. In an article appearing in the Ottawa Citizen, reporter Mohammed Adam notes:

> **...first six months of 1993, demand for Transpo (*sic* Para) services increased 17 per cent over 1992...**[3]

Pat Larkin, Director of Para Transpo, noted the following in 1992:

> **Para Transpo provides transportation to about 15,000 mobility-impaired persons within the Ottawa-Carleton area. Para Transpo has come a long way since 1975, its full year of operation. Back then, it offered 495,000 km of service over the year, using 10 vehicles. In 1992, "Para", as it's familiarly known, will run 5.7 million km of service with a fleet of 130 vehicles.**[4]

The operating statistics of Para Transpo for 1993 indicate 6.1 million km of service with a fleet of 135 vehicles.

Once people with disabilities felt that they could rely on the local transportation services and as they became more educated, got better jobs, and became more aware of their rights, they also demanded better access to public buildings and facilities as well. Therefore, schools, colleges and universities, as well as work places, are now becoming more accessible. The increase of education and skill levels for persons with disabilities is leading to increased employment opportunities.

Employment

People with disabilities are now starting to be employed in various types of work. As employment increases and persons with disabilities have larger disposable incomes, it can be assumed that the demand for long distance travel will follow.

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[3] The Ottawa Citizen, February 6, 1994, p. A8.

[4] PARA NEWS, volume 4 No. 2, Winter 1992

The Employment Equity Act was proclaimed in August of 1986. The Act applies to federally regulated employers with 100 or more employees, covering employers primarily in the banking, communications, and transportation industries. The purpose of the legislation is to ensure that members of designated groups, including persons with disabilities, are afforded equitable employment opportunities and benefits which are consistent with their skills, abilities and potential. The Government of Canada's Federal Contractors Program requires that employers with at least 100 employees who bid on federal goods and services contracts certify their commitment to employment equity. As of 1992, there were 1,348 employers representing over 1,111,258 employees having certified their commitment under the Federal Contractors Program. The effect of this legislation will further increase the number of persons with disabilities in the work force.

Labour Force Status of Men and Women With Disabilities
1986 and 1991 (Age 15 to 64)
HALS (1986, 1991)

STATUS	1986		1991	
Employed	711,573	41.0%	1,106,205	48.2%
Unemployed	128,406	7.4%	186,300	8.1%
Total Labour Force	839,979		1,292,505	
Not in Labour Force	895,984	51.6%	1,004,630	43.7%
TOTAL	1,735,963	100.0%	2,297,135	100.0%
Unemployment Rate*	15.2%		14.4%	

*(unemployed/total labour force)

Given that 1986 and 1991 mark the only two milestones in terms of census data of Canadians with disabilities, substantive time series analysis is difficult to make. However, the comparison of 1986 and 1991 data indicates an upward trend in employment for men and women with disabilities (age 15 to 64). In 1991, 48.2% were employed as opposed to 41% in 1986. Moreover, the number of persons with disabilities not in the labour force has declined from 51.6% in 1986 to 43.7% in 1991. The unemployment rate has also declined from 15.2% to 14.4% from 1986 to 1991. Although the employment figures of persons with disabilities are lower than those of the general population, they do show signs of progress or movement towards the "open house".

These statistics indicate that a number of persons with disabilities are employed and earning income. One can also assume that increased employment will derive more demand for travel. One could consequently assume that this increased demand for transportation will spill over to support industries and services, such as travel agencies, hotels, restaurants, and terminal facilities. In keeping with this latent demand and in order to support a "seamless" transportation network, these support industries will also have to be accessible to travellers with disabilities.

Increased Travel

As a result of increased access to municipal transportation systems for persons with disabilities and in conjunction with better access to education facilities, housing, recreation and workplaces, opportunities have been created at the local level. This level of local opportunities is growing into demand and opportunities on a nationwide level.

Increased employment leads to more disposable income for persons with disabilities. Consequently, more disposable income for persons with disabilities would potentially increase demand for leisure and vacation travel. Everything from hotels, parks and even campgrounds would be in high demand by persons with disabilities and seniors as well. Customized personal vehicles and accessible public transportation provide the gateway of opportunity to these accessible services.

Business and industry have already started to recognize this latent market share and have begun to capitalize. In a regulatory impact assessment study conducted by the Agency, it was reported that currently persons with disabilities take about 700,000 round trips by air each year. Services such as travel agencies have recognized the need for increased accessible services and have begun to offer specialized travel services in Canada and around the world.

The increased integration of persons with disabilities into society has provided opportunities of all kinds. To give one example, the Para-Olympics has now been recognized as a world-class event and has consequently been combined with the Olympic Games. Similarly, the Commonwealth Games, which will take place in Victoria, British Columbia in 1994, include athletes with disabilities. Of the 66 nations competing, there will be athletes with disabilities from 15 nations around the Commonwealth travelling to Canada to compete.

While all of these factors combine to create a demand-pull by consumers, this in itself is not totally sufficient to produce the needed changes in a consistent and timely manner. Regulations developed by government provide the push that is

necessary to ensure consistency in accessibility throughout the Canadian transportation network.

Legislation - Policy

There are currently several pieces of Canadian federal inclusion legislation instruments such as the *Charter of Rights and Freedoms*, *Canadian Human Rights Act*, and the *National Transportation Act, 1987*. These instruments legislate the inclusion of persons with disabilities in mainstream society and prohibit discrimination on the basis of disability.

The Government of Canada's national transportation policy is stated in the *National Transportation Act, 1987*. It asserts that:

> **...a safe, economic, efficient and adequate network of viable and effective transportation services accessible to persons with disabilities and making the best use of all available modes of transportation at the lowest total cost is essential to serve the transportation needs of shippers and travellers, including persons with disabilities.**

Transport Canada has further outlined a policy for meeting the needs of persons with disabilities within the country's transportation network. The theme of this policy is "Accessible transportation is a right, not a privilege".

One of the roles of government, through legislation and regulations, is to ensure the access to accessible transportation. The Canadian Government has initially developed regulations to oblige industry to make their transportation systems accessible. Industry has been regulated to provide standard minimum levels of services. Once travellers start to know what to expect and feel comfortable with the level of services instituted as a result of government regulations, they will utilize the transportation system to travel more frequently, thus increasing demand.

The National Transportation Agency has the authority to make regulations in order to remove undue obstacles in the federally regulated transportation network. Also, the Agency may, of its own motion or upon application, inquire into a matter to determine whether there is an undue obstacle to the mobility of persons with disabilities. Where an undue obstacle is found, the Agency may order the taking of corrective measures or the payment of compensation for expenses arising out of an undue obstacle, or both.

This power enables the Agency to prescribe regulations for the purposes of eliminating undue obstacles in transportation to the mobility of persons with disabilities in the following areas:

a) the design, construction and modification of means of transportation and related facilities, premises and equipment,

b) the use of signs,

c) the training of staff,

d) the terms and conditions for carrying persons with disabilities, and

e) the communication of information to persons with disabilities.

The Agency has recently introduced new regulations. These new regulations are described below.

Terms and Conditions of Carriage:

Following an amendment to the *Air Transportation Regulations*, the Agency has started to regulate the terms and conditions of the domestic carriage of persons with disabilities in aircraft of 30 or more passenger seats. Since January 1, 1994, air carriers are required to offer uniform services to travellers with disabilities.

These services include assisting travellers with disabilities in almost all facets of the trip, including boarding and deboarding, seat transfers, carriage of mobility aids, requests for special meals, stowing and retrieving baggage, moving to and from an aircraft washroom, etc. Air carriers must also accept service animals free of charge. Air carriers are responsible for the transportation of mobility aids and must repair or replace ones that have been damaged or lost during that trip.

Personnel Training Standards:

The Agency determined that the lack of appropriate training of personnel working in the federal transportation network constituted an undue obstacle to the mobility of persons with disabilities. Consequently, the Agency decided to regulate the training of transportation personnel in this regard.

The Training Regulations were approved by the Governor in Council and published in Part II of the *Canada Gazette* on January 26, 1994. They will come into effect on January 26, 1995.

Rail, marine and air carriers, with the exception of small air carriers, as well as rail, marine and air terminal operators, with the exception of small air terminal operators, will be required to ensure that their employees and contractors who provide different types of transportation-related services to persons with disabilities are properly trained to do so.

These regulations provide an outline of the minimum standards that must be complied with. While the regulations provide air carriers with precise information about the results that must be achieved, they do not specify how the carrier is to reach these desired results. This approach allows air carriers the freedom to achieve these goals through procedures and mechanisms best suited to their unique operational environments.

The Agency is also developing other regulations to benefit persons with disabilities. Other regulations will apply to air fares for a required attendant; uniform standards of accessibility of equipment; and terms and conditions of transportation in other modes of transportation under federal jurisdiction.

National Strategy

The Government of Canada has also created a National Strategy for the Integration of Persons with Disabilities to assist and promote accessibility. The ten participating government departments and agencies develop and maintain programs in areas such as employment, housing, and transportation. To accomplish this goal, a sum of $158 m. has been devoted to the development of a five year program. For the purposes of this paper, however, only the portion of the program assisting transportation industries will be discussed.

Transport Canada, under the 5 year program, has made $24.6 million available to the transportation industry to develop and use equipment that makes Canada's transportation system more accessible. These funds are divided into separate modal areas. For example, $3.5 million is available to Canadian intercity bus operators to purchase or install lifts, devices and other accessibility features to make buses more accessible; $350,000 is available for developing, testing and demonstrating an accessible charter bus; $600,000 to help stimulate the development of low-floor accessible urban buses; $4.1 million for commercial carriers to purchase boarding devices; $2.5 million is available for purchasing or installing lifts and other devices to make airport taxis and airport shuttle buses more accessible; $1.5 million is provided on a cost-shared basis to small communities to buy vans and minibuses adapted for persons with disabilities and seniors annually; $675,000 is available to car rental companies to equip cars with hand controls, lifts and installation of other devices on automobiles; $675,000 is available for training programs for staff of airlines, trains, buses and ferry

services; $860,000 is available for workshops on the travel needs of travellers with mobility, visual and hearing disabilities; $740,000 is available for the development of mobility clubs in small communities; and $2.9 million to install, test and evaluate small scale transportation technologies.

The Agency is also a participating department in the National Strategy. Under this program, the Agency was granted additional resources in order to accelerate its regulatory initiatives. These resources are assuring that the Agency plays an active role in achieving the three key goals of the National Strategy: equal access; economic integration and effective participation by Canadians with disabilities in the mainstream of society.

Conclusion

The initiatives by industry and government, discussed throughout this paper, have furthered the integration of persons with disabilities by assisting and/or ensuring the transportation industry in becoming more accessible. The increased access to goods and services is creating greater opportunities for persons with disabilities to become active participating members of the community. For seniors and persons with disabilities, independence as well as economic and social integration depend, among other things, on access to a barrier-free transportation network.

Persons with disabilities and seniors not only desire, but have come to expect the provision of increased routine services as opposed to limited special services in the transportation system. The efforts of government, industry and consumers will make accessible transportation a reality for Canada.

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LIABILITY AND EFFICACY IN MARINE TRANSPORTATION: IMPACTS OF THE NEW CARRIAGE OF GOODS BY WATER ACT

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Introduction

In May 1993 Canada adopted a new liability regime for marine transportation. It, like its predecessor, regulates carrier liability for cargo loss and damage. However, the new Carriage of Goods by Water Act,[1] or COGWA 1993 for short, sets higher limits and different conditions of liability, which are more in line with current international standards for the movement of overseas trade. So the question naturally arises as to the effect the new regime is likely to have on the business efficacy of marine transportation.

COGWA 1993 made three changes to Canadian law. It repealed the Hague Rules[2] in force since 1936, it implemented the Hague/Visby Rules[3] as the current law of sea carriage, and it enacted the Hamburg Rules[4] as potential law for the future. The source of all three sets of rules are successive intergovernmental agreements, none of which have been signed by Canada. However, Canada is free to adopt the contents of the conventions as local law, as it has chosen to do. Since the Hamburg Rules are only a future consideration and may never be brought into force in Canada,[5] they will not be discussed in this paper.

Emphasis will be placed on the consequences of adopting the Hague/Visby Rules. However, their consequences can only be understood against the background of the past law, ie., the Hague Rules, which they replaced. Furthermore, knowledge of the Rules is an insufficient context in which to assess their operational effects on marine transportation. Technological changes in shipping, market pressures on carriers, and marine insurance practices all exert symbiotic forces that demanded the reforms in the law and will shape its impacts. Hence, the first part of the paper explores the legal prescriptions while the second part takes into account the business experience of the shipping

community, before the conclusion seeks to predict the long term impacts of the new COGWA 1993.

Part I: Legal Prescriptions

The carriage of goods by sea is regulated by more laws than COGWA. Therefore, this part begins with a description of the major principles and differences in the Rules enacted by the former and the new COGWA and then goes on to discuss their operational interaction with the broader legal process.

1. Past Law: Hague Rules

Under the Hague Rules, the shipping line had broad responsibility for the goods being carried. It had to exercise due diligence to provide a seaworthy ship at the port of loading and had to properly and carefully load, stow and keep the goods during the voyage.[6] If the cargo owner could show the goods were delivered in short quantity or a damaged condition, the carrier was presumed to be liable for the loss. It could escape liability by proving it had in fact exercised the relevant diligence and care. Its presumed fault could also be excused on any one of seventeen enumerated "excepted perils".[7] This long list of exceptions mostly excused the shipping line if it could show the loss was occasioned by someone else's fault, but in one famous (infamous?) clause the carrier was exempted from responsibility for the negligence of the master and crew in the navigation and management of the ship.[8]

In return for assuming this legislated minimum responsibility for cargo, the shipping lines were accorded a maximum limit of liability, which was set at Can. $500 per package or unit of the goods being carried.[9] A higher level of compensation was only exceptionally payable when a higher value for the cargo was declared (and a higher freight paid) by the shipper or a fundamental breach of the carriage contract (such as a material deviation in the voyage) was committed by the carrier.[10] There were no grounds expressed in the Rules themselves for breaking the limits of liability for egregious wrongdoing.

These principles applied to cargoes of general merchandise carried under bills of lading and nowadays typically moved in containers. The Rules never applied to bulk cargoes moved on chartered ships.[11] Carriage by chartered vessels is not subject to any legislated regulations.

2. Present Law: Hague/Visby Rules

The present law is only an amended version of the past rules and not a wholesale reform of them. Two sets of internationally agreed amendments have been adopted in COGWA 1993. The first and substantive reforms are the Visby Rules agreed in 1968 (hence the name Hague/Visby Rules) and the later amendment is the Brussels or SDR Protocol of 1979.

The Hague/Visby Rules do not alter the shipping line's scope of responsibility or presumed liability upon proof of a cargo loss. Instead, they concentrate on the contentious issue of the carrier's limit of liability. While Can. $500 per handleable package might have been a satisfactory, even generous, limit of liability when introduced in 1936, variations in exchange rates and inflation in monetary values has reduced that sum to a minimal, some would say derisory, amount of compensation. The Hague/Visby Rules effectively doubled this limit of liability. The Visby Rules first expressed the new limit in Poincaré gold francs but, seeing that nearly all the world's major currencies had gone off the gold standard by 1972, the subsequent Brussels Protocol converted the sum into 667.67 SDRs or Special Drawing Rights of the International Monetary Fund.[12] This system provides a daily verifiable equivalence in local currency which on February 18, 1994, approximated $1.87 Canadian, thus producing a limit of liability of Can. $1,245 per package or unit.

While a limit of liability expressed in SDRs has greatly reduced the impact of individual currency fluctuations, it has done nothing to prevent depreciation in the value of compensation through world wide inflation. A recent UNCTAD Report[13] cited the IMF's own calculations that between 1979 and 1987 the limit of liability fell in value by a third, that is, 667 SDRs had become worth only 447 SDRs at 1979 rates. Inflation, even at lowered rates, has obviously continued to take its toll in the 1990s.

As an alternative, the Hague/Visby Rules introduced a second limit of liability by weight.[14] It was set at 2 SDRs per kilo which, again on February 18, 1994, was roughly equal to Can. $3.75 per kilo. This method may assist the fixing of compensation for large unpackaged goods, like pieces of machinery, boats and vehicles, which would otherwise be treated, under Canadian law, as single units subject to a maximum recovery of 667 SDRs. It may also apply as an alternative to the limit of liability for packages which are very heavy, since the Rules state that the higher level of compensation shall be paid. However, the UNCTAD Report previously referred to also records that the average package in international container traffic weighs no more than 50 kilos, which would yield a limit of liability of only 100 SDRs by weight. A package will have to

weigh 333 kilos, that is, more than 6.5 times the average weight, in order to approach the limit of liability of 667 SDR assessed by item.

The Hague/Visby Rules make one further refinement to the assessment of liability by settling the manner in which packages are to be counted. Various forms of unitization of goods, including sleds, pallets and containers, had increased the uncertainty in calculating the maximum liability payable. Some shipping lines' bills of lading contained clauses asserting that a complete forty foot container would be treated as one package. The Rules now define packages in terms of their enumeration on the face of the bill of lading.[15] Thus the shipper now has the power and the responsibility to protect itself by suitably describing the number of individual boxes and cartons of merchandise that it hands over on pallets or in a stuffed container to the carrier. This new rule confirmed what had already become, by judicial interpretation, the legal practice in Canada.

The one other significant change made by the Hague/Visby Rules to the liability regime is the introduction of a provision regarding unlimited liability. An award in excess of the limits of liability may be made when the cargo owner proves that its loss "resulted from an act or omission of the carrier done with intent to cause damage, or recklessly and with knowledge that damage would probably result."[16] These are very strict grounds for breaking the limits of liability, requiring such a degree of disregard for operating efficiency by the carrier as likely to render it incapable of continuing business in the highly competitive shipping industry.

3. Other Legal Prescriptions

The Hague/Visby Rules may have increased the ceiling of liability but they have not changed the circumstances in which a recovery is possible. The legal context in which the Rules operate contain a number of prescriptions that constrict legitimate cargo claims. These concern, in particular, problems of proof as well as the right to bring a claim.

The number and complexity of "excepted perils" in the Rules provide the carrier with plenty of grounds to dispute a claim and to dissuade the cargo owner from pursuing it. Their complexity compounds disputations over the facts of a claim by obscuring the burdens of proof, or which side should prove what. Bear in mind the difficulty for the cargo claimant of establishing the cause of its loss when all the available evidence about the voyage, and especially the peril encountered, is in the control of the carrier. In addition, the convenient use of containers has taken away much of the benefit to the cargo claimant of

possessing a clean bill of lading. It use to provide convincing evidence against the carrier of the cargo in its charge. But when, as is now usual, a shipment is presented for carriage in a container stuffed and sealed by the shipper and the carrier denies knowledge of its contents, the cargo claimant may be put to the affirmative proof of the goods themselves, as well as the reasons for their loss.[17]

In addition to proof problems, there are also stringent requirements on making a claim. In the first place, notice of any loss or damage to the goods is expected to be given to the carrier at the port of discharge immediately upon their delivery. If the damage is concealed, a leeway of three days is allowed. Otherwise, the shipping line is entitled to assume it has fulfilled the delivery in good order.[18] But the prevalent use of containers frequently makes it unlikely that the cargo claimant can meet these time limits. Containers of cargo are regularly forwarded from the port of discharge still sealed and are not opened and inspected until they reach their inland destination several days later. Thus, the time for notifying a loss may have passed even before the damage is discovered. In these circumstances, a claim is not prohibited but the cargo owner is put to the extra burden of proving positively that the loss occurred while the goods were still in the charge of the shipping line.

Secondly, the claimant only has one year in which to institute a law suit for compensation. The penalty for exceeding the deadline is much more severe than the sanction for notifying the loss out of time: any legal action is barred.[19] The one year time limit can easily catch a claimant out. It is a much shorter period than is customarily allowed for suits either in contract or tort in Canada and many other countries. In practice, many shipping claims are not settled within one year, and either an agreement between the parties has to be reached to extend the time limit or a scramble ensues to begin an action prematurely. This result is evidenced by the large number of reported cases fought about how to count the days constituting the one year limit.

Even if the time limits for claims are satisfied, the claimant may fail for lack of title to sue. Under the general law for maritime claims, following the common law tradition, the claimant must have been the owner of the goods at the time they were lost or damaged,[20] and, if the suit is for breach of contract, must also be privy to the agreement for transportation with the carrier.[21] The ownership rule, whether the action is in contract or tort, is grounded in the reasonable idea that the claimant must be able to show a sufficient interest in the goods in order to claim compensation for their loss or damage. Unfortunately, the law's interpretation of sufficiency of interest is full ownership. The expectation of ownership or the assumption of risk, such as the consignee might have when the goods are shipped but not yet delivered, is not

enough. Consider, for example, a typical international sale of goods against documents which is executed by negotiation of the carrier's bill of lading to the consignee during the voyage. The right of the consignee to sue for any loss may turn on the sheer coincidence whether the injury to the cargo occurred before or after the bill of lading was transferred.

The privity rule is a basic requirement of the concept of a contract, that it binds only the parties to it. Strangers are, in general, neither obliged by, nor have rights under, other people's agreements. Since a contract of carriage is typically made between the shipper and the carrier, the consignee, though intended to benefit from the agreement, is technically a third party or stranger to it and thus without a right to rely upon it or sue for its breach. This situation was recognized long ago as quite unsatisfactory not only for the cargo owner who might want to claim for a loss, but also for the carrier who may wish to sue the consignee for unpaid freight or some other unfulfilled obligation of the carriage. Hence legislation, in the form of the Bills of Lading Act,[22] was enacted to effect a translation of the shipper's rights and obligations in the carriage contract to the consignee on transfer of the ownership in the goods between them by negotiation of the bill of lading. By this subtle stroke, both prerequisites to the right to sue were satisfied at the same moment.

This arrangement works very satisfactorily whenever a bill of lading is employed to process the carriage, but that once ubiquitous document is much less commonly used nowadays. Frequently shippers, alias exporters, do not sell goods against documents. Increasingly, shipping lines move containerized cargoes not on bills of lading, but under non-negotiable documents, such as sea waybills and freight receipts, or by electronic processing, like EDI. In all these situations the Bills of Lading Act does not apply and so the consignee may not have the privity of contract necessary to found a claim for breach of carriage.[23]

These kinds of constraints do not deny carriers' liability, but they strongly affect cargo owners' opportunities for prosecuting legitimate claims. It makes no difference what level of compensation the Hague/Visby Rules grant if the circumstances surrounding the loss inhibit the bringing of a claim. In addition, the operation of the liability regime in the Rules also depends on how the shipping industry conducts its business.

Part II: Business Conditions and Practices

The legal web of regulation in which shipping lines operate interacts with a wide variety of shipping market realities and industry practices. Some of those that impact most significantly on the application of the legal regime concern technological developments in cargo handling, others arise because of the competitive circumstances of carriers and cargo owners and their insurers.

1. Technological Developments

It is no secret that bigger and stronger vessels with better motive power and specialized design, such as purpose-built container ships, have contributed to reducing the likelihood of cargo losses at sea. Marine risks are proportionately greater for the goods when ashore! Shipping lines are responsible by Canadian maritime law for cargoes in their custody at ports of loading, transhipment and discharge, so it is fair to speak of their exposure to injury as marine risks, but the Hague/Visby Rules are not compulsorily applicable at these points. The scope of the Rules is limited to the period the cargo is afloat between loading and discharge,[24] and so the shipping lines are free, by suitable notice in their transport documents, to set their own levels of liability for goods beyond the ship's tackle.

The practice of consolidating cargo in containers has also tended to reduce claims under the Rules. Firstly, containerization greatly simplifies the shipping lines' duties of care and significantly lowers the risks of loss and damage to the cargo. Secondly, when goods are damaged, containers are likely to conceal the injury. This feature increases the cargo owner's difficulty both in establishing the cause of the loss and in attributing the fault to the responsible carrier.

Container services have also encouraged much greater use of mainline and feeder systems of marine transportation to the advantage of both shipping lines and shippers in expeditious delivery, but when a loss occurs it becomes rather easier for each segmental carrier to disclaim liability and to force the claimant to search out the evidence of fault, much of which is exclusively within carrier control. Containers have also permitted the excellent development of efficient multimodal door-to-door deliveries but, in the event of a loss, this service has aggravated the problems of concealed damage and attribution of loss. The number of sea and land carriers and associated transhipment terminals on different phases of the movement simply multiplies the complications.

The general effect of technological improvements, therefore, is a positive reduction in the risks of cargo losses but a negative impact on the ability to

affix liability and make recovery under the Hague/Visby Rules when damage to the goods does occur.

2. Market Forces

The business conditions in at least two markets related to shipping also impact on the operation of the cargo liability regime. There is the shipping industry itself which must answer for cargo losses up to the statutory limit of liability, and there is the marine insurance industry which covers cargo losses in excess of that limit. So far as the shipping industry is concerned, carriers are wont to assert that any increase in their legal liabilities to cargo owners will rebound through a rise in freight rates. If this assertion is a version of the view that the total costs of the carrier must ultimately be borne by its customers, the cargo owners, it is a truism. But if it is made to suggest that there is a direct relation between greater recoveries from shipping lines and higher freight rates, and, more particularly, that an increase in liabilities must inevitably induce a rise in rates, it is not self-evidently true. Others who have studied the situation have concluded that the argument has not been sustained by the evidence.[25]

In any case, other items, such as bunker fuel and crew's wages, account for a far greater proportion of the costs of running a ship than cargo liabilities.[26] It would seem that the fluctuations in world prices for bunkers and the ability of the shipping lines to reduce crew costs dwarf the impact of the changes in the levels of cargo compensation. In addition, on highly competitive container trade routes, such as the major market of the North Atlantic crossing, only the most efficient and reliable shipping lines can survive. That means that everything must be done to minimize cargo losses for fear that shippers will move their custom to another carrier. In sum, although the shipping lines must absorb the new levels of liability under the Hague/Visby Rules, they are not likely to feel much pressure from them compared to other sources of existing commercial costs and concerns. In this, the carriers would also appear to be helped by the practices of the marine insurance industry.

Whether or not shippers know about the carrier's limit of liability or the difficulty in pressing claims, the common practice in exporting is to insure the goods against the risks of loss in transit for 110 per cent of their invoice value. When a loss occurs, the cargo owner receives full and effective compensation out of the policy, and insurers are the ones that actually have to face the problems of recovering the claim from the shipping line and its insurers, the P and I Clubs. In this the marine insurance industry seems to be none too successful or vigorous, for a variety of realistic commercial reasons.

The impression is that some recovery is made on about half the claims against carriers but the amounts received are usually a very small proportion of the sums paid out of insurance to the cargo owners.[27] The reasons for the poor rate of recovery are the ones already discussed. Finding hard evidence to confront the carrier that denies liability is difficult and time consuming. Bargaining for payment of even a portion of the carrier's limited liability is necessary. The ultimate recourse to litigation is slow and difficult, because of the legal complexities. In other words, seeking recovery is a very expensive business. Indeed, for many insurance companies it seems to be viewed as a waste of money and effort for they do not even have recovery departments.

These impressions are supported by the general wisdom of the industry that insurance companies do not make their business in claims but out of invested premia. Putting that proposition another, it may be said that recoveries from defaulting carriers are a profit centre. Claims are anticipated in setting insurance premia, so that any recovery is a bonus. Although the annual value of paid out claims for cargo losses totals millions of dollars there is little incentive to do much about their recovery since they are spread so widely amongst many insurance companies onto their very many more cargo clients. This, after all, is the *raison d'être* of the insurance industry: it can hardly be expected to injure its own business and livelihood.

The result is that cargo owners do not push their claims because they do not need to. Their insurance takes care of them. And their insurers often do not push very hard for recoveries on paid claims because it is not good business for them. So the shipping lines, who do not have much to fear from the cost of claims compared to other commercial considerations, are even relieved of some of that pressure by the unaggressive approach of the cargo's insurers.

Conclusion

In all the circumstances, how much change in marine transportation is the new COGWA 1993 going to make? So far as the introduction of the Hague/Visby Rules into Canadian law is concerned, the speculative answer is not much. The rights and responsibilities of shippers and carriers are not altered. Only in the event of a cargo loss in circumstances that attract carrier liability under the rights and responsibilities of the Rules may there be a different result. The difference arises from the upward movement of the limits of carrier liability. Since insured cargo claimants already receive full compensation out of their marine policies, they will continue to do so. Therefore, the increase in the level of carrier liability does not directly affect them. However, greater limits of liability ought to mean better recoveries of paid losses for cargo insurers.

At 666.67 SDRs or roughly Can. $1245 per package, the potential for recovery is nearly 2.5 times the old limit of Can. $500. It must be recognized, however, that this amount is continually subject to the inflation of monetary values. In particular, the new limit of liability is much less than the old one of $500 when converted into dollars at the time of its enactment in 1936. The addition of an alternative limit of liability by weight will improve the level of recovery for unpackaged items like heavy equipment and Ro-Ro units generally. But at 2 SDRs or roughly Can. $3.75 per kilo, maximum compensation will not make much of a contribution to a total loss. Consider, for instance, the limit of recovery for a 3 tonne tractor or truck: instead of Can. $500 per unit under the old Hague Rules, or Can. $1245 per unit under the Hague/Visby Rules, the carrier must pay Can. $3.75 x 3000 kilos or Can. $11,250. This sum is markedly greater compensation yet still very substantially less than the value of a new truck. The likelihood of breaking these limits of liability in order to recover an amount more like full compensation is practically nil in face of the new rule requiring proof of intentional damage or wantonly reckless behaviour by the carrier.

These increases in carrier liability seem meagre by comparison to the old limit of compensation when set in 1936 or the full value of merchandise and equipment today. But for each legitimate claim against the carrier, the insurance company ought to make a somewhat greater recovery if it pursues the case vigorously. To date, it frequently has not been worthwhile. One must ponder whether the potential for increased recoveries on the scale discussed is sufficient to encourage marine insurance companies to handle claims any differently than before. If not, the shipping lines have little to worry about, for they won't be called upon to answer for any greater proportion of cargo owners' claims and they won't have to pay that much more on the claims they do respond to. In sum, the business of marine transportation is set to sail on, minimally affected by the new liability regime introduced by COGWA 1993 in the form of the Hague/Visby Rules, - until, perhaps, the Minister of Transport chooses to invoke their replacement under the Act in the form of the Hamburg Rules, but that is another enquiry.

ENDNOTES

1. S.C. 1993, c. 21.
2. Found in the International Convention for the Unification of Certain Rules of Law Relating to Bills of Lading, done at Brussels in 1924.
3. Found in the 1924 convention, *ibid.*, as amended by the Protocols done at Brussels in 1968 and 1979.
4. Found in the United Nations Convention on the Carriage of Goods by Sea, done at Hamburg in 1978.
5. They came into force internationally in November 1993.
6. Hague Rules, *supra*, n. 2, Arts. III (1) and (2), IV (1).
7. Art. IV (2).
8. Art. IV (2)(a).
9. Art. IV (5).
10. See, e.g., *Stag Line v. Foscolo, Mango & Co.*, [1932] A.C. 328 (H.L.).
11. Hague Rules, Art. I (b).
12. As enacted together in COGWA 1993, *supra*, n. 1, in Schedule I, the Hague/Visby Rules, Art. IV (5)(a).
13. UNCTAD, The Economic and Commercial Implications of the Entry into Force of the Hamburg Rules and the Multimodal Transport Convention, U.N. Doc. TD/B/C.4/315/Rev. 1 (1991) at 14.
14. Hague/Visby Rules, *supra*, n. 2, Art. IV (5)(a).
15. Art. IV (5)(c).
16. Art. IV (5)(e).
17. However, the carrier may not deny receipt of the goods as described in the bill of lading if it has been transferred to a third party claimant who relied on it in good faith: Art. III (4).
18. Art. III (6).
19. *Ibid.*

20. *The Albazero*, [1976] 2 Lloyd's Rep. 467 (H.L.); *The Sanix Ace*, [1987] 1 Lloyd's Rep. 465; *The Wear Breeze*, [1969] 1 Q.B. 219; *The Aliakmon*, [1986] 2 Lloyd's Rep. 1 (H.L.).

21. See W. Tetley, *Marine Cargo Claims* (3rd ed. 1988) 177.

22. R.S.C. 1985, c. B-5.

23. Unless the consignee can convince the court to imply a separate contract with the carrier: see *Brandt v. Liverpool, Brazil and River Plate Steam Navigation Co. Ltd.*, [1924] 1 K.B. 575; *The Captain Gregos (No. 2)*, [1990] 2 Lloyd's Rep. 395 (C.A.).

24. Hague/Visby Rules, *supra*, n. 12, Art. I(e).

25. See J.C. Sweeney, "UNCITRAL and the Hamburg Rules - The Risk Allocation Problem in Maritime Transport of Goods" (1991), 22 *J. Mar. L. & Com.* 511, at 531.

26. See Dalhousie Ocean Studies Programme, *The Future of Canadian Carriage of Goods by Water Law* (1982) 287.

27. These impressions of the marine insurance industry were gathered from discussions with Ms. Patricia Bodkin, Wm. H. McGee Ins. Co.; Mr. Matthew Wrezel, Toplis & Harding; and Mr. Matthew Davis, Norwich Union Insurance Group, all of Toronto. See also UNCTAD report, *supra*, n. 13, at 39.

A Cluster Analysis of Vessel Accidents

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Introduction

Several studies [3] [9] [11] have reported that the Port of New Orleans and the lower Mississippi River ranked first among the nation's ports and waterways in deaths and injuries and second in dollar loss resulting from vessel accidents. According to Carpenter [2] and based on historic casualty records for the Port of New Orleans, the average cost of each vessel accident was estimated at $545,000.

Accidents are, by definition, unplanned and unforeseen occurrences. Their causes are often circumstantial, with chance serving as a catalyst [9]. But accidents are not necessarily improbable occurrences. Indeed, circumstances may provide any degree of likelihood that they will occur [7]. This study investigates the circumstances surrounding navigational accidents and evinces some significant conclusions about the likelihood associated with such events. Its usefulness lies more in the realm of navigational policy for the lower Mississippi River than it does in the area of short term cause and effect inferences.

As applied in this research, clustering provides an analytical technique which can be used to develop meaningful subgroups of vessel accidents. Specifically, the objective of cluster analysis is to classify a sample of entities into a small number of mutually exclusive groups based on the similarities among the entities. Unlike discriminant analysis, the groups are not pre-defined (i.e., discriminant analysis requires a priori knowledge of group membership to derive the classification rule). Instead, a clustering technique is used to identify the groups.

Cluster analysis is also different from other multivariate statistical techniques in that it does not treat some variables as independent and some as dependent. Instead, cluster analysis attempts to identify interdependencies among a number of variables without treating any of them as dependent or independent, such as required by factor analysis. Based on cluster analysis, this study is an empirical characterization of the population of more than 900 vessel accidents which occurred on the lower Mississippi River from 1979 through 1987. By studying clusters of vessel accidents, the research can determine the characteristics or attributes that the casualties share, as well as those in which they differ.

Multivariate Methods

Multivariate methods refer to those statistical techniques which focus upon the structure of simultaneous relationships among three or more phenomena. Multivariate analysis emphasizes the examination of the simultaneous relationships among phenomena. Multivariate methods differ from simple univariate (single phenomenon) statistical techniques in terms of a shift of focus away from the levels (averages) and distributions (variances) of the phenomena, and instead concentrate upon the degree of relationships (correlations or covariances) among these phenomena. They also differ from bivariate (two phenomena) statistical techniques by shifting attention away from pairwise relationships to the more complex simultaneous relationships among phenomena.

Multivariate methods can be broadly categorized into two types: functional and structural multivariate techniques.

Functional multivariate methods are most appropriate for building predictive models with which the researcher can forecast, or explain one or more phenomena from the knowledge of other phenomena based on their relationships. In order to satisfactorily utilize the functional multivariate methods, it is essential that the researcher has considerable knowledge or theory about the phenomenon with which to properly conceptualize a realistic model.

Structural multivariate methods are more descriptive and less predictive in nature. They are essentially data reduction techniques which simplify complex and diverse relationships among phenomena in a manner which enables the researcher to gain insights into the underlying and nonintuitive structure of relationships.

Cluster analysis is a structural multivariate method which enables the researcher to classify, segment or disaggregate entities into homogeneous subgroups based on their similarities on a profile of information. The objective in cluster analysis is to meaningfully classify a group of entities into mutually exclusive clusters based on some judgmental or statistical rule. There are many different algorithms available for cluster analysis, and very few have any statistical inferential properties. Therefore, cluster analysis is more a heuristic than a statistical technique. However, it does provide insights into the typology or segments present in the data.

Cluster analysis usually involves at least two separate steps. The first is the measurement of similarity or association between the entities in order to determine how many groups really exist in the sample. The second step is to profile the variables in order to understand group composition.

The Nature of Clusters

The primary reason for the use of cluster analysis is to find groups of similar entities in a sample of data. These groups are conveniently referred to as clusters. There is no standard definition of the term "cluster." Despite the lack of a consistent definition of the term, it is clear that clusters have certain properties, the most important of which are density, variance, dimension, shape and separation [10].

Density is a property of a cluster that defines it as a relatively thick swarm of data points in a space when compared to other areas of the space that may have comparatively few or no points. There is no absolute measure of density, but the concept is intuitively obvious. *Variance* is the degree of dispersion of the points in this space from the center of the cluster (i.e., the relative nearness of points to one another in the space). Therefore, clusters can be said to be "tight" when all data points are near the centroid, or they may be "loose" when the data points are dispersed from the center. *Dimension* is a property closely related to that of variance; if a cluster can be identified, it is then possible to measure its "radius."

Shape is simply the arrangement of points in the space. While the typical conception of the shape of clusters is that they are ellipsoids, many different kinds of shapes, such as elongated clusters, are possible. If clusters are shaped in this manner, the concept of a radius or diameter is not useful. Instead, the "connectivity" of the points in the cluster, a relative measure of the distance between them, can be calculated. *Separation* is the degree to which clusters overlap or lie apart in the space. For instance, clusters may be relatively close to one another with no clear boundaries or they may be widely separated with large gaps between them.

Taken together, these terms can be used to describe any type of clusters within a space. From Everitt [5], clusters are "continuous regions of (a) space containing a relatively high density of points, separated from other such regions by regions containing a relatively low density of points." This definition does not restrict the conceptualization of clusters to any particular form before data analysis takes place, nor does it restrict the analysis to any specific clustering method.

Marine Casualty Database

In this research process, the choice of variables to be used with cluster analysis is the most critical step, i.e., to find that set of variables which best represents the concept of similarity. If important variables are excluded, poor or misleading findings may result. Ideally, variables should be chosen within the context of an explicitly stated theory that is used to support the classification [4]. The theory is the basis for the rational choice of the variables to be used in the study. In practice, however, the theory that supports any classification research is often implicit. For this study, recognized experts in maritime safety for the lower Mississippi River were surveyed to determine the most critical variables to use in this cluster analysis.

The terms "case," "entity," "object" and "pattern" denote the accident data being classified; whereas, "variable,' "attribute," "characteristics" and "feature" of the accidents are used to assess the cases' similarity.

The variables for this cluster analysis were identified as the result of discussions with members of the Port Safety Council, Port of New Orleans. Members of the Council include representatives from the following maritime groups: U.S. Coast Guard (Captain of the Port, Marine Inspection Office, Commanding Officer of NOLA-VTS); U.S. Army Corps of Engineers; dock and harbor authorities (Ports of Baton Rouge and New Orleans); steamship companies; barge lines and towing firms; pilot associations; and shippers (Exxon Shipping Co., Texaco, Inc., Chevron U.S.A.). All maritime parties who were interviewed agreed that the following variables concerning vessel safety were most important for any study of accidents on the lower Mississippi River.

The New Orleans Vessel Traffic Service (NOLA-VTS) monitors vessel traffic on the lower Mississippi River from Devil's Swamp near Baton Rouge south to the Gulf of Mexico beyond New Orleans - a distance of about 250 miles [12]. As a voluntary vessel movement reporting system, NOLA-VTS provides ocean-going ships, large barge tows, and other river traffic with pertinent information to aid in making decisions as to the proper navigation strategy in plying the lower Mississippi River. In addition, the NOLA-VTS audits vessel accidents and records them on a daily log.

This database was arranged so as to be consistent with the six operational sectors of the lower Mississippi River as delineated by NOLA-VTS, the primary data source. Table 1 shows the six VTS sectors and their respective mile marks.

Table 1. Vessel Traffic Service Sector Boundaries

Sector	Ports	Description - Mile Marks
I	Port Sulphur	Southwest Pass - 75.5 AHP
IA		MS River Gulf outlet - MRGO 50.7
II	New Orleans	75.5 AHP - 113.0 AHP
IIA	Avondale	MRGO 50.7 mile - Industrial Lock
III	Destrehan Grammercy St. Rose Good Hope	113.0 AHP - 159.5 AHP
IV	Baton Rouge	159.5 - 242.0 AHP

Note: Mile marks are posted at each tenth of a mile and refer to the lowest Mississippi River or the Mississippi River Gulf Outlet (MRGO) above Head of Passes (AHP).

The data set for this research study is comprised of 936 cases of vessel accident data occurring between 1979 and 1987 on the lower Mississippi River. Each accident record consists of the following attributes: 1) whether or not the vessel(s) involved in an accident were participating in the vessel tracking; 2) accident type; 3) river stage; 4) traffic level; 5) utilization rate of the U.S. Coast Guard's vessel tracking service; 6) accident location; 7) weather; and, 8) time of the accident. Table 2a and Table 2b provide descriptive statistics about the following variables used in the cluster analysis of vessel accidents.

Participation - This dichotomous variable [6] indicates whether or not a vessel, which was involved in an accident, was participating in the vessel tracking service. This indicates communication between vessel and NOLA-VTS's control center and the exchange of pertinent information to aid navigation efforts.

Accident Type - According to NOLA-VTS, casualty types include: 1) collisions; 2) rammings; and, 3) groundings. A *collision* is defined as any contact between vessels which are underway, anchored, moored, or in the process of docking or undocking. A *ramming* is the collision of a vessel with a fixed object such as a wharf, dock, pier, bridge, submerged object, or aid to navigation. *Groundings* represent vessel contact with the river bottom, and may or may not result in damage to the vessel. [6]

River Stage - The stage of the river (height above sea level measured in feet) is a very critical element of vessel safety, because river stage directly determines the velocity of the current. The hazardous conditions that often accompany the changes in the river stage (hence, river current) precipitate many vessel casualties on the lower Mississippi River between Baton Rouge and the Gulf of Mexico. River stage is a continuous variable.

Traffic Level - According to maritime authorities, traffic level is another major element influencing the occurrence of accidents in the study area. The measure of traffic includes ocean-going ships, barge tow assemblies, tugs, as well as excursion craft. Traffic level, as measured by the number of vessel movements, represents the number of vessel transits on the day of the accident. Traffic level is a continuous variable.

System Utilization - The system utilization variable is defined as the percentage of total vessel movements which were VTS-supported on the day of the accident. The U.S. Coast Guard calculates the level of utilization for the NOLA-VTS at the hour of peak daily traffic. System utilization is a continuous variable.

Location - Indicator variables provide the area of the lower Mississippi River where the accident happened. Six areas, each with a different physical geography, were employed. (Refer to Table 1 for definition of sectors and Table 2b for frequencies of where accidents occurred.) The percentages of accidents occurring in each location category were used as indicators of the relative strength of the areas in determining accidents.

Weather - Meteorological conditions that are hazardous to navigation in the study area are those which produce strong winds, heavy rainfall, and fog. Indicator variables were constructed to model these seasonal weather patterns which affect navigational safety on the lower Mississippi River (i.e., Dec-Jan, Feb-Mar, Apr-May, Oct-Nov, Jun-Sep). The percentages of accidents occurring in each weather category were used as indicators of the relative strength of the weather groupings in determining accidents. The percentages of accidents occurring in each time category were used as indicators of the relative strength of the time groupings in determining accidents.

Time - The time that a vessel casualty occurs is recorded by the U.S. Coast Guard using the standard military clock. For purposes of this analysis, the time of an accident was indicated by one of four categories: between midnight and 6:00 AM, between 6:00 AM and noon; between noon and 6:00 PM, and between 6:00 PM and midnight.

Table 2a. Descriptive Statistics - Continuous Variables

	Frequency	Percent	Mean	Min	Max
River Stage					
.1 - 4.5	309	33.0	9.2	.1	17.2
4.5 - 9.2	180	19.2			
9.2 - 13.2	128	13.7			
13.2 - 17.2	319	34.1			
Traffic Level					
3 - 130	6	.6	256	3	466
130 - 256	474	50.6			
256 - 361	373	39.9			
361 - 466	82	8.8			
Utilization					
3.0 - 18.4	7	.7	33.8	3.0	65.0
18.4 - 33.9	469	50.1			
33.9 - 49.4	449	48.0			
49.4 - 65.0	11	1.2			

Table 2b. Descriptive Statistics - Categorical Variables

	Frequency	Percent
Accident Type		
Collision	207	22.1
Ramming	422	45.1
Grounding	297	31.7
Time		
0:00 - 5:59 AM	266	28.4
6:00 - 11:59 AM	178	19.0
12:00 - 17:59 PM	230	24.6
18:00 - 23:59 PM	262	28.0
Participation		
Non-Participant	505	54.0
Participant	428	45.7
Weather		
Dec - Jan	172	18.4
Feb - Mar	120	12.8
Apr - May	295	31.5
Oct - Nov	92	9.8
Jun - Sep	257	27.5
Location		
I - Miss River	194	20.7
IA - Gulf Outlet	14	1.5
II - Miss River	228	24.4
IIA - Gulf Outlet	9	1.0
III - Miss River	169	18.1
IV - Miss River	322	34.4

The Cluster Procedure

There are many methods available for cluster formation. For a particular problem, selection of a technique depends not only on their features but also on the data set to be analyzed.

An algorithm based on nearest centroid sorting [1] was employed to efficiently cluster this large number of cases. Unlike other clustering algorithms, which result in a series of solutions corresponding to different numbers of clusters, this procedure generates only a single solution for the number of clusters requested. The number of groups must be designated by the analyst.

With this algorithm, a case is assigned to the cluster for which the distance between the cases and the center of the cluster (centroid) is smallest. The actual mechanics of the procedure depend on the information available. If the cluster centers are known, they can be specified in advance and case assignment is based on them. Otherwise, cluster centers are estimated from the data.

Table 3, giving the final cluster centers, contains the average values of the variables for each cluster but provides no evidence of the variability or correlation between variables. The number of accident cases assigned to each of the four groups is also shown.

In this analysis, solutions ranging from two to six clusters were tested by discriminant analysis. Discriminant models were built using the same variables which were used to cluster the groups. The discriminant criterion used to determine the optimum cluster solution was the percentage of cases correctly classified into clustered groups by the discriminant model. This criterion indicated that the four-group cluster solution was optimal, with 96 percent of cases being correctly classified. All variables were standardized to "Z" scores prior to clustering to prevent number sizes of the different measurements from affecting the analysis.

Table 3. Group Means for Accident Clusters (N = 923)

	Group 1	Group 2	Group 3	Group 4	Total
# Cases	224	226	133	340	-----
Participation	1.000	.677	.368	.000	.462
Accident Type	1.906	2.535	2.068	1.950	2.099
River Stage	6.255	14.115	7.022	8.409	9.084
Traffic	229.204	335.487	235.986	227.239	255.481
Utilization	32.578	37.529	34.035	32.177	33.852
Location	28.475	25.813	20.537	25.174	25.464
Weather	21.188	30.397	21.129	21.095	23.400
Time	26.169	25.604	20.176	27.209	25.551

Table 4. Description of Accident Clusters

	Group 1	Group 2	Group 3	Group 4
Cases	224	226	133	340
V1	1.00000	.67699	.36842	.00000
V2	62% Ram[a] 86% C&R[b]	66% Ground[c]	53% Ram 73% C&R	49% Ram 77% C&R
V3	Slow Current[d] 69% < 7 Feet	Fast Current 73% > 14 Feet	Slow Current 58% < 7 Feet	Slow Current 48% < 7 Feet
V4	Moderate	Heavy	Moderately Heavy	Moderate
V5	Moderate	Heavy	Moderately Heavy	Moderate
V6	Concentrated Sector IV	Scattered	Scattered	Scattered
V7	36% Bad Weather	74% Apr-May Bad Weather	43% Bad Weather	45% Bad Weather
V8	Dispersed	Dispersed	83% Mornings 94% Daylight	0 Mornings 73% Night

[a]Ram is abbreviation for ramming.
[b]C&R represents collisions and rammings combined.
[c]Ground refers to a grounding of a vessel on the river bottom.
[d]Speed of current is directly related to river stage (i.e., the lower the river stage the slower the current and vice versa.

V1 = Participation; V2 = Accident Type; V3 = River Stage; V4 = Traffic; V5 = Utilization; V6 = Location; V7 = Weather; and, V8 = Time.

Description of Clusters

The resulting clusters will be discussed and compared in an order which emphasizes the apparent general impact of the VTS participation rate across the four groupings. Despite their obvious influence, the other seven features of the accident cases had varying effects on particular clusters.

Group 4 - Group 4 may be characterized as *Accidents that Shouldn't Have Happened*. This cluster consists of 340 accident cases, the largest cluster containing more than one-third of the sample of 923. By inspection of the descriptive information in Table 4, which was prepared by reviewing cross-tabulations of attributes by group membership, the attribute values of this group describe generally good navigational conditions, such as slow current, moderate traffic levels, and moderate (i.e., not low) utilization levels of the VTS along the lower Mississippi River. Other characteristics of these entities include a preponderance of collisions and rammings which usually occurred at night and not concentrated in any particular sector of the river. Forty-five percent of accidents occurred during months enduring bad weather (i.e., December, January, April and May), indicating that bad weather as expected contributed to casualties [8].

The most distinctive property of this group was that **none** of these vessels involved in an accident was participating in the NOLA-VTS at the moment of the incident. This phenomena, added to the serious nature of collisions and rammings along with moderate levels of VTS utilization by mariners plying the river at the time of the accident, indicates a powerful influence to ascribe these accident cases to Cluster 4. These accident cases reveal potentially serious casualties, despite reasonable navigational conditions and in conjunction with no mariner in this group partaking of the tracking service.

Group 2 - Group 2 may be characterized as *Bad Conditions for Good Navigators*. This cluster represents a dramatically different set of attribute values than does group 4. In general, group 2 is characterized by relatively poor circumstances for navigation, such as fast current, heavy traffic and the bad weather conditions of April and May (i.e., 73 percent of these cases occurred in these two months). The location and time attributes were not concentrated in any particular category but were distributed across these respective dimensions. The distinguishing attribute values for this group were: the high utilization levels (i.e., 80 percent of the cases were at "high" utilization rates) of the tracking service by mariners across the system at the time of these accidents; the high participation rate (67 percent) in the VTS for these accident cases in group 2; and, that the majority (66 percent) of accident types was a grounding.

A grounding is not a serious marine casualty like a collision or ramming. A grounding is defined as the vessel touching the river bottom, without regard to damage to the craft or whether the vessel was immobilized. Despite poor or even treacherous conditions, these accident cases in group 2 were most likely to be a non-serious casualty. Coupled with the

high participation rate, these attribute values indicate that these mariners were doing a good job during the most trying of conditions, in contrast to the accident cases in group 4.

Group 3 - Group 3 may be characterized as *Probably Preventable*. This cluster exhibits attribute values that lie between the initial two groups already discussed. These intermediate characteristics depict mediocre conditions for navigation and associated accidents. This group of entities, with the least number of assigned cases (e.g., 133 entities or 14 percent), manifested slow river current and moderately heavy traffic. System-wide utilization of the NOLA-VTS was moderately heavy, while the location of accidents was scattered along the lower Mississippi River and not concentrated in any particular sector. About 43 percent of these accidents occurred during the months with bad weather for navigation. Of particular interest, 83 percent of these accidents materialized during the morning hours between 6:00 AM and noon, and 94 percent of all accidents happened during the usual daylight hours (e.g., 6:00 AM to 6:00 PM). Collisions and rammings accounted for 73 percent of all accidents in group 3, while the participation rate was about 37 percent.

Group 3 is relatively similar to group 4. A distinct property of both these groups was a relatively low (39 percent) in the former and the non-existent participation rate in the latter for NOLA-VTS at the moment of the incident. The serious nature of collisions and rammings, combined with moderate or even higher levels of VTS utilization as well as tolerable maritime conditions, suggests similar but nevertheless different groups. Group 3 is distinct because of the higher participation feature and the very high percentage of accidents that occurred during the morning hours. Group 4 experienced 73 percent accidents at night.

Group 1 - This cluster is another very interesting and unique group, especially in reference to group 4. Group 1 may be characterized as *Danger Zone*. Group 1 experienced a 100 percent participation rate, while group 4 had zero participation. Group 1 contains about 25 percent of the accident cases. As for attribute values in cluster 1, rammings comprise 62 percent of accident types, while collisions add another 24 percent. Together, these potentially serious casualties total 86 percent of accident types. There is no particular time segment when these accidents are more likely to occur. Thirty-six percent of the casualties happen during bad weather, slow current, moderate traffic levels, and moderate (i.e., not low) utilization levels of the VTS along the lower Mississippi River.

However, the *location* of the collisions and rammings is a very distinctive feature of this cluster. Fifty-six (56) percent of the accident cases are located in Sector IV of the lower Mississippi River. This section of river is especially dangerous for vessel traffic because of the myriad of narrow twisting turns, making navigation very hazardous for large ships and barge tows which are destined for the heavy concentration of petrochemical refineries and grain elevators in this area of the Mississippi River. This group can be characterized by river mariners attempting to provide safe passage for their vessels, cargoes and crews in treacherous waters as evinced by the 100 percent participation rate, but experiencing more than half of their accidents (typically collisions and rammings) in a most dangerous sector of the lower Mississippi River.

Table 5. Pooled Within-Group Correlation Matrix

	V1	V2	V3	V4	V5	V6	V7	V8
V1	1.000							
V2	.046	1.000						
V3	-.077	-.158	1.000					
V4	.004	.106	-.229	1.000				
V5	-.031	-.063	.006	.003	1.000			
V6	-.144	-.029	.064	-.100	-.036	1.000		
V7	-.029	-.105	.226	-.494	-.018	.008	1.000	
V8	.107	-.031	-.049	.045	.019	-.231	.021	1.000

As shown in Table 5, the pooled within-groups correlation matrix indicates if there is any substantial association between the various attributes. The highest correlation coefficient is -.229 between river stage (the proxy for speed of current) and traffic. This maximum correlation level indicates a minimum association between two variables and suggests that these attributes are very independent features of the accident cases.

Table 6 contains F-ratios for examining differences between the clusters. The F statistics represent the ratio of between-clusters mean square to within-cluster mean square. Large ratios (with 3 and 919 degrees of freedom) and small observed significance levels are associated with variables that differ between the clusters. However, the F tests should be used only for descriptive purposes since the clusters have been chosen to maximize the differences among cases in different clusters. The observed significance levels are not corrected for this, and thus cannot be interpreted as tests of the hypothesis that the cluster means are equal. Nevertheless, all variables had highly significant F statistics, indicating that the mean values of the attributes could be decidedly different and account for the assignment of cases to unique groups.

Table 6. Analysis of Variance

Variable	F-Ratio	Significance
Participation	568.00	.0000
Accident Type	41.69	.0000
River Stage	122.90	.0000
Traffic	188.40	.0000
Utilization	35.77	.0000
Location	35.09	.0000
Weather	104.50	.0000
Time	225.70	.0000

Summary and Conclusions

For this large sample of accident cases, cluster analysis generated four groupings that are relatively unique in their respective attribute values. These categories are logical groups, giving the realities of navigating the lower Mississippi River.

The most interesting conclusion is that for individual vessel participation in the NOLA-VTS; and, the most interesting comparison is that between Group 4, *Accidents that Shouldn't Have Happened* and Group 2, *Bad Conditions for Good Navigators*. The former group, with *none* of the vessels participating, consisted of relatively severe accidents occurring in relatively good navigating conditions. The latter group, with two-thirds of vessels participating, consisted of relatively non-severe accidents occurring only in the worst of conditions. In addition, Group 1 (*Danger Zone*) accidents, with 100 percent of vessels participating, were characterized primarily by their location in the most treacherous area of the river. Finally, Group 3 (*Probably Preventable* accidents), with their low participation rate, also included relatively severe accidents occurring in average or good conditions. In brief, heavy participation rates were associated with less severe accidents occurring in the worst of conditions, whereas low participation rates were associated with more severe accidents occurring in relatively good navigating conditions.

The individual participation rate of the VTS measures the linkage between specific mariners, the vessel tracking technology, and the system performance dimension of accidents. Accidents serve as an operational measure of marine safety, and specifically the safety of vessels, crews and cargoes. Significant incremental participation rates for the marine tracking technology across the accident clusters effectively distinguishes between casualty groups. From a risk and insurance perspective, these findings might provide justification to require participation in the vessel tracking service, either by governmental agencies or private insurers.

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THE DETERMINANTS OF SHIPPING RATES: A NORTH ATLANTIC CASE STUDY

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Abstract

This paper explores the factors that influence the rates charged by liner shipping firms on the North Atlantic. In particular a case study is presented looking at the effects of various cost and demand variables on standard (dry van) container rates. The study makes use of a unique data base to examine the role of factors such as cargo weight and nautical distance as determinants of the prices paid. The nature of the customer (freight forwarder, consignee or shipper) is also examined to reflect the influences of requirement variations on pricing in addition to that of the commodity cost of provision. The study takes account of the direction of the trade (i.e., eastbound vs. westbound) as a further influence. The study uses basic statistical procedures to consider variability of rates and to relate these to the set of explanatory factors. No previous studies of conference pricing have included a customer type variable.

Literature Review

The pricing of liner shipping has been a major issue since the UK's Royal Commission on Shipping Rings reported in 1909. The majority of studies have examined how conferences set prices and have taken one of two approaches: they either focus on how conferences should be regulated or, by reviewing published tariffs, attempt to draw conclusions about the influence of relevant variables upon the published prices. This paper is written in the latter vein.

In liner shipping it has long been established that differential pricing is beneficial to both shippers and the line. As explained by Heaver (1977), commodity D is not profitable to carry, and B and C would not move if the average cost were charged but will if some variant of differential pricing is used (Exhibit 1). A detailed look at the Australia–Europe Conference by Zerby and Conlon (1978) produced a breakdown of rates which generally confirmed that the low value-bulk cargoes (i.e., ores and metals) that are carried at (or sometimes slightly below if ballast is required) the average incremental costs of loading and unloading, while high value products are carried at considerably higher rates with a ceiling imposed by competition from air transport. Such a pricing approach enabled carriers to broaden the service beyond the levels which would be carried under a simple FAK pricing structure.

Exhibit 1: Liner Pricing Based on Relevant Costs

Commodity	Ability to Pay	Average Cost Per Unit	Incremental Cost
A	2.50	2.22	2.22
B	1.80	1.95	1.60
C	1.50	1.82	1.30
D	1.00	1.75	1.10

Source: Heaver (1977), page 35. (Not all data reproduced but demand, ship size and ship cost were). This table also appears in Heaver (1982).

Early liner pricing studies, such as O'Loughlin (1967) and Bennathan and Walters (1969) focused on port/distance determinants and elasticity of demand respectively but their findings have little relevance to the containerization era. Subsequent studies can be considered more relevant. Bryan (1974) statistically examined the impact of unit value, stowage, distance, quantity shipped, conference membership, and number of non-conference competitors on ocean-going freight rate variations for outbound Canadian liner cargo in 1969. After performing separate and combined regression analysis models, Bryan concluded that while "conferences and monopoly liners" discriminated upon both unit value and bulk, variations based on distance, quantity shipped and competition although significant were less pronounced. As with many of the other early studies, liner prices were evaluated on a per ton basis rather than a per TEU basis.

Heaver (1973) refuted O'Loughlin's research; he examined four independent variables in an effort to identify the determinants of freight rates—the stowage factor (in cubic feet per long ton), the value of the goods (dollars FOB per long ton), total quantity shipped per year (dollars FOB for each commodity annually i.e., aggregate not by individual firm) and the requirement for refrigeration. The tariff is the one published, which may not be the one paid, and the value was taken from trade statistics and not the individual company paying the freight bill. The study explained 75 to 92 percent of the variation in price paid and Heaver (1973) concluded that the rate is not set at "all the market will bear" but at a cost-determined rate in which the stowage factor is the fundamental determinant—reflecting loading and discharging costs as well as vessel capacity—and some recognition is given to the unit value of the commodity carried. To be sure that loading and discharging costs do not obscure the factors influencing the rate paid on the ocean leg, the study presented in this paper excludes loading and discharging costs, and uses the **actual price paid** taken from invoice summaries rather than the tariff published, an important difference from any other liner pricing research.

Deakin and Seward (1973) examined the value of the product carried, tonnage, stowage, hazardous nature, need for refrigeration, "individually priced items" or classed items, and a variable for other items. They concluded that demand factors accounted for about two-thirds of pricing variation while cost factors accounted for the remaining one-third and that buyer knowledge of market prices is limited. This last is very different now, not just for a given route but on a world wide basis, due to the globalization of the business of the buyer.

While several studies found that the stowage factor and the unit value of the commodity to be the most important factors accounting for variations in liner freight rates, Schneerson (1976) concluded that demand played a significant role in establishing rates and that "misconceptions of costs as reflected in the use of the stowage factor in establishing rates is perhaps the practice in most urgent need of rectification in the pricing system."

Wei *et al.* (1984) used published tariffs to analyze freight rates on the North Atlantic and did not follow Schneerson's (1976) advice. Their results showed a positive correlation between the conference tariff, the unit value, the stowage factor, and the dummy variable for temperature-controlled containers. The particular problem of estimating the value of the cargo and the stowage factor persisted even though it was clear that the market was in the throes of change and that stowage is only relevant if the ocean leg is fully utilized, not common in the climate of excess capacity experienced in the 1980s. The problem with including cargo value is further discussed by Sjostrom (1992) as a confounding factor.

The deficiencies of most studies using published rates is they do not reflect that individual lines within the conference may opt to change the rate (Jansson and Schneerson, 1987). In a study comparing a conference index with an individual line's freight index, they concluded that the conference index showed much greater rate stability and was different in both direction and magnitude to the actual paid. Evidence also showed that changes in conference rates did not reflect "across-the-board" changes but were route-specific, e.g., they behaved according to the specific conditions prevailing on a particular route. Concluding that published rates are a poor guide to the actual development of rates, they believed that such rates should be interpreted as "ceiling" or "maximum recommended prices." The need to look at actual prices paid is clear.

Furthermore, Jansson and Schneerson (1987) predicted that the stowage factor no longer carries "any particular significance." The correlation between dependent variables was strongest between weight and container size, not surprising as very heavy products cannot exploit the cube benefits of a 40' over a 20' container. They concluded that the reason for the strong stowage factor influence on freight rates is due to freight rates being the sum of the direct handling cost plus a "contribution margin" based on the principle of charging what the traffic will bear. This review indicates the need for a study which isolates the ocean leg from terminal and inland charges as well.

There have been few studies which have compared conference prices to non-conference prices on the same route—one exception being Bryan (1974). The flurry of activity examining liner pricing diminished in the early 1980s—with the exception of Wei *et al.* (1984) and Jansson and Schneerson (1987), both of which made valuable contributions to the literature—only to be revived by the Federal Maritime Commission (1989) and Sjostrom (1992) along with the current debate about how conferences are regulated in the U.S. and the European Union, particularly with respect to the TransAtlantic Agreement.

This literature review has highlighted the prevailing rationale for liner prices and the debate which existed in the 1970s. But the marketplace has changed. Changes in technology have restructured the marketplace for liner shipping over the past decade, particularly broadening the hinterland of specific

routes and forcing carriers to contemplate hardware-sharing on a large scale. The "product" has changed from predominantly breakbulk to a relatively anonymous box even for traditional bulk commodities. Management techniques have certainly changed with the professionalization of ship management and, finally, the non-conference share of liner shipping has grown to be significant. Competition from tramp and neo-bulk carriers continue to set a ceiling on how high prices for the transport of resource-based shipments may go before shippers switch and the availability of air cargo continues to influence the relevant range for finished goods with high-value, low-density characteristics. The argument about whether rates are cost-based or value-based appears less relevant. Carriers have better information on costs and buyers have better information on prices and their market options.

Assuming for the moment that conferences allow price differentiation by shipper, this study will consider the possibility that current pricing already includes such differentiation. As seen in Exhibit 1, price discrimination can result in more goods being traded because of cross-subsidization. Also price differentiation is possible because some buyers are prepared to pay for the provision of differing levels of service and therefore encourage this type of pricing behaviour on the part of transport suppliers. But there must be a perceptible difference in service for the strategy to work.

In summary, the majority of liner pricing studies have focused on the macroeconomic issues and the regulation of liner shipping conferences. Very few have focused at the micro-economic level and the effect of liner membership on the pricing strategies of the firm. The few micro-economic studies have been based on published tariffs and not the price actually paid, and none have contemplated whether or not prices have been influenced by the type of customer seeking the service. In particular, they fail to address the question facing many liner conference members: is it appropriate to abandon commodity-based tariff systems and move to a freight rate structure reflecting different service levels? Where such service level pricing is deemed inappropriate by regulatory agencies, are there other pricing strategies possible? This paper intends to provide additional information to assist liner shipping firms in addressing these questions but does not go so far as to answer them. That is a strategic planning problem to be solved by the individual firm.

Price Differentiation—The Potential

One possible new approach to pricing is some variant of yield management—a strategy which focuses on isolating the high and low price markets and differentiating the product enough so that the low price version is unattractive to the high price market thereby minimizing the probability of revenue dilution. Unlike the classic economic model of price discrimination where management increases revenue by charging different groups of customers (differentiated by their price elasticities) different prices for the *same product*, some qualitative or other form of product differentiation is involved in yield management. This requires some means of isolating customer groups, for example, by the provision of special services demanded by one group and not another. (For a more detailed discussion of the principles, see Brooks and Button, 1994.) Therefore, from one point of view, it is worthwhile determining if customer type is a significant factor in existing liner prices. From another, it has been shown that

different types of customers have different needs (Brooks, 1993) and there may be the potential to extract greater revenue without an equal or greater rise in costs if an alternate pricing system is used.

Methodology

The research data presented here were collected from the manifests of four sailings—two Eastbound and two Westbound on the North Atlantic. On this route, conference carriers easily carry non-conference cargo, and therefore within the same vessel identical cargoes may bear different prices for the ocean leg. The conference structure limits pricing latitude while the non-conference cargo may be carried at whatever price the carrier is able to negotiate. The manifests chosen had a mix of conference and non-conference cargo and took place within a three-week period in 1990, prior to the implementation of the rationalization agreement of May 1991 and the attendant slot-charter arrangements between the conference operators in the Canadian trades.

For each shipment, the data collected comprised the sailing (1 of 4), the direction (eastbound or westbound—EB or WB), the number of containers in the shipment, length of container (20' or 40'), the type of container (dry van, reefer, other), port-to-port combination for the ocean leg (later converted to nautical miles), the ocean tariff actually paid (in both its original currency and USD equivalent), the commodity classification (2-digit SIC), the weight of each container (in kilograms per TEU), and the conference/non-conference status. (A TEU is a 20' Equivalent Unit.) Collecting only the tariff for the ocean leg stems from the fact that most carriers merely pass the other costs along; although the shipper buys based on a door-to-door price, the carrier has only nominal control over this part of the container's journey. From these data, the TEU for each shipment was calculated, as was the tariff in USD per TEU using the exchange rate employed for accounting purposes (the *Financial Times* published interbank rate for the date of sailing) for those shipments not already converted to U.S. dollars by the carrier on the invoice summary.

The data were cleaned by deleting those shipments with a mix of 20s and 40s (and only a single tariff noted), and those which were repositionings or billed on another voyage and therefore no tariff was recorded. Those shipments traveling on multiple bills of lading, but in one container and with one tariff, were aggregated for weight data purposes and recorded as "consolidated cargo." The full data set Eastbound contains 50 2-digit SIC product categories of non-conference cargo and 60 product categories of conference cargo, while Westbound there are more non-conference categories at 57 with 53 conference product categories. The parameters of the data set appear in Exhibit 2. Although empty containers being repositioned were deleted from the data set, it is not possible to remove those containers being moved with very little cargo primarily for repositioning purposes and containing some revenue-contributing cargo which otherwise would not move; there is nothing on a bill of lading to indicate the extent of this practice and whether the particular container has been incrementally priced for this reason.

Exhibit 2: Statistics on Full Data Set

Voyage	Shipments	Containers	TEU	Mean* per TEU	Maximum* per TEU	Minimum* per TEU
1 (WB)	497	679	961	1.1783	5.5203	.1792
2 (WB)	505	681	971	1.1447	4.7638	.1792
3 (EB)	494	770	1103	.7741	4.2783	.0656
4 (EB)	357	636	861	.8587	9.5586	.0817
WB Total	1002	1360	1932	1.1616	5.5206	.1792
EB Total	851	1404	1962	.8100	9.5586	.0656
Total	1853	2764	3894	1.0000	9.5586	.0656

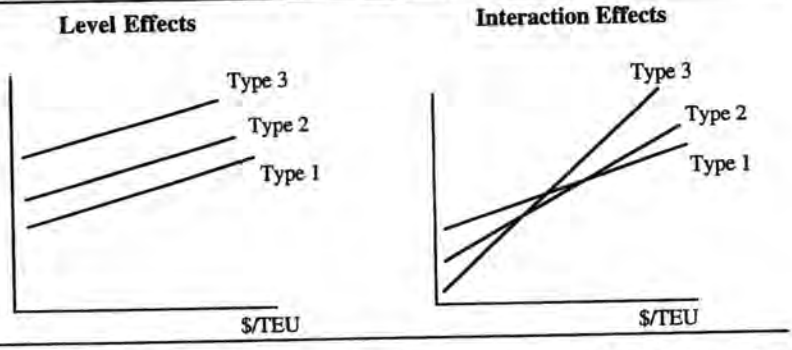
Note: * All means are reported as indexed to protect the confidentiality of the data. The difference between the means Eastbound and Westbound was tested and found to be significantly different (at $p = .01$).

For the purposes of analyzing the data, all alphabetic values were converted to numeric and where data were not ordinal, variations were coded via the use of dummy variables. The 2-digit SIC codes were aggregated into fewer classification categories as detailed in Appendix 1. These 14 commodity categories resulted in 13 dummy variables for the product shipped.

One objective of the study was to identify the factors influencing the price paid for liner services for standard containers on the North Atlantic trade route and to identify customer effects on price. There are two simple effects to consider, illustrated in Exhibit 3:

1) **level effects**, where the relationship between the co-variates and the price is the same for each customer type and the price is simply adjusted up or down after accounting for the various factors affecting price; and
2) **interaction effects**, where there is a different pricing formula for each customer type; that is, the contribution of weight, distance and so on varies by customer type.

Exhibit 3: Level and Interaction Effects



With level effects, the addition of the customer variable to the pricing formula results in prices remaining constant for one of the three customer types, with the other two each paying a constant amount more or less than the base formula. Referring to Exhibit 3, if there are three types of customers, Type 1 pays the base formula, while Type 2 and Type 3 pay an adjusted price. With interaction effects, pricing is not a simple adjustment to the base pricing formula but there is a different formula for each customer type, as illustrated by three unrelated formulae.

To account for these separately, the basic pricing factors without the inclusion of the customer type variables are examined. Ideally, once this has been accomplished, the customer variable is added to the pricing formula, the analysis is redone, and the customer effect tested by comparing the adjusted means. Because of the nature of the variables, and a large number of dummy variables, a compromise approach of examining the two formulae has been adopted.

The Model

The general model employed in this study is:

> Price per TEU for a dry van container = f (the commodity shipped, weight of the container per TEU in kilograms, the direction of the sailing on the particular trade route, conference or non-conference status of the shipment, the distance in nautical miles, container length, number of containers per shipment, and customer type)

This study does not include an estimate of the value of the goods or of the stowage factor as was the case with many earlier pricing studies. The commodity shipped (a 2-digit SIC code) provides a partial proxy for the value of the shipment as machinery and auto parts are clearly more valuable per TEU than agricultural products like navy beans or peat moss. The commodity and its weight relate to the stowage factor as commodities such as copper may weigh

out before they cube out. The study includes variables taken from the bill of lading and accompanying invoice summary.

On the North Atlantic it is often maintained by liner companies that ships will weigh before they cube out eastbound, because of the greater share of heavier boxes on that leg, but what is the impact of this on price? It may be argued two ways. Heavier boxes should pay more because fewer may be loaded, thereby providing fewer to spread costs over or, conversely, heavier boxes serve a useful and stabilizing ballast function if loaded at the bottom of the hold, thereby providing a compensable service for which a discount should be offered. Alternately, prices on the leg more heavily utilized may be higher than those on the underutilized leg in order to generate a more balanced traffic pattern.

Other variables, such as distance (nautical miles port-to-port), direction (easbound or westbound) and container length (20' or 40') have been included in previous studies and are examined here too, as is the role of conference or non-conference status of the shipment. Shipping a box on a longer ocean leg does have a cost component, as well as using space which might have yielded greater revenue from two shorter hauls. The vessel utilization on a leg (direction), and the confusion about how to explain its impact, have already been noted. Although the 40' differs from the 20' in port handling costs, it is not possible to know if this variable has a role in explaining ocean freight rate differences. The volume a shipper has should depress the rate paid per box as one would expect quantity discounts on the ocean leg for non-conference shipments. All data is actual not estimated.

A correlation analysis uncovered that the sailing direction and particular sailing dummy variables were highly correlated and so the direction variable was retained and the particular sailing variable dropped.

The methodology calls for the model to be analyzed, first with the full data set minus the customer type variables and then with them. For the analysis of customer effect, a random sample of 10% of each sailing's dry van shipments was taken. (As there would be very few non-dry van containers in the sample, the container type was also dropped from both the full data set and the sample.) This sample data set contains all of the information listed above, but with the addition of one variable—customer type—defined as **shipper** (the exporter who is sending the cargo to its destination and pays the freight bill), **consignee** (the importer who receives the cargo at its final destination and is responsible for paying the freight bill), and **forwarder** (a third party company, be it a freight forwarder or cargo consolidator, who acts on behalf of the shipper or consignee).

Classification was not so simple. Consignee buyers, of course, were obvious from the invoice summary and the bill of lading. But for other purchases not all customer types were readily classified. As each shipper or forwarder had to be identified from the name and address of the invoiced party, and qualified via overseas Canadian embassies and consulates or Canadian directories, only a 10% sample was selected for the second part of the analysis.

The sample data means were compared to the full data set means and the differences were not significant. (See Exhibit 4.) As with the full data set presented in Exhibit 2, the eastbound sample price was **significantly** less than the westbound sample price.

Exhibit 4: Comparison of 10% Sample to Full Data Set of Dry Vans Only

Variable	Full Data Mean*	Sample Mean*	T-stat	Significance
EB Dry Van	0.753	0.691	1.14	NS
WB Dry Van	1.122	1.085	0.699	NS

Note: All means are reported as indexed to protect the confidentiality of the data.
NS = not significant at p = .05.

General Findings About Liner Prices

In addition to the finding just noted that easbound prices are significantly less than westbound prices, preliminary analysis of the full data set supports the notion that shippers pay a premium for services involving specialized containers regardless of the direction. (See Exhibit 5.) (In addition, the weight differences directionally are also significant.)

Exhibit 5: General Comparisons on Full Data Set

Variable		Mean*	T-stat	Significance
Container Type EB	DV	0.733		
	non-DV	1.382	-9.70	.000
Container Type WB	DV WB	1.113		
	non-DV	1.625	08.82	.000
Weight	EB	15,627 kg		
	WB	11,372 kg	13.96	.000

Notes: * per TEU (USD prices indexed as in Exhibit 2.)

To specifically identify the role of the factors in liner pricing, the full data set without the customer type variable (or the container type variable) is evaluated based on the model. The regression results for the **full data set** (minus the variables having a probability greater than 0.05) are:

Predictor	Coef	Stdev	t-ratio	p
Constant	1655.1	216.6	7.64	0.000
Direction EB	-284.23	15.36	-18.51	0.000
Conference Shipment	177.93	15.07	11.81	0.000
Container Length 20'	195.33	17.83	10.96	0.000
Distance	-0.31	0.07	-4.28	0.000
Weight	-0.00989	0.002	-5.74	0.000
Commodity-Chemicals	112.63	26.10	4.32	0.000
Commodity-Wood	-119.83	40.26	-2.98	0.003
Commodity-Glass	-84.04	38.69	-2.17	0.030
Commodity-Transp. Equip.	-86.32	30.71	-2.81	0.005

with the following Analysis of Variance:

Source	DF	SS	MS	F	p
Regression	19	64892152	3415376	41.15	0.000
Error	1669	138512864	82992		
Total	1688	203405024			

s = 288.1 R-sq = 31.9% R-sq(adj) = 31.1%

Regression analysis on the full data set explains a significant proportion of the price for a container with the variables explaining 31.9% R^2 of the price variation. It confirms differential pricing between eastbound and westbound traffic with eastbound rates being substantially lower. It also corrorborates that conference prices are set at a premium over non-conference prices, although the magnitude is not as great as either the premium paid for westbound cargo or for cargo moving in a 20' dry van rather than a 40' dry van. This verifies to shippers that not only are there cube benefits of using a 40' over a 20' for lower density cargoes, but that there is also a price break associated with the choice. The impact of the weight of the container provides heavier commodities with a discount, perhaps reflecting their ballast contribution or the need to balance the trade or even the fact that many high value goods are less dense. Finally, the commodity class has a significant influence for some of the classifications. Surprisingly, higher value transportation equipment (including auto parts) gets a price break, while the very low value agriculture products category does not. Chemicals, including many hazardous products, do not get a price break; perhaps reflecting the risk to the carrier, but wood products and glass do. For all the discussion about commodity-based tariffs and price discrimination, the commodity results are, for some categories, surprising.

Is Customer Type a Determinant of Price?

Now to assess the impact of customer type, the smaller sample is examined. Remember the sample is statistically equivalent to the full data set. The regression results on the 10% sample (with customer type variables added) are:

Predictor	Coef	Stdev	t-ratio	p
Constant	832.9	610.0	1.37	0.174
Direction EB	-363.18	50.36	7.21	0.000
Conference Shipment	167.42	45.17	3.71	0.000
Container Length 20'	200.30	46.48	4.31	0.000
Commodity-Machinery	249.42	88.38	2.82	0.005
Shipper	-117.42	59.27	-1.98	0.049

Again the variables with a probability of greater than 0.05 have been deleted but are available from the authors on request. The Analysis of Variance table follows:

Source	DF	SS	MS	F	p
Regression	21	7571500	360548	6.29	0.000
Error	148	8488642	57356		
Total	169	16060142			

s = 239.5 R-sq = 47.1% R-sq(adj) = 39.6%

Although the premiums paid for westbound, conference and 20' shipments are relatively close to those noted with the full data set pricing formula, the regression analysis equation on the sample is different from the equation for the full data set. The constant term is approximately one-half the size of the constant term for the full data set. It would appear that these three factors—direction, length of container and conference status—their similar direction and magnitude coupled with the dramatic difference in the constant term exert a level effects influence. But this is the only evidence of level effects. Distance and weight are no longer an influence on the price. And the commodity influence calls different variables into play. Only the dummy variable for machinery shows a significant premium on the price paid. Therefore it is not likely that level effects model is entirely appropriate but that there is an interaction effects pricing equation for different customer types.

The equation including the customer type variables has a much greater predictive value with an R^2 of, a strong indicator of customer type influence..

Conclusions and Summary

This research, based on a unique and different type of data source—bills of lading and accompanying invoices, shows that there is already an influence on price by the type of customer being served. The customer variable has not been included in previous studies because they depended so heavily on the use of published tariffs, and the two approaches are incompatible. Whether the customer influence was present as an unexplained variation in previous studies is not known. It may also have gradually been incorporated through growing customer power over the past decade it may be only now being seen because of the serious restructuring taking place in the market.

As conferences are prohibited from establishing price levels for differing levels of service in Europe, one can only assume that these may have been incorporated into conference rate negotiations with shipper organizations over time for commodities where a few large shippers dominate the trade. It is likely that across-the-board adjustments to account for customer type (level effects) do not take place but that the pricing process is an interaction effects one.

As pointed out by Bennathan and Waters (1969) there is no substitute for qualitative knowledge to accompany modeling such as undertaken here. Some of the prices seen may well be due to long-term contracts providing an effective rebate or the carrier incurring repositioning losses to place an empty container in a needed location for a regular customer with significant but seasonal volume.

Customer differences provide an alternate basis for setting prices. Brooks (1993) identified that significant customer differences in requirements exist. In her study, large shippers in North America and Europe were similar in their needs but the pattern of requirements between North America and Europe is somewhat different for freight forwarders. Freight forwarders in Europe place greater value on timely pick-up than do their North American counterparts. North American consignees place greater value on transit time and on-time delivery than do their European counterparts. Neither consignees in North America or those in Europe place great importance on the price of the service. These service patterns may provide scope for further price differentiation, providing pricing opportunities if the complexities of such demands can be

translated into service levels where price differentiation can be effectively implemented. Obviously this will require conference operators to look seriously at their options as the Competition Directorate of European Union has ruled that the TAA may manage capacity or rates but not both.

Note: The authors would like to thank Gus Gassmann and Len MacLean for their assistance in undertaking the statistical analysis.

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Appendix 1: Standard Industrial Classification Aggregation

Codes 1-5	Animal and vegetable products including live animals
Codes 16-24	Prepared foodstuffs, beverages including liquor, and tobacco products
Codes 25-27	Salt, ores and mineral fuels
Codes 28-38	Products of the chemical industry, including fertilizers and pharmaceuticals
Codes 39-40	Plastic and rubber articles
Codes 41-46	Fur and leather products, wood, including lumber, cork and straw, including wicker
Codes 47-49	Pulp and paper products, including published materials
Codes 50-67	Textiles, apparel, footwear
Codes 68-70	Articles of stone, cement, ceramic or glass
Codes 72-83	Base metals and articles of base metals
Codes 84-85	Machinery
Codes 86-89	Transport equipment and parts
Codes 90-96	Instruments and miscellaneous manufactured articles, including household goods
Code 98	Consolidated cargo

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A Black Box Approach To The Airline Mess

BY ALEX PHILLIPS *

Canada's failing airline deregulation policy finally hit the fan when the Federal Conservative Government realized it had to give Canadian Airlines a $50 million loan guarantee and Terence Corcoran of the Globe and Mail proclaimed in his column of November 25th, 1992 entitled Ottawa's Flight To Nowhere that "The federal government is caught in a business-political-policy-economic mess of almost indescribable complexity."

Mr. Corcoran used similar language in his column of February 2nd, 1993, This Is No Way To Set Airline Policy, to suggest that the future of the Canadian airline industry would depend on the outcome of a "murky proceeding before the Competition Tribunal over the Gemini computer reservation system" involving a "knee deep load of legal, economic, business and political claims from all sides" where "most of the evidence will be beyond average human comprehension".

In my view, the current financial and competition policy mess in the Canadian airline industry may indeed be complex but it is not beyond average human comprehension.

The current airline mess is a predictable result of adopting a flawed airline deregulation policy from the United States coupled with a reluctance to strictly enforce Canadian competition laws when the deregulation policy was not only failing to achieve a truly competitive marketplace but was effectively resulting in anticompetitive conduct among rival airlines.

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As a regulatory tribunal with independent discretion to apply existing competition laws, the Competition Tribunal, was recently called upon by the Bureau of Competition Policy within the Department of Consumer and Corporate Affairs to help determine what the limits of lawful competition should be within a deregulated Canadian airline industry particularly given the shared use of computer reservations systems.

Calling on the Competition Tribunal was a positive first step in fixing the airline mess but this should not be confused with the Minister of Transport's continuing responsibility to establish a workable airline policy.

Indeed, the very existence of the airline mess itself suggests that the former Conservative Government's "flight of fancy" with airline deregulation has led to a near "crash and burn" scenario for the Canadian airline industry and air travellers alike.

Consequently, in order to assist our new Liberal Government, I suggest we replay Canada's "deregulation" flight recorder now and try to use a "black box approach" to identify the likely causes of the current airline mess.

Intended Destination and Alternative Flight Plans

To begin with, Canada's deregulation flight recorder indicates that even before a legislated U.S. style deregulation flight plan was finally adopted in July, 1985, the intended destination seemed clear enough. Canadians wanted adequate air service for their communities, the lowest possible air fares based on fair competition and efficient air carriers which would operate at a profit and generate a reasonable rate of return on invested capital so that they would remain financially viable.

Indeed, many different flight plans had been discussed in the early 1980's in order to reach this destination. Transport Canada wanted continued regulation. The Economic Council of Canada wanted to adopt U.S. style airline deregulation. The House of Commons Standing Committee on Transport advocated liberalization of the existing regulatory framework. The former Air Transport Committee of the Canadian Transport Commission wanted limited reforms that would not substantially restrict its regulatory powers.

Regulatory Framework Overhaul

In May, 1984, Liberal Transport Minister Lloyd Axworthy adopted a liberalization flight plan known as The New Canadian Air Policy based on the recommendations of the Standing Committee and the first stage of U.S. airline deregulation. He also proposed we take a liberalization test flight before we imported the entire U.S. deregulation model.

In adopting a liberalization policy, Lloyd Axworthy recognized the consensus which emerged from the lengthy review process in the early 1980's that Canadians did not want to import a legislated U.S. deregulation model in its entirety. At the same time, he also recognized that the old regulatory air framework needed some initial overhaul work.

The original regulatory air framework was inefficient and unreliable in helping us to reach our intended destination. Under this framework, the Air Transport Committee had their hands on independent regulatory controls to licence new commercial airlines, to authorize service on new routes and to control the level of air fares. The exercise of this regulatory discretion took into account Ministerial policy statements which included protecting the routes of Crown-owned Air Canada and promoting a regional air carrier policy.

Under this regulated air framework, new competition for existing demand was restricted. There was virtually no price competition only service competition and regional carriers could not expand beyond defined geographical boundaries. Carriers tended to develop high cost linear non-stop route patterns and service levels. Carriers also had no incentive to reduce inflated costs associated with their service schedule because their regulated fares were based on covering their costs plus receiving an adequate rate of return.

This regulatory air framework first began to crack in 1979. In that year, the Federal Government allowed Canadian Pacific Airlines to compete to a greater extent on a transcontinental basis with Air Canada. In addition, the regional boundaries defined under the regional air carrier policy were beginning to be overlooked by the Air Transport Committee when it granted new routes to the existing regional jet carriers. These initial moves to promote greater competition within the existing regulatory framework

also coincided with the enactment of airline deregulation legislation in 1978 in the United States.

New U.S. Deregulation Model

Under U.S. deregulation legislation, the independent regulatory discretion of the Civil Aeronautics Board to licence carriers, grant new routes and set air fares was initially restricted during a liberalization period. Specifically, from 1978 to 1982, the CAB was required by the legislation to consider greater competition and the encouragement of entry as a major factor in the licencing of new carriers or the granting of new routes. Similarly from 1978 to 1983, all fares filed with the CAB were deemed to be approved provided the fares fell within a defined zone of reasonableness. The fare zone established a ceiling above which the CAB could rule that the fare was too high and amounted to unjust discrimination. It also established a fare floor below which the CAB could determine a fare to be too low or predatory in nature before the fares filed could become effective.

In 1982, the CAB's control over licences and routes was abolished and any fit, willing and able U.S. carrier has since been free to enter any domestic U.S. airline market. In 1983, the CAB's control over fares and the reasonable fare zone concept was also abolished. Thereafter, carriers were free to set air fares at will and were only subject to antitrust laws prohibiting predatory pricing. In 1985, the CAB itself was abolished. Antitrust oversight was transferred to the U.S. Department of Justice. Regulatory control over international air transport licences, routes and fares was transferred to the U.S. Department of Transportation.

Liberalization Flight Plan

Lloyd Axworthy's liberalization flight plan of May, 1984 incorporated similar provisions to the initial liberalization provisions of the U.S. deregulation legislation. He maintained independent regulatory discretion for the ATC but at the same time, his liberalization policy statement asked the ATC to take into account competition as the primary factor in exercising its licencing discretion. He also proposed flexible fare zones within which fares should be deemed by the ATC to be just and reasonable. In doing so, he maintained the independent regulatory discretion given to the ATC to deal with both high discriminatory fares as well as low predatory fares before these fares would become effective.

The ATC copilots felt that this liberalization flight plan took away too much of their independence to regulate. While there appeared to be a struggle for control of the cockpit behind the scenes, the election of the Conservatives in September 1984 effectively grounded Mr. Axworthy and put any debate over the extent of regulatory independence to rest.

Switch To Autopilot

Within one year, the Conservative navigators filed a fully legislated U.S. style deregulation flight plan. With it came the abolition of the Air Transport Committee copilots and their exercise of independent regulatory discretion. There would be one supreme commander - the Minister of Transport - who now had the power to issue binding policy directives to be followed by a new agency called the National Transportation Agency. The flight plan would also rely on free market forces to achieve greater competition as the U.S. legislation had done since 1982.

The initial Conservative commander in charge of importing a U.S. style deregulation flight plan and modifying it for use in Canada was then Transport Minister Don Mazankowski. His White Paper entitled "Freedom To Move" in July, 1985 served as the framework for the transport deregulation legislative reform package enacted in January, 1988.

Ironically, this was the very same commander who returned to the cockpit in late November, 1992 to join the latest in a series of pilots, Jean Corbeil, to switch off the deregulation policy autopilot and take corrective action before crash landing at an unintended destination known simply as monopoly.

And whether deregulation theorists and policymakers like it or not, these emergency commanders showed great courage in the face of economic reality by agreeing to give $50 million in government assistance to Canadian Airlines and by recognizing the need to address the structural problems and anticompetitive conduct which resulted from enacting the entire U.S. style airline deregulation model in Canada. In this respect, Jean Corbeil and Don Mazankowski deserve some credit for taking evasive action to avert imminent economic disaster for Canadian Airlines and for ignoring "stay the course advice" from would be pilots at the Royal Commission on National Passenger Transportation.

The Royal Commission on National Passenger Transportation publicly concluded just before the Government decided to provide financial assistance to Canadian Airlines that continued reliance on "free market forces" and deregulation without government intervention would have been the preferred course of action and that consumers would continue to benefit from lower fares and improved service levels from free market forces under a continued deregulation policy.

Unfortunately, Commission navigators must have been continuing to rely on faulty economic instruments to conclude that we were still on the right course because our commanders should have been approaching our intended destination by now rather than rapidly approaching monopoly.

Instrument Inspection

A closer inspection of the economic instruments reveals that airline deregulation in theory relied on the economic assumption that the airline industry is characterized by few if any economic barriers to entry and therefore airline markets should be contestable by potential new entrants.

With few barriers and contestable markets, a deregulation policy relying on free market entry and pricing promised a self-regulating competitive market of efficient firms, lower air fares, greater service and no tendency among existing airline firms to consolidate or engage in anticompetitive conduct to acquire market share. To this extent, the need to rely on competition laws which generally apply to all industries to ensure that fair market competition resulted in the airline industry seemed unlikely.

The fundamental problem with airline deregulation in practice, however, is that the economic assumption of there being few if any entry barriers in the aviation industry is simply wrong.

There are numerous barriers to entry in the aviation industry for new competition. These barriers include the high costs associated with (i) the cost of equipment and having the proper aircraft type for both long-haul and short-haul markets of differing passenger traffic levels; (ii) establishing market identification and brand loyalty particularly given the establishment of frequent flyer programs; (iii) establishing a ticket distribution network through travel agents including the ability to market flights through computer reservation systems; (iv) gaining access to limited airport landing

and takeoff time slots and airport gates particularly since hub airports have developed and (v) providing convenient through ticketing and baggage handling services through carrier alliance agreements.

Given the existence of entry barriers, existing firms could more easily engage in anticompetitive mergers, market sharing and predatory tactics to gain market share rather than be forced by new entrants or the threat of new entrants to compete solely on the basis of innovation, efficiency gains and lower costs.

As a result, deregulation with its reliance on free market entry and pricing when coupled with entry bariers and the opportunity for existing firms to grow through anticompetitive behaviour placed the burden of achieving fair market competition on the enforcement of general competition laws and not self-regulating free market forces.

Stormy Weather Forecast

In January, 1988, when the legislated deregulation policy was enacted, I filed a "stormy weather forecast" with the University of Manitoba Transport Institute entitled "Airline Deregulation: Its Process, Effects and Implications For Canadian Competition Law" which read in part:

> As a policy choice, the success of deregulation in achieving the goals of an economic, efficient and adequate air transport system depend on the effects of deregulation as well as the suitability and potential effectiveness of new Canadian competition laws in dealing with the anticompetitive effects of deregulation. To the extent that competition law is inadequate in performing its complementary role with a deregulation policy, the effects of deregulation, particularly those associated with increasing concentration, market power and anticompetitive conduct may be far worse than the costs associated with liberalized regulation.
>
> In effect, unbridled deregulation may prevent the very competition originally viewed as the engine of economic efficiency and innovativeness and may lead us upon reflection, to the view that liberalization of the former regulatory framework would have been a more prudent policy choice rather than the adoption of a U.S. style deregulation competition policy.

Turbulence Throws Us Off Course

Indeed, the effects of deregulation were not what was promised in the flight plan.

Statistics Canada data indicates that, since legislated deregulation was implemented in 1988, there has been a dramatic increase in economy class fares compared to the consumer inflation rate not a decrease as promised by deregulation theory. The airlines suggest higher economy fares are necessary to make up for the fact that more people are flying on lower discount fares. It is true a higher percentage of travellers are now using some form of discount ticket and while the average price of discount fares did indeed go down during the first year of deregulation in 1988, this was largely attributable to the limited fare war initiated by Wardair. In 1989 and 1990, however, after Wardair was driven by mounting losses to merge with Canadian Airlines in January, 1989, the average price of discount fares increased faster than the annual consumer inflation rate.

The net result of the increases in both economy and discount fare levels particularly in 1989 and 1990 is that the average price of all fares (ie. business, economy and discount classes) has increased faster overall than the rate of consumer inflation since deregulation was introduced.

In addition, improved service levels are a reflection of increased flight frequencies and the use of smaller turboprop aircraft by aligned commuter carriers which replaced regional jet service to small communities and the adoption of hub and spoke route networks which replaced nonstop linear route patterns.

Despite a trend which suggests higher average fares overall have been charged under deregulation coupled with cost-cutting measures to make them more efficient, the major airlines in Canada are still sufferring from huge losses.

To the average Canadian, this makes no sense at all. If deregulation has led to higher not lower average fares and airlines are operating more efficiently, why are the major airlines losing so much money?

The answer lies in the fact that though passenger levels have declined during the recession, capacity (ie. flights and seats) has increased at a time when the airlines are burdened with extremely high levels of debt compared to shareholders equity. When the major airlines say that fares are "too low" then, this means that existing fare levels do not generate enough revenues to cover their costs which have been progressively inflated by debt service charges and by providing excessive capacity.

Debt has been progressively incurred to finance the merger activity with the former regional jet carriers and the staged process of greater equity participation in local commuter carriers now known as alliance or connector carriers. Continual merger activity coupled with joint feed and scheduling agreements with local commuter carriers has resulted in rapid consolidation and increased concentration in the airline industry.

The market power economies of scale and scope of the major carriers also increased as the respective "carrier family" networks expanded. So did the major carriers ability to engage in anticompetitive behaviour such as predatory pricing (ie. pricing below cost) and predatory scheduling (ie. flooding particularly competitive city-pairs with excessive capacity by increasing flight frequencies and the number of seats regardless of demand) in an effort to gain market share from competitors and deter new entrants.

To the extent that predatory scheduling has been engaged in, service levels as measured by increased flight frequency and seat capacity will temporarily be high. However, if independent competition is driven from the market (ie. like Wardair or Nationair) by continued losses and forced merger or bankruptcy and potential entrants who could choose to compete on a scheduled basis (ie. Canada 3000) are effectively deterred by the likelihood of incurring the same fate, such predatory tactics ultimately lead to service level cuts and an even higher average level of air fares.

As a result, in my view, Canadians have been paying higher average fares overall under deregulation to help service the debt incurred by existing carriers to finance the pursuit and achievement of less competition in the Canadian airline market. Clearly, paying more to achieve less competition and a potential airline monopoly was not our intended destination.

Corrective Action

If an airline monopoly ultimately results, commissioners at the National Transportation Act Review Commission have recommended that the Federal Government allow foreign air carriers to serve domestic routes within Canada to achieve a competitive marketplace.

In my view, placing even greater reliance on deregulation theory in this way would not be effective. It would only perpetuate and enlarge the current structural problem, create a greater potential for renewed

anticompetitive conduct and likely lead to consolidation and control by larger U.S. carriers and their alliance carrier networks. It would not promote greater competition by independent carriers and it would likely result in inadequate service in the long term.

Consequently, in my view, the Federal Government should consider adopting a revised policy approach of ensuring "effective competition".

Specifically, Canadian airlines should continue to compete freely by setting their own fares and entering domestic markets at will without Government preapproval. However, the National Transportation Agency, with its existing airline monitoring expertise, should be given a limited "preemptive" jurisdiction to review upon complaint and disallow air fares which are set so high as to be discriminatory, air fares which are set so low as to be clearly predatory and capacity levels (ie. flights and seats) which are clearly excessive relative to demand (ie. passenger traffic) in particular city-pair markets.

In addition, the Competition Tribunal should play an active and complementary role by clearly defining unlawful anticompetitive conduct from lawful competitive practices in a deregulated airline marketplace particularly with respect to anticompetitive versus failing business mergers, predatory versus competitive response pricing and market sharing conspiracies versus efficient carrier alliance agreements.

Final Approach

In short, unbridled deregulation and anticompetitive conduct needs to be managed, in my view, to achieve an economic, efficient and adequate air transport system in Canada. Canada can no longer afford to solely rely on simple but flawed economic theory from the United States to solve complex economic and regulatory problems.

Canada needs a revised airline policy which promotes effective competition not one which results in destructive competition and is simply characterized as another "tough" decision.

Reregulation of the Airline Industry – Would Price Cap Regulation Work?

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I. Introduction

Fifteen years after passage of the Airline Deregulation Act in the United States, air transport regulatory liberalization has spread to all continents. In the Americas, the U.S., Canada and Chile have deregulated their domestic markets. In Europe, the European Community has undertaken substantial regulatory reform, and this has extended to some of the non EC nations as well. Both Australia and New Zealand have deregulated domestic markets. In Asia, while formal deregulation is yet to take place, competition has been fierce from the city state carriers Singapore and Cathay Pacific, and in Korea and Japan, at least some route competition exists.

But even while deregulation is still spreading, there are calls for some form of reregulation. Some calls were heard almost before the ink was dry on the U.S. legislation. Demands for some form of reregulation have intensified since 1991 when the combined effect of the Gulf War, the recession and a temporary run-up of fuel prices put severe financial pressure on carriers throughout the world. When combined with the usual poor timing of aircraft purchases (aircraft orders placed in good times for delivery during the worst of times), some observers believe that the industry faces disaster. An often cited claim is that carriers have lost more money than their cumulative profits in their entire history. (This claim fails to correct for inflation even though the price index has increased by roughly 140% since 1978.)

In Canada, the pressure to reregulate intensified in 1992 and 1993 when Canadian Airlines International Ltd. (CAI), one of the only two national network carriers, faced the threat of bankruptcy. The government was faced with the prospect of accepting a proposed merger of CAI and Air Canada. Such a merger would have created a virtual monopoly, according to the findings of both the

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Competition Tribunal and the National Transportation Agency. If a monopoly had been formed, then regulation would have been necessary, barring some other method to maintain competition in the domestic market, such as the authorization of cabotage rights to U.S. carriers.

While the immediate crisis in Canada has abated with the approval of an investment in CAI by American Airlines, the issue of reregulation of airline prices continues to be a matter of policy debate. If policy makers were to reregulate the industry, then the question arises as to which form of regulation to adopt. The purpose of this paper is to examine one form of regulation which has been proposed for application to the airline industry: price cap regulation.

I. Reasons For Regulating the Airline Industry

It is useful to begin by reviewing some basic characteristics of airline output. Individual carriers provide services on many routes. On any given route, there are many separate consumer segments: some prefer first class services, others prefer coach; some are highly price sensitive (e.g., retired individuals), some moderately price sensitive (family vacations), and others which are less price sensitive (business travel). Demand on any given route and in any given customer segment is highly variable. Demand varies by season, day of the week, hour of the day, and over the business cycle. Further, demand variation is different among the different customer segments – e.g., business travel tends to be somewhat lower in August while leisure travel tends to peak in August. To service demand, airlines offer services in discreet capacity blocks. I.e., the carrier provides service in an aircraft of a fixed size, even if demand is only for limited number of seats on a given day and hour. The airline service is perishable, in the sense that once the flight commences, the unsold "inventory" of seats cannot be stored for future sale.

A number of authors have examined in great detail the various reasons for regulating air transport. Broadly, the reasons focus on two extremes: the threat of monopoly power or destructive competition. The monopoly argument claims that the economics of airline operations are leading to high levels of concentration, and that a handful of mega carriers will dominate domestic and world markets. A subsidiary argument applies specifically to the "fortress hubs" of these large carriers, i.e., the hubs from which they operate large hub and spoke operations. Many hubs are dominated by a single carrier, and there is evidence of some monopoly power in these markets (e.g., Borenstein, 1989). An alternative and very different rationale for regulation is a fear of destructive competition: that where airlines compete, they drive fares below the costs necessary to sustain the

carrier in the long run. Thus competition would lead to eventual bankruptcies and disruption of service.[2]

Over the last two decades, most economists and policy makers rejected these reasons for regulation of the industry. Carriers with properly sized aircraft could provide service on routes to small communities even without subsidy. Empirical evidence disputed whether economies of scale existed justifying fears of monopoly. Indeed, in both Canada and the U.S. many routes of different traffic levels had service by more than one carrier. Most convincingly, evidence from the relatively unregulated California and freight express markets suggested that carriers could prosper without regulation. This led to the deregulation of the airline industry.

As described in the introduction, in the post 1991 period, carriers have been besieged by terrorism threats, recession, fuel price increases, and imprudent aircraft purchase decisions. This has resulted in massive losses at many carriers, bankruptcies of major and small U.S. carriers, bankruptcies of Canadian charter carriers, and the near bankruptcy of one of Canada's two major scheduled carriers. This has led to renewed claims for regulation. The arguments put forward are that the industry is a combination of oligopoly or monopoly, and that carriers tend toward destructive competition. In both Canada and the U.S., irresponsible carrier fare wars have supposedly resulted in the major losses, and that without regulation the industry could destroy itself.

II. Pre-deregulation Methods of Regulation

In the United States, regulation of the airline industry was the responsibility of the Civil Aeronautics Board. Ostensibly, the CAB used a rate of return regulation for this industry. However, while the CAB established an allowed rate of return for carriers, this return was rarely achieved. Thus, important questions which arise in rate of return regulation never had to be resolved: specifically, what is the rate base to which the allowed return would be applied, and would this return be a maximum for the industry overall, or for individual carriers? Applying rate of return regulation to one carrier which was bumping against the limit would create a price differential between that carrier and the less profitable carriers. This in turn would have upset the economics of the industry, as the

[2] Historically, there were some other reasons for regulation including a desire to cross subsidize services which were uneconomic for carriers to provide, but which society wished to have provided for social reasons. In Canada an additional (related) reason for regulation was to prevent revenue erosion for the government owned carrier, Air Canada, which was presumably charged with meeting some non-economic social goals.

profitable carrier, with lower prices, would gather additional traffic from the higher price carriers when the consumer had a choice of carriers (or equivalently a choice of routings).

In practice, the CAB applied regulation by approving or denying price increases applied for by individual carriers. The basis for determining whether or not to allow price increases was a formula based on carrier costs. In later years, this was formalized in the form of the *Standard Industry Fare Level* (SIFL). In the early 1970s, the CAB discovered what critics of its regulation had known for some time: the formula allowed price increases whenever carriers lowered their load factors (the percentage of seats sold). Lower load factors led to higher per seat costs, and thus began a spiral of lower load factors leading to higher prices which in turn resulted in traffic reductions which lower load factors, etc. The SIFL was thus modified to adopt a "reasonable" (although arbitrarily determined) load factor, which halted the erosion of load factors.

During this era, the CAB only had to determine what permissible fares were for two classes of service -- coach and first class.[3] Since first class cabins had a fixed number of seats, the CAB essentially assumed a fixed number of first class seats would be sold, then subtracted these revenues from the increase in costs to determine allowed coach fares. It should also be pointed out that the regulatory formula contained a degree of cross subsidy -- long haul services had fares set higher than costs would justify in order to provide carriers with profits to allow short haul services to be offered below costs.[4]

Regulatory lag was considerable, often taking years to determine in the case of fares, and decades in the case of route authorities. To ease the burden, the SIFL was recomputed on a regular basis, generally once every two years with more frequent determinations when carriers faced rapid increases in fuel prices. Determination and verification of actual carrier cost increases through an

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[3]The local service air carriers were only allowed to offer a single class of service. Only the trunk carriers could offer first class.

[4]Exit regulation prevented carriers from dropping short haul services at will. However as documented by Jordan (1979), over the 1960s and 1970s, carriers in both the U.S. and Canada were successful in their applications to drop a large number of short haul services. Typically the justification for termination of service on a route was that the larger aircraft chosen by the carriers were too expensive for short haul and low traffic markets. Unfortunately, the CAB chose not to authorize the emerging "commuter" carriers from providing service on these routes. Such services which did emerge were provided by carriers operating aircraft small enough to be exempt from CAB regulation.

administrative process required much time and expenditure of resources by carriers and the CAB alike.

In Canada, the framework was generally similar. Carriers would apply for rate increases and these would be determined based on a cost formula. In Canada the cost formula used the costs of government owned Air Canada, and not an average of the costs of all carriers as was the case in the U.S. Canada also directly controlled carrier capacity, thus avoiding the lower load factor leading to higher allowed prices phenomena in the U.S.

Regulation of airlines was criticized for being cumbersome and for removing any incentives for carriers to collectively control their costs. Caves (1962) and others questioned whether there was any legitimate reason for regulation of this industry. However, it was the evidence of Jordan (1970) and others concerning the behaviour of the non CAB regulated carriers in California, and to a lesser extent Texas and Florida, which provided the impetus for deregulation.[5] Under U.S. law, carriers which flew within the borders of a single state were not subject to federal regulation. Although these carriers were regulated by their respective state governments, the nature of this regulation was not onerous. Carriers such as PSA operated identical aircraft to the CAB regulated carriers, yet could sell seats at a much lower cost.

III. Price Cap Regulation

In contrast to rate of return regulation which attempts to regulate individual prices, price cap regulation has been proposed and adopted in some industries. This is a form of regulation which attempts to regulate a multiproduct monopolist. The concept is similar to that of Ramsey pricing. The ultimate goal of price regulation is to maximize economic welfare. Economists recognize that welfare is maximized when "first best" prices (prices equal to marginal costs) are charged. The problem is that in some markets (those without constant marginal costs) these prices may produce a shortfall of revenue, or alternatively, economic profits. Ramsey prices are a form of "second best" prices. They maximize economic welfare subject to the constraint that sufficient revenues be raised to cover total costs, or in the case of increasing cost industries, that total revenue exceed total costs only by a specific allowed amount. Unlike the CAB type of regulation where all prices are increased by a common percentage, in Ramsey pricing the inverse elasticity rule is followed. This allows prices to increase more on services

[5]The success of Federal Express in operating outside the bounds of CAB regulation by flying small aircraft exempt from regulation provided evidence of the benefits of deregulation of cargo transport. Cargo was deregulated in 1977, one year before the deregulation of passenger and combination services.

with relatively inelastic demands. In this manner the total deadweight loss from pricing above marginal cost is minimized.

In the CAB type of regulation, services with highly elastic demands are subject to the same price increase percentage as the inelastic demands. This results in squeezing out a large proportion of the elastic demand consumers. This is not desirable, since with lower prices on these services more consumers would derive well being from being able to consume services. To make up the revenue shortfall, services with inelastic demands experience larger proportional price increases. However, because these demands are inelastic, there is little in the form of reduced demand, and thus a smaller welfare loss.

Theoretically, a CAB type regulation could be used to determine Ramsey prices for multioutput industries. In practice, the regulator would need to know demand elasticities (and cross elasticities) and quantities for every output along with corresponding marginal costs. In practice this is a problem, especially for air transport. In any industry, it is questionable whether the regulator can obtain sufficiently precise measures of elasticities. Air transport has the additional problems that a) marginal costs for some types of traffic are very low -- arguably close to zero, while for other services they are very high -- when the carrier must add a discreet unit of capacity; and b) in the case of airlines, demand quantities are highly variable, confounding the determination of optimal prices. Because the demand for services between Toronto and Saskatoon on a Friday in August can be very different than on a Tuesday in February, the optimal prices to charge will be very different, even though the capacity offered may be the same.

A second problem with the CAB type regulation is that there are no incentives for carriers to control costs. If costs go up, the carrier suffers no loss, since prices can be increased.

Price cap regulation has been proposed to address all these problems. With price cap regulation, the regulator sets an *overall* rate of price increase which is allowed -- the price cap. The carrier is free to determine which services will have price increases and by which amount and which will not have prices increased. All that matters is that the weighted average of the price increase not exceed the price cap.[6] Thus, price caps focus on the average increase in prices over time,

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[6]The price cap is typically set as the rate of increase in a widely available price index, such as the consumer price index, less an amount set to recognize productivity growth which is to be passed on to customers in the form of lower prices. This is referred to as the RPI minus X formula, where RPI is the Rate of Price Increase, and X is the limiting offset. In some industries where price cap regulation has been applied, (continued...)

targeting the allowable increases to be just sufficient to cover expected increases in costs. Price cap regulation solves three problems. First, it allows the carrier to vary prices as often as it deems desirable – every day if demand changes daily. Second, profit seeking behaviour by the carrier would lead it to charge the inelastic demands higher prices, and the elastic demands lower prices, similar to what Ramsey pricing would have done. Third, if the price cap is determined relatively infrequently – every five years in the case of the British airports and telecommunications – then the carrier has an incentive to control costs. During the interval during which the price cap is set, the carrier can keep any economic profits it earns.[7]

The regulator's job is greatly simplified with price cap regulation. It no longer has to determine demand elasticities for any service offered by the carrier. It does not even have to monitor carrier costs on a regular basis, only on an infrequent basis – when the price cap is reset. As mentioned, in the case of the British Airports Authority where price cap regulation is used, the regulator resets the cap every five years. On the reset date, a carrier which achieved lower costs and economic profits would likely face a lower price cap for the next period. But again, if the carrier can achieve performance greater than its past record, it will be able to keep the new profits for a period of time.

IV. Regulation of Prices in Air Transport

We now examine possible approaches to reregulation of prices in the airline industry. First, we argue that it is not possible to reimpose CAB type regulation on the industry. This type of regulation was not successful, as demonstrated by the lower costs of the intrastate carriers, and the growth of airline markets following deregulation when new consumers realized welfare gains of previously unaffordable air services. Noting that CAB type regulation produced suboptimal results in the case when services offered were simple – only first class and coach --- how can it be successful when any given route has a plethora of fare types? Any attempt at regulation with multiple fare classes will be subverted by carriers unless the fare classes are simplified back to coach and first class.

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[6](...continued)
RPI is set to the readily available consumer price index. If the industry achieves high productivity growth, then X might be large relative to a low productivity industry.

[7] For an overview of price cap regulation, see the special issue of the *Rand Journal of Economics* edited by Acton and Vogelsang (1989), especially the paper by Beesley and Littlechild (1989).

We believe it would not be politically possible to reimpose the old first class and coach only regime. Consumers have come to enjoy the benefits they achieved by airline deregulation. If all consumers were forced back to paying for coach tickets, even if coach prices were somewhat lower,[8] there would be a large scale consumer revolt facing politicians. Low prices are not possible when fares are not allowed to vary with demand in order to fill up available capacity.

Given that discount prices would be continued in some form, consider the extreme case of carriers being confined to first class, coach and only a single discounted fareclass. Here the regulator would probably follow the old procedure of assuming what demand will be for first class and either coach or discount. The remaining fareclass would then have its fare set so as to provide the carrier with the needed revenue, but no more. Alternative assumptions could be used, such as a constant ratio of coach to discount customers or vice versa.

This pricing system is easily subverted by a carrier. The carrier only needs to change the number of seats its makes available on a given flight at a discount to change its revenue. For example, suppose the regulator assumed that on a typical flight in a given market 5 first class, 40 coach and 20 discount seats would be sold at fixed prices for each class. This would produce an allowed revenue by the regulator. However if demand for the flight is strong, the carrier only needs to reduce the number of discount seats it sells to raise its revenues. Doing so allows it to sell more seats at the higher coach fare and thus increase its revenues. Conversely, if the carrier experiences weak demand, it can make more seats available at the discount fare, and thus stimulate the price elastic segment of the market.

The only way the regulator can confine a reregulated carrier to a reasonable return would be to regulate not just prices, but also to regulate the capacity offered at each price. In a multi-output industry such as air transport, price regulation

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[8]We argue that with the elimination of discounted tickets, coach prices could very well be higher than they are at present. First of all, Morrison (1993) has determined that actual average prices are now less than they would have been if the pricing formulas of the CAB or the CTC had continued to be used. In addition to this empirical observation, there is a conceptual reason why prices would be higher. The argument put forth by Boeing when it proposed discount pricing to carriers is that passengers who occupied seats which would otherwise be empty, provide additional revenues to the carrier. These extra revenues can be used either to increase carrier profits, or to keep coach prices down. So long as the discount customer pays a fare higher than the cost of service (which is very low if this is an otherwise empty seat), then he or she is making a positive contribution to carrier overhead costs. To put it another way, the discount passenger cross subsidizes the full fare customer, not the other way around.

without corresponding capacity regulation is ineffective. Indeed, this is the reason why the CTC regulated carrier capacity during the regulated era.

Can the regulator regulate capacity in individual fare classes? Carrier seat managers vary capacity in fareclasses on individual flights on a daily basis, and sometimes on an hourly basis. To do this and other chores, air carriers own the largest computer systems in the world not in the hands of the U.S. defence and intelligence agencies. Clearly, regulating capacity on a daily, weekly or even monthly basis is not possible for the regulator. We suggest that is not even possible on an annual basis. There are too many routes, even in Canada, and too many variables (such as diversion rates between fareclasses, between different flights of a carrier, between flights of different carriers, and between different routings) for the regulator be effective in regulating the capacity to offer at discount and coach fares.

On the other hand, price cap regulation offers some promise. Here, the regulatory agency need not concern itself with either the regulation of individual fares or capacities. The carrier retains its freedom to manage prices and capacities. As at present, prices will vary day by day, and the carrier will vary the number of seats at the various fare classes. Price cap regulation will thus allow Ramsey like prices to emerge.

Will price cap regulation be effective? We think not. The goal of this regulatory approach is to limit carriers to a reasonable return while allowing economically efficient prices. But the problem at the present time is that carriers are not profitable. Even with complete pricing freedom, they are not achieving adequate rates of return. Price cap regulation would have no effect. The price cap would not be binding, and thus there would be no change in current carrier practices. The only way price cap regulation would become effective is if the industry were formed into a monopoly, so that carriers experience more inelastic demands than they now have.[9]

The one area of current airline operations which are accused of generating economic profits are in the hubs dominated by giant carriers. Researchers have found evidence of higher prices on flights out of these "fortress hubs." It might be possible to apply price cap regulation to these markets. Carriers would have to record their sales of various ticket types in hub markets to compute an index or weighted average of all ticket sales. Prices will vary from day to day and even

[9]Even if overall demand in a market segment is inelastic, when there is more than one firm in the market, demands for an individual firm will tend to be elastic. This limits the ability of firms to raise their prices in the absence of some form of price leadership.

by season, so an annual index (or average) would be the guide for regulatory review. Price cap regulation would limit the allowable increase in the average price from year to year. If prices rose too rapidly, the carrier would have to adjust prices and/or seats allocated at those prices to stay within the "price cap." Note that because price caps focus on the *change* in prices year to year, it does not bring any immediate correction to prices which may be already deemed to be too high.[10]

One other objective of regulation might be to put floors under prices -- establish minimum prices. Price cap regulation is not effective here. Its objective is merely to cap the overall growth in a carriers prices. Some other means of minimum price regulation is required. In most industries, minimum price regulation is achieved by application of the predatory pricing provisions in competition law. A problem is that predatory pricing theory was developed with manufacturing industries in mind. Perishable services industries, such as air transport, may need a new approach toward predatory pricing, but that is a topic beyond the scope of this paper.

V. Conclusion

We have argued that airline consumers are unlikely to allow governments to go back to the old regime of selling only first class and coach fares. People have become accustomed to the benefits of inexpensive air travel, and will fight to preserve these benefits. We also argued that a return to the CAB/CTC style of price regulation would be ineffective when there is even one discount fare class. Unless capacity is also regulated, price regulation would be ineffective. Regulation of airline capacity even in a three fareclass regime is a task beyond any regulator's ability. Demand for airline services is highly variable. We conclude that a return to traditional price regulation in the airline industry is not possible.

An alternative to the traditional "cost increase" form of airline price regulation is price cap regulation. Here a carrier is limited to a specified average rate of price growth, with the carrier being free to determine which services are charged higher prices. This regulatory approach is administratively simpler, and

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[10] However, applying the price cap model to a portion of the system (the hub rather than all traffic) is inconsistent with the usual model of price caps which would apply to overall operations. The idea of price caps is to allow pricing freedom so that prices are higher where demands are inelastic (less elastic); a price cap applied system wide would allow higher pricing in primary hubs because demands were less elastic there. This raises an issue in Ramsey pricing of whether or not to distinguish between demand elasticities of the final users from demand elasticities influenced by the presence or absence of competition. See Damus (1984) and Taplin and Waters (1985).

it can produce prices close to economically efficient prices. The problem is that carriers currently are not achieving adequate rates of return, and thus the price cap would be ineffective. This type of price regulation would have no effect in improving carrier profitability. It also has no mechanism for establishing minimum prices. In the current situation, price cap regulation, like traditional airline price regulation, would not be effective. If at some point in the future, the industry were to become a monopoly, then price cap regulation might be a regulatory model worth pursing, but barring this, it is not a viable solution. Applying price caps to major hubs might be workable, but it would further reduce current profitability, which already is unsustainable.

Rather than end this paper on the bleak note that price reregulation seems to offer no benefit to society, we provide some speculation and suggestions for further research. One area where gains *might* be achieved is in the form of a new approach toward predatory pricing in order to set floors on fares. When deregulation was implemented in North America, minimum price regulation fell to application of predatory pricing provisions in competition law. Unfortunately predatory pricing law has been developed with an implicit assumption that the industry being regulated is a manufacturing industry. To date, economists have not considered the issue of predatory pricing for the case of perishable service industries such as air transport. This should be a high priority area for further work.

Second, the airline industry is an oligopoly, both in Canada and the United States. In recent years, economists have made great strides in understanding behaviour of oligopolists. Game theory has become the fashion to examine oligopoly behaviour. Game theory analysis has taught economists that the way firms perceive the "game" they are playing has significant implications for firm behaviour. Specifically, if firms believe that the game has a finite number of moves, then behaviour can be very competitive, potentially destructively so. One might argue that as carriers make the transition from regulation to deregulation, there will be a period of time when they are simply learning the rules of the new game they are playing. Until they believe that the game will be "infinitely repeated", they would rationally chose behaviour which could be destructively competitive. If this is the case, then the role of government policy is to make sure they do not create opportunities for carriers to make a game finite by successful predation or manipulation of the government policy making process. Additional work in the area of transition strategies and the role of government policy during a transition may have a greater payoff to industry stability than reconsideration of price regulation.

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Transportation Revenue and Expenditure Issues in Saskatchewan

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1.0 Introduction

Saskatchewan highways and Transportation (SHT) was requested to prepare a Comprehensive Transportation Policy. This policy initiative is part of the provincial government's Partnership for Renewal Economic Development Strategy.

A Transportation Policy Council (TPC) was formed. The members were from SHT, Saskatchewan Municipal Government (SMG), Saskatchewan Association of Rural Municipalities (SARM) and Saskatchewan Urban Municipality Association (SUMA). This council was established to provide direction on policy initiatives and create a forum for informed decision making. This council consulted key stakeholders on transportation issues and requested the department to conduct specific studies.

The revenue and expenditure review was one of these studies requested by the TPC. The project team for the Revenue and Expenditure Review had members from SHT and SMG.

Several revenue and expenditure figures were reviewed. A number of issues were highlighted from this review. A discussion paper highlighting these early issues and options was prepared. Various options were then openly discussed with a small group of key stakeholders. Several other interested parties were invited to submit comments.

The issues were amalgamated into four general issues on the basis of these stakeholder consultations. The recommendations, if implemented will help

increase revenues, target expenditures to the needs and desires of the users and improve the public's perception of how their tax dollars are spent.

This paper attempts to present the users' opinions. These opinions are developed largely from discussions with officials from groups and associations that represent the users. This paper does not necessarily represent the official view of any one party.

Issues:

1. Dedicated fuel taxes and registration fees -- Should fuel taxes and registration fees be dedicated to transportation? If yes, how should they be dedicated? For example, fuel taxes could be 100% dedicated meaning that all fuel tax revenue must go to transportation services. Under this scenario, the province could keep that tax level at current levels and increase expenditures, or reduce the tax levels to meet existing or any other expenditure level.

   Any portion of fuel taxes and registration fees could be dedicated to transportation. Using current expenditure levels, 57 % of fuel tax and vehicle registration revenue is spent on transportation. If this percentage was dedicated, the remaining 43 % could continue to be used for other purposes.

2. Private sector funding -- Several private sector groups have indicated a willingness to consider direct investments in transportation infrastructure. However, these sources indicate an unwillingness to contribute if:

   a) There is no assurance their funds will increase transportation expenditures.

   b) There is no assurance of a level playing field (i.e. their competitors must also contribute equally).

   Procedures and legislation in place today make it difficult for the department to give these assurances. As a result, there are very few examples of non-government funds being used for highway improvements.

3. Transportation Network Rationalization – Several stakeholders believe the provincial and local governments are maintaining unneeded transportation infrastructure. Consolidation of services, like health care and grain delivery points, is changing the needs. Some roads and

highways may require higher standards, while others may need lower standards. Some may not even be needed.

These trends are most noticeable in rural Saskatchewan. Urban transportation, however, is also undergoing changes. Transit is being promoted. Services like postal outlets are being consolidated. City cores are being renewed. All of these affect transportation needs and priorities.

4. Stakeholder Participation -- Through most of the discussions with the TPC and other stakeholders, we found that additional input from user groups and local government is wanted. Also, by forming alliances with these groups, we can improve cooperation and communication between the public and private sectors. Recommendations are made on how to improve stakeholder representation and participation in a decision making role.

For each issue, comments are discussed and recommendations are made. The following discussion is based on stakeholder input and may not accurately represent the views of the provincial government, general public or specific stakeholder group.

2.0 Dedicated Fuel Taxes and Registration Fees

All key stakeholders that we met regarding this issue have endorsed the use of dedicated revenues in one form or another. Some indicate a desire to have fuel taxes and registration fees dedicated 100 % to transportation. Others believe in partial dedication; splitting the tax between transportation and social programs such as health and education.

The general public believes there is a link between fuel taxes and provincial expenditures on transportation. They are under the impression that provincial fuel tax revenues go to SHT to construct and maintain highways and roads. If an increase occurs, they believe it is due to the rising costs of providing transportation services. They do not relate these increases to deficit fighting or other program services.

The public does not relate vehicle registration fees to the cost of providing transportation services. Instead, the public considers these fees an administration charge of Saskatchewan Government Insurance.

The point is, people like to know where their tax dollars are going; apparently, they don't.

The consolidated fund also confuses things since most revenues are lumped together in a single fund. Any changes to tax and fee structures are not linked to the program service responsible for the change. This makes it difficult for the people to relate such changes to the performance of the government. However, certain program services need subsidization.

A dedicated fuel tax would allow a direct link between taxation and expenditures. If taxes go up, transportation spending also goes up. The public will understand why they are paying more or less and they will expect to see a difference in the service provided. This increases the publics' awareness of how their tax dollars are spent and improves the accountability and credibility of government.

Some stakeholders have indicated a strong desire to dedicate most of the provincial revenues. They feel services should pay for themselves. Fuel taxes should pay for transportation infrastructure. Fines and penalties should go to enforcement. Property taxes should fund land access. Services needing subsidization should be funded by income taxes and not by other service fees.

2.1 Options

A.1 Full dedication of fuel taxes and registration fees

Most stakeholders have endorsed full dedication of these revenues. Under this scenario, fuel taxes and registration fees could be reduced to reflect the current level of expenditures or any appropriate expenditure level. This assumes that transportation expenditures would not increase to match current tax revenues. Given the above assumption, fuel taxes and registration fees could be dropped by up to 43 %.

The lost revenues would be reclaimed through other taxes or user fees. Some people expressed some concern regarding the method of reclaiming this lost revenue. Others have boldly stated that income tax should be used.

Pros:

1. True public awareness of where their tax dollars are being spent.
2. High degree of accountability is possible. The public can easily judge the service received relative to the cost.
3. Taxes and fees are easily set to fund needed expenditures for the level of service wanted by the public.
4. Large scale upgrading projects could be funded by temporary increases in fuel tax with less fear that the tax will remain after completion of the project.
5. A reduced transportation fee structure would assist Saskatchewan's ability to attract new business with high transportation components. Existing business would also have a better ability to compete nationally and internationally.

Cons:

1. Prevents the fuel tax from being used as a tool to reduce the provincial deficit or fund other program services.
2. Dedication of taxes can be removed at a later date.
3. Other taxes or user fees would increase. Therefore reducing economic benefits of slashed transportation taxes and fees.

A.2 Partial dedication of fuel taxes and registration fees

Some stakeholders preferred partially dedicated fuel taxes and registration fees. They felt existing levels of revenue should be maintained to help fund other program services besides transportation.

Pros:

1. Good public awareness of where their tax dollars are being spent.
2. Some improvement in accountability is likely. The public can judge the service received relative to the cost.
3. Fees and taxes are easily set to fund needed expenditures for the level of service wanted by the public.
4. Large scale upgrading projects could be funded by temporary increases in fuel tax with reduced fear that the tax will remain after completion of the project.

Cons:

1. Dedication could easily be removed at a later date.
2. An increase in the non-dedicated portion of fuel taxes could be construed by the public as being a transportation tax increase.

A.3 Status Quo

No stakeholder completely endorsed the status quo.

Pros:

1. Government can use any portion of the fuel tax and registration fee to fund any program service and fight the provincial deficit. Budgeting flexibility is maintained.
2. No implementation is required.

Cons:

1. Poor public awareness of where their tax dollars are being spent.
2. Low degree of accountability is possible. The public cannot easily judge the service received relative to the cost.
3. SHT budgets will continue to come under pressure in the fight against the provincial deficit, reducing the level of service provided and increasing transportation costs within the province.

Recommendation

Partial dedication of fuel taxes and registration fees is recommended.

Existing levels of expenditure should be covered by dedicated funding. All future adjustments in fuel taxes and registration fees should be directly linked to transportation expenditures.

Revenues collected in excess of current expenditures should be used for other programs until other sources of revenue can be found for those programs.

3.0 Private Sector Funding

The province has several sources of transportation related revenues other than fuel taxes and vehicle registration fees. Several of these sources are used extensively. Others, such as industry funding and developer fees are not used much. Some of these sources are listed below:

1. Industry funded projects
2. Developer fees
3. Other provincial governments
4. Federal government
5. Special programs (e.g. Bulk commodity program)
6. Fines and penalties
7. Custom work
8. Permits

Other potentially new sources of revenue include tolls, lotteries and vehicle (property) taxes. Most stakeholders indicated they do not favor tolls. These would be difficult to apply in Saskatchewan. Vehicle taxes got more favorable response. However, there were questions regarding the need for additional sources that taxed the general road user. In addition, people felt registration fees are a vehicle tax. A lottery stands out as a potentially new source. However, there is doubt about its revenue generating power in Saskatchewan.

Perhaps the largest potential for additional funding is the private sector. Cooperation between the provincial government and industry could produce partnerships for transportation infrastructure investments. Industry funds would be spent on highway construction and upgrading. Their payback is a reduced operating cost. For example, a new twinned section of highway could expand LCV operations cutting transport costs significantly. A new structural pavement or bridge may allow use of primary weights.

Some potential investors are currently unwilling to contribute to transportation projects. This unwillingness is not based on the viability of the project or investment. They realize the benefits of such investments and know they would have a direct return larger than their original investment. Their unwillingness or hesitation is due to three major factors:

1. Their funds would go directly to the consolidate fund and would have no effect on SHT's budget. The project will be done but paid for out of the existing SHT budget level. Therefore, they feel they have made a contribution to the provincial deficit and not a transportation project.

2. They are concerned that their competitors may receive the same or similar benefits without making any contributions. A fair playing field is very important to them.

3. They fear future department budget cuts will offset the benefits of their contributions. They also believe contributions by them may make it easier for the provincial government to cut transportation budgets.

3.1 Options

B.1 Trust fund

Funds from partnerships could be deposited into a trust fund for use by SHT. The trust fund may also obtain dedicated taxes and fees or a provincial capital budget allotment. The fund would be jointly managed by SHT and private sector groups. Both would have defined signing authorities and equal representation on the board.

Industry is more likely to contribute to a trust fund for transportation projects if they have a strong voice on the board. They will feel their interests will be heard and managed appropriately. Such a board would have significant influence. It would bring a business attitude to department expenditure decisions. The board could also set guidelines on how industry funds are collected and used, ensuring an even playing field between competitors.

Pros:

1. Board members representing the user groups and industry would have strong influential powers to lobby governments and industry for funds.
2. Board members would provide necessary user input into Transportation programming and policy decisions.
3. Potential contributors will have greater say and influence on future transportation budget decisions. This should help improve investor confidence.
4. Industry concerns regarding fair playing field between contributors and non-contributors are reduced or eliminated.
5. Revenues should increase.
6. More transportation investments would be based on a sound business case, increasing the economic benefits of transportation expenditures.

Cons:

1. The provincial government and SHT may have less decision making authority regarding expenditures.
2. If not managed properly, the board may become another level of decision makers demanding department resources and information.

B.2 Crown Corporation

A crown corporation could be established to solicit, collect and manage revenues from various sources. There is a range of implementation options. The crown could be small and manage nontraditional sources of revenue for specific capital projects. On the other extreme is a large crown corporation controlling all provincial transportation expenditures using revenues from fuel taxes, registration fees, permit fees, special agreements and others.

The crown could utilize the trust fund concept thereby realizing most of the same benefits as option B.1.

The added benefit of creating a crown corporation is it presents a sense of permanency. Industry is quite sure that the crown corporation will be there for some time. Also, potential contributors will have more confidence that base funding levels will be maintained if these revenues were dedicated.

On the downside, the public will view the crown as a bureaucratic monster. Most stakeholders expressed a strong dislike for this option. Apparently, crown corporations are not trusted by the public.

Pros:

1. Board members representing the user groups and industry would have strong influential powers to lobby government and industry for funds.
2. Board members would provide necessary user input into transportation programming and policy decisions.
3. Potential contributors will have greater confidence in future budget levels being maintained reducing their hesitation to contribute.
4. Industry concerns regarding fair playing field between contributors and non-contributors may be reduced or eliminated.
5. Revenues should increase.
6. More transportation investments would be based on a sound business case, increasing the economic benefits of transportation expenditures.

Cons:

1. The provincial government and SHT will have less decision making authority regarding expenditures.
2. People will view the crown corporation as a bureaucratic monster.

Recommendation

Develop the legislative authority to establish trust accounts. This authority must also allow contributors to be represented on the board of trustees. Use this authority to assist in developing partnerships with the private sector.

To add credibility, include a small capital fund from the department's budget. For example, the department could add sufficient funds to carry out current legal agreements to construct roads in the north.

Build on initial trust fund by adding other sources of dedicated revenues such as fuel taxes and registration fees as they become available.

4.0 Transportation Network Rationalization

Stakeholders consistently state that the road system and it's inter modal connections need to be rationalized. They feel we are paying too much to maintain and operate low volume highways and roads. Some are not even required. They understand the economic conditions are not as they were when these roads and highways were initially constructed.

They also see inconsistencies in how decisions are made between different levels of government. They feel coordination of programs and planning is needed.

Stakeholders want to work with the government to develop the highway and road system of the future. They would consider innovative ways to reduce the length of the systems, set defined service levels for each road type, identify needs and recommend programs to meet those needs. These service levels, needs and programs must correspond with the users' willingness and ability to pay. User involvement will help ensure that this happens.

Recommendation

Conduct a Transportation system rationalization study. This study will outline a strategy for the transportation system of the future.

This study should examine which highways and roads are important and which are not. It should recommend service levels, functional designs and develop implementation strategies for dropping any unneeded routes.

Urban streets and roads that interact with the rural highway and road networks should be included.

5.0 Stakeholder Participation

All stakeholders have expressed an interest in working closely with the provincial government in defining transportation needs, setting priorities, reviewing expenditure levels, and setting programs.

A standing committee with government and user group representation could oversee important and controversial policy initiatives such as the system

rationalization study mentioned above. Such a group would be useful to help make difficult decisions on transportation problems. It would provide a useful mechanism for obtaining consensus for sensitive issues.

Northern community access is another example of a sensitive policy area. It is an expensive undertaking with relatively little economic return or benefit to the province. Yet, northern people deserve a basic quality of service. The committee could help the government set directions, guidelines and priorities for such programs.

The mandate of the committee could also include inter jurisdictional funding between the province and local governments. For example, stakeholders have said funding to local municipalities should be based on identified needs and the local government's ability to pay for those needs. Also, transfer payments should be on a cost-shared arrangement ensuring the funds are spent on priority projects. This is a sensitive issue that is best handled by such a committee.

The committee would also be a powerful lobby group. With representation from provincial and local governments, industry and special interest groups, they would have a strong and united voice.

Recommendation
Develop a committee with user and government representation. The committee should include members from SHT, SMG, Economic Development, SUMA, SARM, CITL, CAA, STA, and the Chamber of Commerce. The committee's mandate will be to provide user and government feedback on sensitive transportation issues.

6.0 What has changed?

All previous discussion represents the views and opinions of various user groups. These views were summarized in a report and submitted to the TPC. This council then took the report into consideration when providing advice on the CTP.

The final draft of the CTP was not completed at the time of writing this paper. Additional changes may also be made to the CTP as it passes through the approval stages.

The draft CTP includes two of the four recommendations in this paper; trust fund legislation and an expanded and permanent TPC. We are hopeful that both will be approved. Senior government officials are using the TPC as a good example of how to obtain needed public and local government input for policy decisions.

Dedication of fuel taxes would represent a major shift in the philosophy of the provincial government. We do not expect any movement in this area soon.

The department is also undertaking a road rationalization study. We are examining how expenditure decisions are made for the provincial and rural road systems. This study will examine levels of service, design standards and functional classifications. The scope will include all rural highways and roads regardless of jurisdiction.

The study will provide alternative processes that will be taken to the public. The public will help decide which process is best. These processes can then be used to make expenditure decisions for rural roads and highways.

One of the intangible results from this study is the improved relationship between SHT and it's stakeholders. We now have a better understanding of each other's concerns, beliefs and problems.

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Disclaimer

This paper is the author's interpretation of the combined views and opinions of several different stakeholders. It does not necessarily represent the views or opinions of any one stakeholder or Saskatchewan Highways and Transportation.

The Funding Options for Transportation Infrastructure Projects

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Introduction

Throughout the western industrialised world, governments of all levels and all political persuasion face the problem of a shortage of revenue, mounting deficits, increasing public expectations, aging and inadequate infrastructure, and a public unwilling to pay still further increases in taxation. In the United States some observers estimate that as much as one trillion US dollars is required simply to maintain the status quo, to fix up what is already in existence. This makes no allowance for new infrastructure.

Traditional tax and spend methods of providing for infrastructure needs have clearly outlived their usefulness and a new approach is required if the basic essential of the western economies, the transportation systems, are to remain as efficient engines of economic development. In British Columbia the situation is even more pressing as we deal with rapid population growth and the challenges of a geographically and demographically diverse province, the challenges of new trade opportunities within the Pacific Rim and competition to the south.

This paper will examine the opportunities that are available to British Columbia to meet these challenges in providing adequate and timely funding, that will allow the provinces transportation infrastructure to keep pace with the demands of our growing economy. The paper will also describe the progress and changes that are already underway and speculate on issues that will face the province in this regard in the near future.

Traditional Funding of Transportation Infrastructure

In British Columbia, the provincial government is responsible for funding the provincial highway and ferry systems, and through a cost sharing formula with the municipalities, the public transit system. In addition the government is the

owner of BC Rail. The largest component of the system is clearly the provincial highway system.

Capital construction, rehabilitation, and maintenance of the highway system, have previously been funded on an annual basis from general government revenue. All expenditures had to be expensed in the year in which they were incurred, and project costs could not be amortized over a period of time. This was an inefficient way of funding capital projects, since without secure funding, multi year schedules could not be committed to and project budgets did not recognise the time value of money, by including the interest incurred during construction before the asset was completed and put into useful service. Many examples of incomplete projects exist around the province because the Ministry of Transportation and Highways was unable to secure the next years funding for projects already in progress.

Competition for general government revenue is always strong, since many of governments traditional roles in education, health and social security compete for the same limited funds. In times of fiscal restraint it was frequently the highways and other major infrastructure projects that were the first to go. This practice not only leads to under investment in infrastructure, but also leads to the stop - go character of the industries involved in their construction, which is both inefficient and disruptive to those involved.

Traditional funding methods have also promoted an isolationist approach to transportation planning in British Columbia. While each provincial agency attempts to co-ordinate its planning activities with others, the reality has been that no one agency has had overall responsibility for coordinating transportation infrastructure in the province. The result is that there has not been a strategic transportation plan for the province and the consequence has been piece meal and inefficient investments in the transportation system. Clearly any new approach to funding transportation infrastructure must address not only the raising of sufficient funds, but also real progress to spending those scarce funds in a far more efficient manner than in the past.

It was the recognition of these problems that lead to the government forming the BC Transportation Financing Authority in British Columbia.

The BC Transportation Financing Authority

The BC Transportation Financing Authority is part of the provincial government's BC 21 strategy to maximize existing government resources to build the foundation for a healthy economy as we move into the twenty-first century. Government puts this plan into action by focusing investments on vital

community infrastructure, facilities and programs. This targeted approach will deliver immediate benefits to the people and regions who need it most.

The passage of the Build BC Act in the spring of 1993 brought the Transportation Financing Authority into existence. That legislation provides the BCTFA with broad powers to undertake transportation infrastructure projects throughout the province.

Ensuring that the transportation links are in place to facilitate the long-term growth of communities and regions throughout the province is a cornerstone of the BC 21 strategy. The government formed the BC Transportation Financing Authority, to implement a new approach to financing highway capital construction and other transportation infrastructure. Instead of funding major projects on an annual basis from general revenue, capital construction costs are amortized over the useful life of the project, as is standard practice in the private sector.

The role of the BCTFA is one of planner and financier. As a separate crown corporation, the Authority can borrow funds and amortize the construction costs over the lifetime of the project. It is intended to operate on a self-financing basis, using new sources of revenue to service the debt and operating costs. Under the Build BC Act the BCTFA already receives revenue from a one cent per litre tax on clear gas and diesel (estimate $46 million annually) and a $1.50 per day tax on vehicle rentals (estimated $6 million annually). The Authority also has the power to establish tolls on transportation facilities subject to the approval of government.

These legislated revenue sources will fund construction of selected transportation projects, initially focusing on highway construction. A revenue strategy and criteria to select projects for funding is now being developed. This will define the BCTFA's approach to financing and form the basis of its business plan.

The mandate of the BCTFA consists of five key areas:

- the Planning Mandate;
- the Financing Mandate;
- the Approval Process;
- the Implementation Mandate;
- the Financing Options

The Planning Mandate describes the relationship between the BCTFA and the Ministry of Transportation and Highways as well as the transportation Crown Corporations. By liaising with all the transportation agencies, the BCTFA can pursue a balanced approach to the province's transportation infrastructure.

The BCTFA is preparing a multi-modal strategic transportation plan for the province, beginning with the vision and then proposing how that vision will become reality. The Authority will establish common guidelines to evaluate competing projects and initiatives across the provincial transportation agencies to ensure the most effective solutions are identified.

The BCTFA will assume responsibility for planning the capital program of the Ministry of Transportation and Highway, which will retain its role in construction, rehabilitation and maintenance of the highway system. Projects will be built using long-term financing, providing more accountability to the taxpayer since the Authority will have revenues dedicated specifically for infrastructure improvements. This will also allow much needed transportation projects to be completed sooner.

Recognizing that existing revenue sources are not sufficient to meet the level of expenditures required for a province-wide multi-modal transportation infrastructure, the Financing Mandate is to explore alternate methods of financing, including the dedication of new or existing revenue sources, tolls, and partnerships between the public and private sectors.

The Approval Process for BCTFA's functions will be the business plan, the vehicle for obtaining government approval for financing and implementing projects. A multi-year business plan will be developed and updated annually. This plan will identify revenues and expenditures associated with projects, borrowing and lending proposals, major project scopes, and measures to meet overall BC 21 objectives. Once the business plan is finalized, the BCTFA will be accountable for delivering the approved projects.

Regarding the Implementation Process, the BCTFA will not directly construct transportation infrastructure. It will, however, maintain a significant project management component to ensure that the Authority expends the funds committed to its care in the most efficient manner. Implementation responsibilities will continue to rest with the provincial transportation agencies, and may, in time, extend to the private sector.

The Ministry of Transportation and Highways will carry out highway construction projects funded by the BCTFA under contractual arrangements with

the Authority. MoTH will be responsible for steering the projects from planning through to completion. Project data will be fed to the BCTFA to monitor scope, budget, schedule and contracted deliverables.

Non-highway projects undertaken by transportation Crown Corporations will be approved on a per project basis in accordance with the overall provincial transportation plan. Again there will be a line of accountability to the BCTFA to permit accurate updating of the business plan.

Under its Financing Mandate BCTFA will examine other potential options for funding from the perspective of who directly benefits from the infrastructure investments. These potential sources include various additional fuel tax options, tolls, land development contributions, vehicle registration fees and other vehicle-related charges.

In each case the BCTFA will identify the type of project, if a particular method of funding is appropriate, the advantages and disadvantages of that funding method, and address any issues before implementing the new funding measure. A number of principals will guide the evaluation of each potential revenue source including economic, behavioral, incidence, revenue forecasting precision, practicality, and consistency in administration.

The BC Transportation Financing Authority is a significant advance in the planning and funding of transportation infrastructure in the province of British Columbia. It provides new opportunities to construct the vital transportation infrastructure required for a rapidly growing province, but in a fiscally efficient and socially responsible manner, taking a balanced multi-modal approach.

The User Pay Environment

With the competition for general government revenue and the limited ability to introduce new taxes or raise existing, governments in many parts of the world are moving towards user pay systems for a variety of services including transportation infrastructure.

In the United States, most readers with a basic knowledge of the transportation scene will be well acquainted with the recent well publicized toll road projects. In Southern California the SR91 project in which private sector interests have constructed additional HOV lanes in the median of an existing freeway in Orange County is one of the most well documented. Closer to home the 407 project in Ontario and the Northumberland Straits Bridge to Prince Edward Island are further examples. However before proceeding further we need to define "User Pay".

In its narrowest context tolls on roads has become a much publicised discussion topic as an example of user pay. In British Columbia, the Greater Vancouver Regional District's "Transport 2021" study has proposed extensive use of tolling both as a fund raising idea, and also as a demand management tool. The issue of tolling will be discussed in more detail later in this paper.

If the user pay concept is to be truly successful it will have to become considerably more sophisticated and innovative than simply slapping tolls on bridges. In its fullest sense "user pay" should be defined as *requiring every beneficiary of the proposed project, in whatever way they benefit, directly or indirectly, to contribute towards the cost of the project.* Ideally that should be in the form of a partnership for the major stake holders and not by the imposition of penal duties. To more fully understand the beneficiaries of transportation projects we need to let our imaginations loose for the moment and consider just a sample of some typical beneficiaries of a new road. These can include:

- ***The motoring public,*** through reduced congestion and ease of travel,
- ***Insurance companies providing auto insurance,*** through reduced accident claims and reduced pay outs,
- ***Major land owners,*** who may now be able to realise windfall profits through the improved accessibility to land parcels or the increased zoning available because of the improved transportation facility,
- ***Trucking and Other Transportation companies,*** who will experience both reduced costs and increased markets,
- ***Commercial Interests such as retail, restaurants, hotels etc.*** who should see increased patronage through improved accessibility,
- ***Citizens in general,*** through improvements in the economy, improved air quality if congestion eases and other numerous side benefits.
- ***Governments at all levels (Federal, Provincial and Municipal),*** through increased tax revenues.

For each project the way in which each group benefits may be different, but it is important to assess the ways in which each project can be funded by assessing the beneficiaries and then capturing a portion of that benefit in a tangible, identifiable and dedicated revenue stream. Nebulous, theoretical and unidentifiable revenue streams such as increased income tax, due to employment

generated, or the value of time savings, may be of interest to the economist, but are not helpful in contributing to the revenue streams which will ultimately bring projects to fruition.

Tolls and Other User Fees

In recent discussions on the funding of transportation infrastructure, considerable emphasis has been placed on the capturing of the benefits of a project to the motoring public. Recent technological advances now allow this to be undertaken electronically as opposed to the traditional attended toll booth which creates delays to traffic and is costly and cumbersome to administer. The extent of tolling varies widely around the world from the conventional project related single point toll, such as the Coquihalla Highway in British Columbia, to the comprehensive ring toll used for both demand management and revenue generation, the most aggressive application of which is probably in the Norwegian cities of Oslo, Bergen and Trondhejm.

The success of the use of tolls to raise revenue depends on a number of key factors:

- ***Public acceptance***, and that acceptance has both cultural and perceived equity components,

- ***Impact on Travel Behaviour***, which includes potential diversion to non tolled routes, and also negative effects on local businesses due to reduced accessibility,

Other publications have dealt at length with the tolling of highways, and at face value it appears a relatively easy and effective means of raising revenue. However tolls bring with them certain disadvantages, particularly in a geographically and demographically diverse province such as British Columbia. In British Columbia consideration is limited to the most populous areas such as Greater Vancouver, Victoria and possibly the Okanagan. Many of the projects which must be undertaken in British Columbia are in more remote areas where there are no alternative means of transportation available, and where projects are often built as development instruments to bring economic opportunities to otherwise stagnant economies.

Even in the populated areas, the effects of widespread tolls may be to bring economic hardship to businesses and travelers alike in some areas, while benefiting others. The problems of equity, where for example one region may have received its bridge for free while another is required to pay tolls should not be discounted. While it seems ever likely that some tolling will be required to

build the new infrastructure required there are other more equitable means of raising revenue given some innovative and imaginative thought. The danger of toll imposition is that it becomes the "easy way out" of solving the tougher funding problems.

Land Appreciation Capture

It is a basic principle of transportation planning that transportation infrastructure and land use issues are inseparable and that one impacts significantly on the other. In a fast developing province such as British Columbia with its relatively buoyant economic future compared to the rest of the western industrialised world, construction of new transportation infrastructure will bring with it rapidly increasing land values, as land use intensifies and new access brings new land into the available land development bank.

It is a reasonable business proposition that if a particular initiative adds significantly to the wealth of a person or business, then that business or person should contribute to the cost of that initiative. The difficulty in the past has been the means of capturing a portion of that wealth increase. There are well documented cases where governments have attempted to capture unrealised land value escalation profits through taxation measures, only to be met by vigorous and vocal opposition from "cash poor" owners.

How then can the frequently large profits associated with land value appreciation be reasonably channeled back into infrastructure improvements in a "win - win" manner? The first and most reasonable approach is by mutual agreement, whereby governments of all levels enter into agreements in advance with private sector interests for the joint development of a particular project. A fuller discussion of the role of public - private partnerships in the development of transportation infrastructure follows in the next section. The discussion in this section is solely to identify one means of capturing increased land values.

For their part the private sector company recognises that if the project proceeds one or more of its assets will appreciate significantly, and if it does not contribute to the project through the partnership, the project may either not proceed or may do so in a way which is less advantageous to its interests. As an example the routing of and accesses to a new highway, can be designed so as to maximise the value of a particular parcel of land. For its part the government recognises that it cannot fund the infrastructure at hand and that the project can be accelerated for the benefit of all, if the design maximises the value of its private sector partners land assets.

If the land value increase is not captured by a partnership agreement, then the other options include the government purchasing additional land over what is required for the immediate right of way, and then selling it for profit after completion of the new transportation infrastructure, or taxing the realised profit due to the improvement in some form of benefiting area tax. In proceeding with the first option care must be taken to ensure that the government does not use its privileged information to purchase land in a manner which might result in a claim by the original owner for a portion or all of the realised profit. However government frequently has significant land holdings in the form of Crown land, and consideration should be given to designing new infrastructure to maximise the value of this land for the public good and using the profits to fund projects.

Logically, where privately held land is involved the partnership route is to be preferred.

Public - Private Sector Partnerships

Public-private partnerships in infrastructure are cooperative ventures between government and private entities to develop or improve public-purpose infrastructure. The private entities may include firms specializing in public-private infrastructure, construction companies, equipment manufacturers, operations specialists, real estate developers, and various advisors.

The mix of public and private responsibilities varies from project to project. The responsibilities to be assigned include: project initiation and planning; design; financing; construction; ownership; operation; and revenue collection.

The benefits of public-private partnerships also vary from project to project, depending on the type of infrastructure and the structure of the partnership. The benefits can include:

- investments in new, improved, or repaired facilities that government could not otherwise afford;
- more rapid or efficient development or operation of a facility;
- new revenues for the facility (e.g., from ancillary development) and for government (through taxes or franchise fees);
- reduced risks for the public sector.

By combining the strengths of the public and private sectors, public-private partnerships can provide a range of benefits. Although benefits will vary by project, potential benefits include:

- *Leveraged Development*

  Many jurisdictions face a growing infrastructure deficit that inconveniences the public and may retard economic growth. Public-private partnerships can provide new capital and leverage the available public funds to develop or repair additional infrastructure.

- *Efficient Development and Operations*

  A public-private partnership may be able to develop new facilities more rapidly and efficiently through the use of design-build construction schedules, flexible contracting and procurement, and other innovative practices. Prospective private operators may also be able to apply specialized expertise and operating flexibility to increase operational efficiency.

- *Project Revenue Enhancement*

  Public-private partnerships frequently rely on user fees (e.g., tolls). Partnerships may also develop innovative revenue sources, such as real estate development, concessions, and parallel uses of the right of way.

- *Increased Public-Sector Revenues*

  Public-Private partnerships can produce new revenues for government, through taxes and through lease or franchise payments. For example, a partnership could include profit-sharing for the government if the private developer's rate of return exceeded a pre-determined level.

- *Risk Allocation*

  Public-private partnerships can transfer risk to the private sector that would otherwise be borne by government (and, ultimately, the taxpayers). For example, a public-private agreement could assign the revenue risk - the risk that revenues might not be sufficient to pay operating and capital costs - to the private partner. Risk-sharing between the public and private partners may allow some important projects to be developed that neither partner would be willing to undertake alone.

Capturing Other Benefits to facilitate Financing of Projects

Previous sections have discussed the options for funding new transportation infrastructure projects using tolls and user fees, and capturing increased land values. Other significant business opportunities exist for raising revenue streams as discussed in previous sections.

However each new project presents a new and unique set of circumstances that require careful consideration to identify the complete and full range of funding options available. Examples might include the ability to raise user fees other than through tolls. Specific suggestions would be surcharges on ski passes for a road leading to a ski resort, surcharges on ferry tickets for roads leading to a ferry terminal, and surcharges on parking fees for highways destined to a major central business district.

The use of vehicle insurance surcharges is also worthy of consideration since the various categories of insurance classes allow user fees to be accurately targeted through user type, e.g. commuters.

Impacts of the User Pay Environment on Fiscal Responsibility

User pay brings a new dimension in project discipline to public sector infrastructure projects. Clearly when an often complex financing package has been assembled for a project, the ramifications of such issues as cost and schedule overruns, justification of project scopes, the development of an optimum project schedule and cancellation of a project take on new meaning.

Unlike private sector projects which have always had this discipline, the overrun of a project budget in the past frequently involved a return to the government to make up the shortfall. Under "user pay", this is no longer an option and new and tough fiscal management of projects will be required. Cost overruns can only be solved by either cutting scope if the overrun is detected early enough, or returning to the market place and negotiating a new financing package, which may not be so easy to do.

However user pay also brings market place discipline to the selection of projects, in that this method of funding can only be used for projects which demonstrate a satisfactory business case in terms of costs versus benefits. It also adds the further discipline that these benefits are real and not in the imagination of some engineer or economist, since the benefits must be captured in a tangible and identifiable revenue stream, which will actually materialise. If the revenue is in the form of tolls, then clearly traffic forecasts for the project must be realised or

toll revenue will be insufficient and other revenue sources will have to be sought to make up the shortfall.

It is a long overdue requirement that the engineers and planners that oversee the expenditure of often very large sums of public funds in transportation infrastructure improvements, should also be involved in raising the revenue required to service the debt. Our own personal financial experience tells us that there is nothing that brings more care to spending money than earning it. The user pay environment brings this principle closer to reality.

Conclusions and Other Observations

The traditional tax and spend techniques of raising revenue for the funding of transportation infrastructure are unable to meet the challenges of the 1990's. In rapidly growing provinces like British Columbia new solutions are required and the government of British Columbia has recognised this through its formation of the BC Transportation Financing Authority (BCTFA).

The BCTFA is responsible for the high level multi-modal planning and the funding of transportation infrastructure projects under provincial control. Recognising that its legislated revenue stream of $52 million annually is insufficient on its own to fund the entire range of transportation improvements required, BCTFA is committed to using innovative funding techniques and strong fiscal discipline, in a user pay environment where possible, to generate the funding required.

While tolls have been the subject of much public attention for raising revenue and meeting demand management objectives, and are viewed by some as an easy funding option, other equally promising methods exist such as capturing land value appreciation and revenues from the full range of project beneficiaries.

The introduction of a "user pay" environment into the public transportation infrastructure system brings with it new fiscal discipline which will ensure that not only are funds raised in a more efficient manner, but they are also expensed in a similarly disciplined way.

"CHALLENGING THE FUTURE: Managing The Cost of Government Services "

J. W. Telford, President
TELCAN management consultants inc. Calgary, Ab

S.D.Shepherdson
SMC Shepherdson Management Consulting Calgary, Ab

1.0 INTRODUCTION

For the past year we have been working with the municipal level of government in northern Alberta to assist them with the process of preparing for incorporation as independent Municipal Districts.

Throughout this process we were guided by the following beliefs:

- the public sector is a business and should be managed under the same rigorous controls;
- balance costs and revenue first through "improved performance", second through "cost containment" and third through "increases in taxes or user charges"; and
- the greatest potential for effectiveness is in creating systems that empower and reward individuals for delivering value to the customer.

This paper outlines the business environment facing local government and the size of that business, the factors driving change, the options available for management, the decisions made and how they relate to public goals.

Our mandate from our clients covered assistance on a variety of issues related to the transition to local government but, in this paper we deal primarily with the question of the transfer and management system for the transportation program.

2.0 TRANSPORTATION INFRASTRUCTURE A GLOBAL PERSPECTIVE

From a global perspective, Canada's road network is relatively small compared to those in Japan and the United States. It is comparable to France's and Australia's in terms of total length of the network (Figure 1).

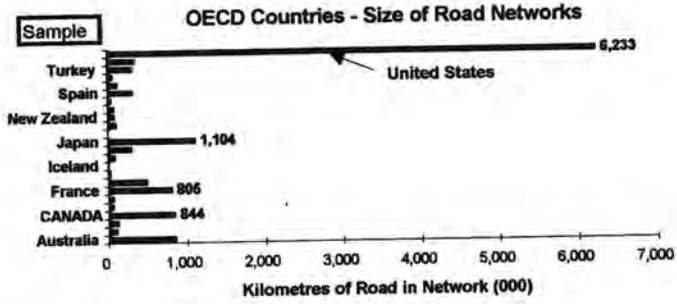


Figure 1[1]

Canada's road network has one of the lowest densities in the world, on par with Australia and Iceland. Road density (kilometers per square kilometer) reflects Canada's large geographic area and relatively modest total length of road. Canada's percentage of paved roads is also relatively low at 29%, compared to Australia at about 50% and the United States at 56%.[2]

3.0 TRANSPORTATION INFRASTRUCTURE THE CANADIAN PERSPECTIVE

How significant is road construction and maintenance in Canada?. Road expenditures for infrastructure construction and maintenance represented over 1% of the 1990 Canadian GDP of $671.5 billion. If we consider all direct transportation expenditures the economic value is about 5% of the GNP.

FY 1988/89 Road Expenditures by Jurisdiction



Figure 2[3]

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[1] The Economist, Book of Vital World Statistics, Random House 1990, p. 106 and p. 110

[2] op. cit.

[3] Canada's Roadway Infrastructure: Selected Facts and Figures, RTAC 1990, p. 19.

Overall, the construction and maintenance of roads in Canada is an eight billion dollar a year industry. On an individual municipal basis in Alberta, the expenditure varies widely. For many Alberta municipalities, road expenditures represents 65 to 80 percent of total budget expenditures.

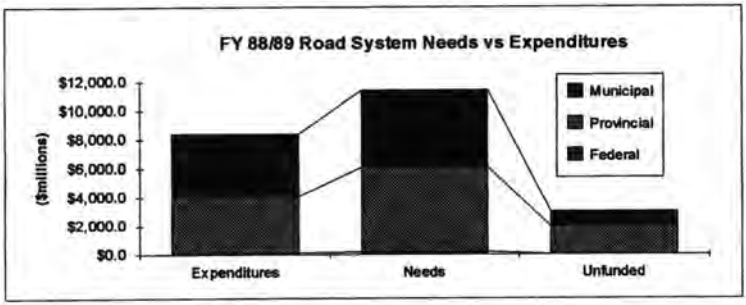


Figure 3[4]

Figure 3 shows the gap between needed expenditures and actual expenditures for the road system. The category "needed expenditures" is described as "what was actually needed to maintain it at current standards." And therein lies part of the problem. What standards? What is the economic value of those standards and can we afford them?

4.0 THE NEED FOR CHANGE THE FEDERAL AND PROVINCIAL VIEW

4.1 The Drivers for Change

The need to manage the deficit is perhaps the most influential factor affecting government today. Low inflation makes it somewhat easier to take required action.

4.2 The Need For Action

Before there can be a broad-based acceptance of a new vision there needs to be a widely shared recognition of the need to change. For example, the fear that continuing deficits will lead to a reduction in our quality of life is widely perceived to be a reality. Coupled with improved tax payer understanding, this "new political reality" makes it at least possible for political leaders to contemplate drastic changes in providing government services.

In Alberta the government is undertaking a number of initiatives to reduce program costs including those in health and education. With high profile

[4] op.cit.

programs such as these that directly touch people's lives under close scrutiny, it is not surprising that road maintenance and construction programs are also specific targets for cost reduction.

4.3 The New Vision

Given wide-spread understanding and acceptance of the need to change, the next phase - articulating the new vision - has to provide the hope and conviction necessary to make required changes. The new vision has to paint a picture of a better future, it has to acknowledge the level of effort required and it has to point the way to success. The ability to provide new analytical and management tools for public sector managers is critical. The ability to demonstrate how success can be achieved is necessary to get commitment and buy-in from major stakeholders particularly managers and employees.

4.4 The Road to Success

To be successful, government must act boldly and with total resolve. There are a number of actions that can be taken by public sector leaders including:

- creating a sense of urgency
- taking a customer orientation
- providing only service and product that has value
- removing bureaucratic processes
- empowering people
- changing reward systems to relate to value provided
- removing redundancy and duplication
- increasing accountability
- measuring performance.

5.0 THE NEED FOR CHANGE THE MUNICIPAL GOVERNMENT VIEW

5.1 Reduction of Support from Two Senior Levels of Government

Federal and Provincial governments in Canada have serious financial problems. Overspending and massive debt limit their ability to continue program delivery and spending at the current levels. Downsizing and downloading of costs to junior levels of government for shared cost programs or reduction of the level of grants will be a fact of life for the next decade. Other alternatives, such as currency devaluation or higher rates of inflation, are not acceptable for Canadians or for the international financial community. Senior governments are faced with the reality that if they do not become more fiscally responsible their world bankers will take action

There is an increasing movement to shift government program costs "closer to the people" that benefit and should pay for them. Some view this as "democratization", others as "abrogation of responsibility".

5.2 Lack of Capital for Infrastructure Renewal and Maintenance

The lack of capital for the renewal of infrastructure in transportation, sewer and water facilities is becoming critical. The average unfunded transportation liability, at the municipal level, as projected by the Transportation Association of Canada study has reached an average of $1,732 per km. This average does not apply to all municipalities but it does indicate a major problem in the financing of transportation infrastructure. This assumes that all the infrastructure provided was not overbuilt in the first place.

The Federal government's recent initiatives to finance job creation through cost-shared public infrastructure projects still leaves a major shortfall in the availability of capital.

5.3 Increasing Taxpayer demands for Efficiency and Effectiveness

With the total level of taxation increasing there is a growing demand from the taxpayer for a reduction in the cost of delivering services. Tax payers are more knowledgeable and information is more readily available.

5.4 Increasing Levels of Debt

Municipalities are limited in the amount of debt they can carry. They must go to the taxpayer for authority to use debt for capital purposes. With most taxpayers at the local level being debt averse, this is making debt a hard option to sell.

5.5 General Pressures for Change at the Local Government Level

When we combine the mood of the electorate with the political reality that government cannot do it all, we find that demands can only be partially met. We also find that there must be change.

5.6 Improvement Districts

The Improvement District form of government was developed in Alberta to provide local government in sparsely populated and under developed areas. The development of energy and forest product resources has changed local economics and the tax assessment base. In the evolution which is taking place, the provincial government first required an elected Advisory Council to advise on needs, programs and tax levels. Gradually the cost of programs was transferred to the local tax base but the Road Authority (which is the major expenditure) and financial administration remained in provincial hands. Several attempts at transition were tried but there was not the underlying urgency needed to meet government's goals. Late in 1992, the province announced that all remaining

programs would be transferred to the local level and the Improvement Districts would be treated the same as municipalities for all purposes. The provincial government's objective for the Improvement Districts was to move them to full incorporation as rapidly as possible, with the final decision left to the local electorate and their Advisory Council.

5.7 The Opportunity

The opportunity resulting from this shift to incorporation is to take a "blank sheet of paper" approach to management of core services - as the organization shifts from the provincial jurisdiction concerning legislation, regulation, human resources policy, and employee pay scales. As newly incorporated bodies, they operate within a new regime under the Municipal Government Act and the Alberta Labour Code.

6.0 CONSIDERATION IN CREATING A SOLUTION

- Our clients' program is to create a major shift to tax-payer sensitive government programs that deliver value, excellence and continuous improvement.
- The solution must also provide elected representatives with a structure that allows the tangible and intangible objectives of government to be weighed against the ability to pay.
- The solution must also accomodate the taxpayer's personal responsibility for activities that are for the individual good.

6.1 Options for a Strategy and Solution

Government has traditionally provided programs - a collection of activities like *"Road Construction" and "Road Maintenance"* that have benefits (travel time for users, safety etc.) and resource costs (internal costs for people, materials and equipment, external contractor costs). Governments today can no longer accept infinitely increasing program costs if they are to control their financial deficits. If the ability to raise tax revenue is limited because of few new economic development initiatives and limited capacity of individual tax payers to pay higher taxes - then government has to turn to cost containment and productivity improvement strategies to improve program effectiveness.

Given government has new criteria, affordability for example, then what are the tools government can use to better manage its programs?

There are three options for the solution to government's dilemma. First - increase taxes or users fees (prices), second - cut costs or third - improve performance. We believe that all three must be considered - BUT in the reverse order to that which has been traditionally taken by government.



Figure 4

6.2 What is the Experience and Beliefs

There is a belief both within government and industry, that cutting staff will automatically achieve objectives of reduced costs or improved profitability. The risk is that this approach can destroy core competencies of the organization that will be critical to achieving the changed level of service and products.

Effective downsizing usually requires a different solution which starts with decisions about where you are going, defining the core services and products that will be required, evaluating alternatives such as the potential and effectiveness of contracting out, application of new technology, and changes in policy that may be de-motivating. Effective action means organizing for effectiveness, retaining required competencies and reducing costs. Performance improvement comes before cost cutting.

7.0 WHAT TOOLS ARE AVAILABLE FOR MANAGEMENT

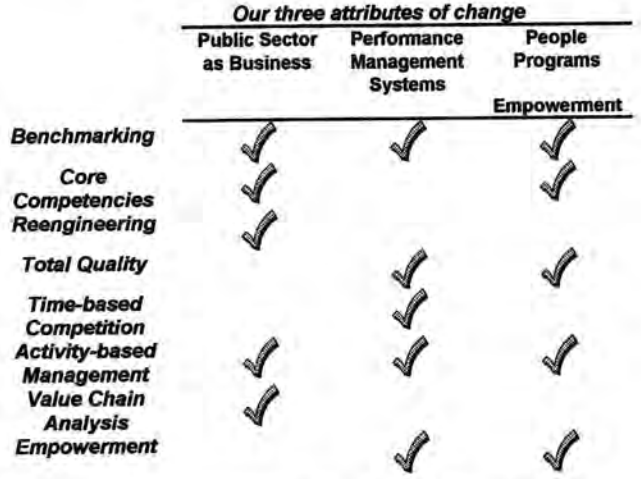
7.1 General Considerations

There are a large number of management tools that are available for various applications. It has been suggested that many of these merely reflect the "expert's" current "flavour of the month". It is hard to keep track of all tools. For example, Ernst & Young in a survey of 584 TQM practitioners found that 945 different "state-of-the-art" TQM programs had been sold to the sample firms![5] Some of those firms either did not like the first solution they purchased or they bought different programs! In our opinion none of these are a quick fix that automatically leads to the intended benefits. Like all models of management they have their time and place.

[5] "Take Charge Managers", Harvard Business Review, p. 128, Jan-Feb. 94.

In a later section of the paper we will cover the mix of tools and management techniques which we applied. We believe that they will provide a system that will deliver a continuum of added performance and value. The actual level of savings or increased service that is delivered will depend on the will of the employees, the effectiveness of management in the implementation and development of the feedback mechanisms.

Figure 5: Management Tools for Creating Value



7.2 Here is our operational definition for these tools;

- **Benchmarking** is about developing standards - goal posts against which you measure your performance relative to someone else
- **Reengineering** is about implementing dynamic, radical change in your key business processes that directly create value for your customers.
- **The evaluation of core competencies** is concerned with determining your strengths and doing those things you do best while letting your business partners do the things they do best.
- **Total quality** is about minimizing variance from standards that create value for your customers.
- **Time based competition** is about reducing the cycle time from start to end of key customer related processes to create customer value.
- **Activity-based management** involves defining "driver factors" in the business that affect costs and developing a data base so that the cost impact of changes in business processes can be evaluated.

- **Value-chain analysis** involves examining alternative means of obtaining customer value through evaluating each stage of activity in a process to determine those that the customer is willing to pay for - our definition of "value-added".
- **Empowerment** involves creation of shared values between employees at various levels in the organization that allow people to function across process boundaries without the limits imposed by traditional organizational hierarchies - (either the functional silos that define internal organizational boundaries or excessive layers of management).

8.0 OTHER CONSIDERATIONS RELATED TO STRATEGY

8.1 The Culture

Culture provides the framework for understanding the decisions and reactions in an organization. Expectations develop from the culture which limit or expand the individual's ideas and emotions. These personal ideas that are developed lead to decisions and implementation of actions which are justified and supportive of the culture.

- Beliefs are the values and expectations that provide structure to what people think they should and should not do. They reflect intentions of how to be successful in certain circumstances
- Behaviour is what we see people do every day. They include how we dress, who talks to who, decision making, conflict resolution etc.,
- Assumptions are the reasons for continuing successful behaviour. Over time, if an action is successful, we cease to reconsider it and it becomes a habit based on an "unconscious assumption"

One of the key challenges is to overcome the tendency for individuals to cling to the status quo. There can be many causes but they generally relate to fear and attitude. Fear of the unknown, fear of failure and in some cases fear of success affect individual's perceptions about the change process. Attitudes may be a limiting factor and must be addressed

Some behaviours stem from a lack of self worth, a scarcity mentality, beliefs that management mistakes and rewards "doing it my way", beliefs that the person lacks education or training or experience, or that you can't trust management, or a belief that you can't trust workers.

Whether these behaviours, attitudes or beliefs are evident or not, they must be addressed in the change process. The perceptions and beliefs of both management and workers have to be dealt with throughout the change process.

8.2 Human Resources

In working with business strategy, venture start-up, and profit improvement issues over the past ten years it is clear that opportunities for change start with the organization of human resources. We agree with Warren Bennis, in his book "On Becoming a Leader" where he says:

> "Only a handful of organizations have even begun to tap into their primary resource, their people, much less give them the means to do what they are capable of doing"

With changes in the level of education, professional mobility and social norms we agree with William Sandy's statement in Forging the Productivity Partnership that:

> "Workers do not listen to or follow others because they are bosses. They pay attention to the authority of competence."

These are insightful comments and an appropriate description of the reality of today's management and workforce. These issues must be considered in the change process.

9.0 CHANGES IN TRANSPORTATION MANAGEMENT

9.1 Considering Process Choices

The tools for corporate management are based on creating value for two key stakeholder groups. First and foremost is the creation of customer value which leads to creation of shareholder value. From a public sector perspective, the taxpayer is both customer and shareholder. In designing the management improvement process we had to address two questions "what key processes create taxpayer value and how do we best manage those processes?"

In our experience a key consideration about the workability of different tools is whether people identify with the methods and will use them to create customer value. In short, we think you should not waste energy debating the respective merits or problems or whether the tools universally apply. Instead, try them, use them, see how people respond to them. Those that work - re-use them. Those that don't work - set them aside for another time. Implementing change must account for the failure of some ideas.

9.2 The Implementation Process

From our evaluation of the options for road system development we reached the conclusion that the following were critical solution elements.

- deliver value to the constituent
- provide maximum opportunity for constituent input
- define system requirements on the basis of value
- manage to engineered standards of input and output

- use benchmarking to confirm cost effectiveness
- use benchmarking to confirm contractor effectiveness
- use road surveys, standards, inspections and special studies to define value on the basis of priority
- set financial priorities based on safety, legal requirements, minimum standards, cost effective projects and desired standards
- identify the level of deferred maintenance
- adopt an operating policy of maximum contracting out
- continuously monitor through activity-based costing etc.

9.3 Overview of Changes

Transportation

The basis of planing the annual road construction and maintenance program is experience and observation. The process creates the basis from which decisions can be made on the current and deferred requirements to maintain the value of public investment for future generations.

In a series of workshops we took the elected Council through consideration of benchmark comparisons from municipal government in Alberta, Saskatchewan and Ontario. This provided an opportunity to compare decisions on policy, standards and funding priorities. Council could choose or modify those that met their objectives, values, beliefs and specific local conditions. Development of operating procedures was left to management.

All policies and standards eventually will be passed as by-laws to assist the public in understanding the decisions of Council. All jargon and engineering technicalities contained in the policies and standards were removed in the by-laws.

The identification of key road program activities and the financial priorities consider questions of safety, legal requirements, minimum requirements to maintain the integrity of the road, cost effectiveness (eg. size of contract) and desirable service levels

As part of the monitoring and feedback process for tracking the impact of change we developed engineered work units and related unit costs.

Budget System

The transportation program is a part of the normal budget process for Improvement Districts but it will cease to be a line code approach. The budget presentation will be based on activities and financing priorities and it will include a revolving fund created to cover gravel crushing and depreciation. Council will deal with activities and the related services such as culverts, signs, regravelling, sanding/plowing etc. rather than just dollars. Through the use of a computer model they will have immediate feedback on the financial impact of their

decisions and the level of deferred or unfunded maintenance resulting from budget decisions.

Accounting System

The accounting systems used in most municipalities are limited and do not provide adequate tracking of assets, including inventories. Most do not have a capability for activity based costing nor an adequate management reporting capability. Our clients are installing the Harrison Muirhead Systems Inc. (Edmonton, Alberta) financial administration and accounting system which uses a fourth generation data base. This will overcome these inadequacies and support new requirements.

Human Resources

Development of Human Resources policy provided an opportunity to empower individuals, to adjust the reward system, and to create incentive for staff to work at a higher level of performance. It is proposed that all staff positions will be paid at prevailing local market rates. An annual earnable bonus based on both personal and team performance will be provided as an incentive for continuous improvement. Other innovations include a "buffet" type benefits plan with a specified dollar limit and a specific number of days off for specified purposes.

10.0 CONCLUSION

Our approach to managing the cost of government services:

- treats municipal government as a business;
- is based on a performance management system that is in turn founded on process evaluation and continuous improvement;
- adopts a system for empowering employees.

We believe changes in policies, standards, and processes for transportation linked with the changes in Human Resources policy will create fundamental changes in the culture. Change in culture is an essential element in making the overall program more effective.

In conclusion we must ask "Will our approach be effective and create the level of efficiency that is the objective?" We can't know at this time. We do know that the level of success will depend on leadership, trust, and the ability to accept change as a way of life.

CANADIAN FEDERALISM: A MAJOR POLICY CONSTRAINT ON THE DEVELOPMENT OF RAILWAY SHORTLINING IN CANADA

Dr. Henry Ropertz

ABSTRACT

The following paper attempts to outline the many difficulties and problems faced by potential short line railway operators in Canada. Canada's unique form of de-centralized government is identified as one of the major impediments to short line operations. A comparison with the experience in the United States is undertaken to demonstrate the many differences between the environment for shortlining in that country with Canada. A proposal for the creation of a Short Line Railway Agency is presented as one way to improve the development of short line railway operations in Canada.

INTRODUCTION

Since the introduction of railroading in Canada and the United States in the early 1800's, North Americans have been intrigued with the mystique of railroading. However, this mystique is reflected differently in each country. In the United States, "it is the proliferation of short lines under a fully deregulated rail system." (1) In Canada, it is the existence of a railway industry operating in a highly regulated environment over a rail network virtually untouched since the 1930's, when rail mileage was at its peak. The existence of strong provincial governments in Canada helped to preserve rail operations to protect communities. Ironically, it would be the growth of the provincial road network which would enable truckers to compete for high valued goods and eventually make it difficult for railways to continue to serve small communities. A highly regulated railway system ensured operations at any cost. To a large degree, this phenomenon remains in place today. Given this situation, what are the

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The views expressed in this paper are those of the author and do not necessarily reflect those of Western Economic Diversification.

opportunities for the development of short line railways in Canada? Fortunately, conditions are changing, albeit slowly which could result in a substantial increase in the development of short line railway operations in Canada.

CANADIAN FEDERALISM

Canada is a confederation comprised of eleven governments, one federal and ten provincial. Each level of government has its own unique powers and responsibilities, making Canada one of the most decentralized countries in the world. The **Constitution Acts (1867) (1982)** give the Canadian provinces constitutional authority equal to that of sovereign states. The provinces have jurisdictional authority in functioning areas of expanding significance, such as health, education and transportation. However, responsibility for navigation and shipping(as transportation was defined in 1867) was originally granted to the federal government. Under section 92:10, the federal government, was given immense authority in transportation including the potential takeover of provincial roads, canals and railways, if it were in the national interest. (2)

The purpose of the original **Constitutional Act (1867)** gave broad powers to the federal government with the intention it appears, of granting extensive control of the economy to the central government. However, there has been a transformation of this sharing of power towards the provinces. For example in transportation, truckers operating under provincial jurisdiction have been successful in capturing 70 per cent of the railway business. Railways today are primarily carriers of high volume, low value bulk commodities. In terms of passenger movement, approximately 90 per cent of all inter-city trips take place over the provincial operated and maintained highway system.

It is both interesting and significant to point out that provincial governments have never contested the responsibility of the federal government to regulate inter-provincial railways. Indeed, it is because such responsibility was acknowledged, that the provincial governments tended to resist any changes in loosening railway regulation or in allowing railways to abandon low density branch lines. This made it virtually impossible for any entrepreneur to establish a short line operation. In turn, railway culture tended to treat potential short line operators as unqualified outsiders.

Prior to the passage of The **National Transportation Act (1967),** transportation law and regulation had become ossified around freight rate provisions which were left-overs from the 1930's, when railways enjoyed a near monopoly of overland freight shipments. This entrenched, parochial and costly environment was also prevalent in the United States. But the virtual collapse of the railway industry in the U.S. in the 1960's brought about by these anachronistic railway policies resulted in significant changes in the manner of how railways were to be treated

in that country.

THE U.S. EXPERIENCE

Railroads in the United States escaped their locust years of the 1960's and 1970's when 20 per cent of mileage was in bankruptcy largely through regulatory freedoms.

The Interstate Commerce Act fostered an efficient and fair national transportation system. The Commission interpreted its act in a realistic fashion and tended to emphasize practical solutions to problems such as significant re-structuring of the U.S. railway network, prior to the passage of the **Staggers Rail Act (1980)**, which permitted elimination of much of the inefficiency encrusted through decades of stultifying economic control. This emphasis on reduced economic regulation of U.S. railroads has not happened on the same scale in Canada. **The Staggers Rail Act** has given the railroads greater flexibility to set rates at market levels and unlike in Canada, rationalize their networks. **The Staggers Act** also introduced certain provisions specific to the formation of short lines. " These are included in sections 401 and 402 of the Act. The purpose of these new provisions was to provide an alternative to inadequate rail service and to preserve feeder lines prior to the downgrading of such lines."(3)

The **Interstate Commerce Act** prohibits individual states (unlike Canadian provinces) from assessing diesel fuel and property taxes against inter-state railway operations. Canadian railways pay significant fuel and property taxes to federal, provincial and municipal governments. For example, here in Vancouver, CN North America pays approximately $1.6 million a year in property taxes to operate its own railway bridge connecting North Vancouver.

The favourable economic and regulatory environment has resulted in over 41,000 unprofitable route miles (about 25 per cent of the class I network) being eliminated, half through abandonment and half through sale. Entrepreneurs, state governments and other organizations established over 200 new short line and regional railways. The overall result was a significant increase in railway investment, productivity and service to customers. Approximately 80 per cent of the new short lines remain in operation and are turning profits on facilities once selected for abandonment.

Canadians can only look in envy to the revolution of the railway industry in the United States, be it class I railroads, short lines or even Amtrack. This is not to conclude that there are no problems. There are problems in the areas of labor productivity and inadequate capital spending, but from the vantage point of Canada, where railways continue to be highly regulated, a level playing field with U.S. railroads seems a long time away. It should come as no surprise, that both CN North America and CP Rail System currently operate about 1/3 of their

total network mileage in the United States and CP Rail System generates approximately 25 per cent of its total revenue in that country. An additional 36 per cent is raised from cross border traffic. It is not difficult to understand why the American flag has been added to the CP Rail logo. This trend can be expected to continue unless something is done to resolve the Canadian railway policy conundrum.

THE CANADIAN RAILWAY POLICY CONUNDRUM

At this point in time, there are only about 1,128 miles of short line railway operations in Canada. This is not surprising, given the fact that prior to the passage of the **National Transportation Act (1987)** there were no provisions in federal law for a third party to acquire portions of railway land and infrastructure as an operating railway. Under the 1987 Act, section 158 covers conveyance of lines without abandonment and section 174 covers conveyance of lines when an abandonment has been applied for. Despite these provisions there has not been the growth in short lines as in the United States. There are still too many impediments in place.

One of the obvious differences between Canada and the U.S. experiences is that a substantially large percentage of Canadian rail branch lines are dependent on a single commodity (grain) than is the case in the United States. " Moreover, in the 1974, the federal government through an Order-In-Council (Cabinet Decision) ordered that approximately 12,500 miles of branch line in the three Prairie Provinces be protected from any abandonment until the year 2000. As a result of various Railway Commissions' recommendations over the next five year period another 3,000 miles of Prairie branch line were added to the protective network. In addition both CN North America and CP Rail System receive a generous cost based subsidy from the federal government of approximately $700 million a year to provide rail service to grain farmers located on these lines."(4)

Unfortunately it will take a change in the **Western Grain Transportation Act (1983)** to allow short line railways to be eligible for this subsidy. The Grain Transportation Agency, which administers the **WGTA** can provide some financial assistance under a program designed to improve system wide efficiencies. However, this program has limited funds and short line railways would have to compete with other options such as subsidized trucking and off-track elevators.

On October 30, 1991 The Hon. Shirley Martin, Junior Transport Minister issued a policy statement affecting funding of short line railroads on the Prairies. The statement **inter alia** offered an explanation that:

> "funding will be provided to short line operators under long-term transportation contracts, only if services represent the lowest

cost alternative to operations by CN North America, CP Rail System, direct trucking and off-track elevators."(5)

The funding would be based on freight rates that are competitive with commercial trucking of grain. These rates are currently set at $9.50/tonne for the first three years and $5.00/tonne thereafter. If this policy remains in place there will be many Prairie branch lines that will not be susceptible to conversion to short lines. However, there remain a number of other lines which although they may be categorized as low density, could support a short line operation.

The National Transportation Act Review Commission in its 1993 Report identified short line railways as a "promising alternative to our current rigid structure". But the Commission also identified a number of impediments to short line operations.(6) These include:

1. The issue as to whether inter-provincial short lines are subject to federal or provincial labor legislation.

2. The issue as to whether short lines railways are eligible to statutory subsidies provided for in legislation such the **Western Grain Transportation Act** or the **Atlantic Region Freight Rate Assistance Act.**

3. The lack of venture capital to support the creation of short line railways.

4. The challenge of regaining former rail customers before a satisfactory revenue base reappears.

5. The complexity of the conveyance process which involves both federal and provincial bodies.

6. Inadequacy of provincial legislation to address the start- up and on-going regulation of short line railways.

The Commission was also concerned that many of the above impediments stem from lack of clarity and certainty in government dealings with a new operator.

If short line railroads are to have a future in Canada, immediate action is required to eliminate the Commission's alarming list of impediments. The driving force behind the necessary changes may well be the financial difficulty currently being experienced by both national railways. They are both in serious financial difficulty. It is for this reason that the issue of rail line abandonment has moved from a debate over the status of a few miles of track to one where the railways are proposing to abandon regions! The long-term financial picture for the national railways is a pessimistic one. Neither railway is expected to experience a significant increase in revenues to offset current operating losses. This situation dictates that plant rationalization on a significant scale must take

place.

The time has come to solve the Canadian rail policy conundrum by removing the rigidity of rail regulation and allowing the railways every opportunity to compete with their U.S. counterparts. It is no longer a question of choice and the new CP Rail System logo will be a constant reminder of that.

The urgent need to address the financial requirements of the national railways should provide a positive opportunity for potential short line operators to step into the breach and provide rail freight service on a number of these low density lines. To help nurture this expected change in opportunities for short line railroads, it is proposed that a **Short Line Railway Authority** be established.

A PROPOSAL TO ESTABLISH A SHORT LINE RAILWAY AGENCY

A review of the U.S. experience demonstrates that short line railroads have a significant role to play in the operation of light density branch lines. However, as documented by The National Transportation Review Commission, there are a number of important "obstacles which retard the growth of the short line industry in this country".(7)

The current circumstances require the establishment of an agency which could act as a promoter, facilitator and advocate of short line operations.

WHY AN AGENCY?

In Canada, buying a railway property is not easy. It can take up to 16 months, as was the case of RailTex's purchase of the rail line between Goderich and Stratford, Ontario. In western Canada, Mr. Tom Payne devoted six years and discussions with 11 different federal and provincial transport Ministers. Conveyance of railway property is a time consuming, complex and demanding process. There can be as many as 100 encumbrances on a single line of track. This has been the case with the federal government's attempts to transfer ownership of approximately 2,000 miles of abandoned railway right-of-way to the three Prairie provinces.

A Short Line Railway Agency could be a one-stop organization where potential short line operators could receive advice and perhaps even some financial assistance in the form of a loan to assist in the purchase of rail property and to provide some cash flow until the new short line is in a revenue producing situation.

The agency could promote the harmonization of changes to provincial legislation which are necessary to accommodate short line operations. The agency could also work to shorten the time between the actual purchase of a rail line to the point

where the short line operator begins to earn revenue.

The agency would be able to guide potential short line operators through the various provincial and federal approval processes and it could act as an advocate to find ways to eliminate the redundant aspects of this lengthy process.

The existence of an agency may be one way to encourage entrepreneurs to come forward to express an interest in a branch line prior to the downgrading of the traffic on such lines.

The agency does not require a legislative base. It should not become a regulator. It should not require any regulatory functions. Its mandate should be that as a promoter, facilitator and advocate and perhaps even ombudsman on behalf of short line operators who have neither the resources nor the time to spend in participating in all the necessary processes that affect the start-up and successful operation of a short line railway.

The location for such an office should probably be in a city such as Saskatoon, Saskatchewan, which is the center of the Prairie grain collection system. This is a region with good potential for short lining, particulary should changes be made to pay the current transportation subsidy directly to farmers. The concept of short line or regional railroads bringing grain to the main lines for subsequent shipment to export ports, could reduce the farmers' overall cost of shipping grain and enable them to take advantage of the lower cost short line operation. There is no need for a large staff and if the agency is successful in removing many of the impediments to short line operations, it may well work itself out of a job. In fact that point should be the agency's mission statement.

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REGULATION OF LOCAL AND REGIONAL RAILROADS: A NATIONAL SURVEY OF PERSPECTIVES AND PRACTICE

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INTRODUCTION

One of the fastest growing sectors of the transportation industry is regional and local railroads. This growth is largely explained by the important function shortline carriers serve in the origination and termination of transporting agricultural and natural resource commodities. In addition, local and regional railroads have fulfilled the void created by Class I carriers divesting themselves of low-density lines. Much of the transformation of low-density lines from Class I carriers to shortline carriers is attributed to operational inefficiencies experienced by Class I carriers ("Regulation of Local and Regional Railroads: A National Survey of Perspectives and Practice," Tolliver, Thoms and Casavant, 1993).

Shortline carriers are quite different than Class I railroads in operating scope, economics of operation and financial resources. Yet, in many areas the same regulations essentially apply to both types of railroads. A large portion of the initial federal and state regulatory legislation was designed for large, Class I carriers and thus designed to fit their economic and operating characteristics. Hence, there has seemingly been an attempt to retrofit an existing set of regulations to the shortline sector of the railroad industry. Economic regulations are aimed primarily at rates, surcharges, routes and abandonments. However, many shortlines operate under track and leasing agreements (from Class I carriers), and do not publish rates. Also since most shortline carriers operate within the boundaries of a single state, county, or industrial park, interstate regulation seems inappropriate. Given the dichotomy emerging in the U. S. railroad industry between shortline and Class I railroads it is conceivable that regulations derived from history may not appropriately fit the railroad

system of the present and future. Accordingly, the evaluation of structure, purpose and effectiveness of regulations may differ significantly from the perspective of the regulator versus the regulated.

OBJECTIVES

The study reported in this paper evaluates the perspectives on, and practice of economic, safety and institutional regulation of local and regional shortline railroads in the U.S. Specific objectives are to:

1. Determine the perceived extent and effect of regulation from the perspectives of the regulated shortline railroads versus the state regulatory agencies.

2. Determine the characteristics of railroads that are related to the alternative perspectives on regulation or to the differences between regulators and railroads.

REVIEW OF SHORTLINE MOVEMENT

American railroads were the first major industrial corporations in the U.S., contributing to much of the country's urban geographical shape (for a detailed review of the development of shortlines and the legal framework, see Tolliver, Thoms and Casavant). The Interstate Commerce Commission (ICC) was the first administrative agency in charge of regulating railroads, which initially had a monopoly on public transportation. The primary purpose of the ICC was to address the concerns of passengers, shippers and state regulators faced with a transportation monopoly. However, in the early 20th century the introduction of the electric interurban railway along with the automobile and airplane facilitated the breakup of the railroads' transportation monopoly. In an effort to adjust to a changing transportation industry, many of the large Class I railroads sought to consolidate resources and merge. However, many of the mergers and consolidations during the sixties led to several disastrous bankruptcies in the seventies. As a result, there is no true transcontinental railroad (except for Amtrak) in operation in the U.S. today. Rather, there are four major railroad systems in the west and three in the east. This led to the move of several large carriers to spin off feeder and branchlines into regional or shortline railroads or go to full railline abandonment.

Shortline and regional railroads typically experience less expensive terminal operations and are usually free of many restrictive union agreements (Tolliver, Thoms and Casavant, 1993). Also shortlines have local management and are able to work well with area shippers for traffic that the larger railroads tended

to overlook. The growth of the shortline and regional railroads was also enhanced by the Regional Rail Reorganization Act of 1973 which gave the secretary of transportation the authority to designate which lines of bankrupt or defunct railroads would be offered to local communities to be run by a designated operator.

SHORTLINE RAILROADS AND THE LAW

There are a wide range of regulatory powers which influence shortline railroads. For example, the ICC retains jurisdiction over rates as well as construction and abandonment authority. No railroad can extend its lines, construct new lines or acquire an existing line without a certificate of public convenience and necessity from the ICC. The ICC also has plenary jurisdiction over rail abandonments.

Labor relations on all railroads are under the jurisdiction of the National Mediation Board. The Railroad Retirement System covers benefits and pension rights for railroad employees and the Federal Employers' Liability Act deals with industrial accidents over the rails. The Department of Transportation has extensive jurisdiction over rail safety, including track inspection and the licensing of engineers through the Federal Railroad Administration. In addition, some states maintain some authority over rail safety when it does not conflict with the federal program. Finally, bankruptcy courts have jurisdiction over the reorganization and liquidation of debtor railroads' estates. States often regulate construction, new formations and abandonments of railroads.

STUDY PROCEDURE

The primary data used for analysis in this study were obtained from two national mail surveys of shortline railroads and state regulatory agencies. Questionnaires structured to elicit the desired information were sent to a list, obtained from the American Shortline Railroad Association, containing most of the known firms operating shortline railroads in the United States, as well as the expected regulatory agencies in each state.

The questionnaires were designed to generate specific information on facts and perspectives. Specific questions for the shortline railroad questionnaire and the state regulator questionnaire were as similar as possible to provide the ability to compare and contrast perspectives on state regulation.

The questionnaires contained both objective and subjective queries. The first three sections of both questionnaires dealt with objective questions concerning (1) economic, (2) safety and (3) institutional regulation respectively. For each

section, respondents were asked to indicate the extent of regulation, problems associated with regulation, and desired changes in regulatory control. Specific questions for economic regulation dealt with intrastate rates, sizing of the firm, and labor issues. Questions concerning safety regulation consisted of areas such as construction, operation, alcohol, drug abuse, etc. Specific questions for institutional regulation dealt with areas such as financial, insurance, reporting, planning and rail passenger concerns. The last section of both questionnaires was basically subjective in nature, designed to elicit major concerns or issues.

Completed responses were received from 91 shortline railroads after two mailings of the questionnaire. The initial mailing list included 480 shortline railroads, thus around a 20% response rate was achieved after the two mailings.

Completed questionnaires were received from 47 of the 50 states, after the initial mailing and follow up phone calls to reach the nonresponding states. The other three states agencies promised responses, but were not received.

GENERAL FINDINGS

Perspectives of State Regulators

States indicated they had a strong responsibility towards shortline railroads. Sixty-four percent of the states had obtained certification to regulate under section 214 of the Staggers Rail Act of 1980, and they still had and were using that authority. Within the certification, 82% included shortline railroads in that regulatory responsibility.

The degree of economic regulation by states reveals a bit of a split personality. As indicated in Table 1, about half of the states regulate some of the intrastate rates while half of them do not. States have generally had few cases or rulings involving intrastate rates, except for fuel adjustment surcharges where 11% of the states have experienced cases or rulings over the past five years. Also 13% of the states indicated they would favor more regulation associated with general rate increases, otherwise 91% were satisfied with the current level of regulation.

States regulated sizing of the firm less but had more cases or rulings over the past five years associated with entry, abandonment, etc. Also, a larger percentage of states indicated a desired increase in regulation associated with sizing of the firm. Very few states regulated labor issues or had any problems over the past five years.

In general, states had not been very active in economic regulation and were quite happy with the existing level of regulatory effort. About 25% of the states did express interest in increasing their authority over mergers, abandonments, etc.

A wide variation in the amount of state regulation for the different safety issues is revealed in Table 2. Few states regulated crew training while 94%, 82% and 79% regulated grade crossing, grade separation and track inspections. Overall more states have experienced cases or rulings associated with safety regulations than with economic regulations. However, the majority of states indicated the existing degree of regulation was preferred for safety issues, although some concern was expressed for hazardous materials.

Table 1. Perceptions of Economic Regulation, State Responses, by Percentage.

Regulatory Item	State Regulation		Cases or Rulings Over Past 5 Yrs.		Desired Changes in Regulation Control			
	Yes	No	Yes	No	Same	More	Less	Eliminate
Intrastate Rates								
General Rate Increase	50	50	4	96	79	13	0	8
Inflation Rate Increase	51	49	4	96	87	4	0	9
Fuel Adjustment Surcharge	44	56	11	89	87	4	0	9
Rate Bureau	41	59	7	93	91	0	0	9
Damage Complaints	44	56	0	100	91	0	0	9
Contract Rates	49	51	7	93	91	0	0	9
Sizing of the Firm								
Entry								
-New Formation	32	68	30	70	82	18	0	0
-Line Purchase	44	56	16	84	83	17	0	0
-New Line Instructions	29	71	19	81	73	27	0	0
Mergers	24	76	8	92	76	24	0	0
Abandonments	63	37	56	44	73	27	0	0
Operating Authority	43	57	30	70	71	29	0	0
Trackage Rights	24	76	12	88	81	19	0	0
Directed Service Orders	25	75	0	100	90	10	0	0
Labor Issues								
Labor Protection	19	81	4	96	96	4	0	0
Craft Lines	3	97	0	100	96	4	0	0
Wage Rates	4	96	0	100	100	0	0	0
Maintaining Service								
Station	63	37	54	46	89	11	0	0
Stationmaster	49	52	42	58	88	12	0	0

Table 2. Perceptions of Safety Regulation, State Responses, by Percentage.

Regulatory Item	State Regulation		Cases or Rulings Over Past 5 Yrs.		Desired Changes in Regulation Control			
	Yes	No	Yes	No	Same	More	Less	Eliminate
Safety Areas								
Construction	56	44	39	61	93	7	0	0
Crew Training	9	91	4	96	96	4	0	0
Fire Guards	30	70	25	75	92	4	0	4
Grade Crossing	94	6	74	26	89	11	0	0
Grade Separation	82	18	57	43	92	8	0	0
Underpass Clearance	68	32	54	46	96	4	0	0
Track Inspection	79	21	58	42	83	17	0	0
Equipment Inspection	61	39	42	58	86	14	0	0
Operation Inspection	44	56	28	72	79	21	0	0
Signal and Train Control	41	59	20	80	81	19	0	0
Hazardous Materials	59	41	40	60	74	26	0	0
Alcohol and Drug Abuse	38	62	25	75	82	18	0	0

There were few states that regulated securities and insurance, but a large percentage of states regulated the other institutional variables in Table 3. There also was a high percentage of states who had experienced cases or rulings over the past five years for reporting, planning and passenger service. However, the majority of states were satisfied with the existing level of regulation or wanted more, with only 5% desiring less regulation for reporting.

Table 3. Perceptions of Institutional Regulation, State Responses, by Percentage.

Regulatory Item	State Regulation		Cases or Rulings Over Past 5 Yrs.		Desired Changes in Regulation Control			
	Yes	No	Yes	No	Same	More	Less	Eliminate
Institutional Issues								
Construction	48	52	20	80	94	6	0	0
Securities	20	80	5	95	94	6	0	0
Insurance	20	80	10	90	85	15	0	0
Reporting	81	19	36	64	75	20	5	0
Planning	68	32	32	68	94	6	0	0
Passenger Service	55	45	32	68	80	20	0	0

Perspectives of Shortline Railroads

It was desired to determine any differences in the perspectives of shortline railroads versus the state regulators. The responses from shortline railroads concerning economic regulations, analogous to the state responses in Table 1, are displayed in Table 4. Shortline railroads felt considerably less state

regulation for intrastate rates existed with much higher percentages in the "no" column for state regulation. Also, the shortline railroads experienced generally less problems with economic regulation over the past 5 years than state regulators reported. Perhaps the most noticeable difference, however, is that more shortline railroads are dissatisfied with the existing level of regulation and desire either less regulation or elimination.

Table 4. Perceptions of Economic Regulation, Shortline Railroad Responses, by Percentage.

Regulatory Item	State Regulation		You've Had Problems With These Regulations over the Past 5 Yrs.		Desired Changes in Regulation Control			
	Yes	No	Yes	No	Same	More	Less	Eliminate
Intrastate Rates								
General Rate Increase	15	85	6	94	45	3	16	36
Inflation Rate Increase	11	89	9	91	46	5	11	38
Fuel Adjustment Surcharge	19	81	9	91	46	4	11	39
Rate Bureau	7	93	6	94	52	2	8	38
Damage Complaints	3	97	8	92	53	4	10	33
Contract Rates	10	90	3	97	53	2	10	35
Sizing of the Firm								
Entry								
-New Formation	49	51	2	98	67	2	12	19
-Line Purchase	51	49	3	97	60	0	17	23
-New Line Instructions	48	52	3	97	60	0	17	23
Mergers	43	57	0	100	60	0	19	21
Abandonments	55	45	6	94	65	2	14	19
Operating Authority	50	50	2	98	62	0	19	19
Trackage Rights	27	73	5	95	60	4	17	19
Directed Service Orders	18	82	0	100	67	0	9	24
Labor Issues								
Labor Protection	15	85	2	98	74	2	9	15
Craft Lines	7	93	4	96	74	2	9	15
Wage Rates	9	91	2	98	76	0	7	17
Maintaining Service								
Station	30	70	9	91	68	0	15	17
Stationmaster	14	86	4	96	70	0	13	17

There was also significant divergence between the shortline and state perspectives concerning safety regulation. Comparing Table 2 and Table 5 reveals more agreement between shortline railroads and state regulators concerning safety, rather than economic, regulation, but shortlines indicated less problems concerning safety regulation than state regulators. Also, shortlines generally preferred less regulation than the states with a fairly high percentage of shortlines preferring elimination of safety-related regulations.

Comparison of Tables 3 and 6 reveals similar analogies for institutional regulation.

Table 5. Perceptions of Safety Regulation, Shortline Railroad Responses, by Percentage.

Regulatory Item	State Regulation		You've Had Problems With These Regulations over the Past 5 Yrs.		Desired Changes in Regulation Control			
	Yes	No	Yes	No	Same	More	Less	Eliminate
Safety Areas								
Construction	49	51	3	97	54	2	18	26
Crew Training	24	76	9	91	52	4	15	29
Fire Guards	25	75	3	97	57	2	9	32
Grade Crossing	89	11	17	83	45	6	25	24
Grade Separation	73	27	8	92	49	4	20	27
Underpass Clearance	75	25	2	98	54	4	10	32
Track Inspection	75	25	23	77	39	3	22	36
Equipment Inspection	52	48	16	84	43	2	19	36
Operation Inspection	45	55	14	86	51	2	16	31
Signal and Train Control	43	57	8	92	54	4	20	22
Hazardous Materials	53	47	9	91	52	7	20	21
Alcohol and Drug Abuse	29	71	3	97	57	5	14	24

Table 6. Perceptions of Institutional Regulation, Shortline Railroad Responses, by Percentage.

Regulatory Item	State Regulation		You've Had Problems With These Regulations over the Past 5 Yrs.		Desired Changes in Regulation Control			
	Yes	No	Yes	No	Same	More	Less	Eliminate
Institutional Issues								
Construction	43	57	9	91	56	2	13	29
Securities	50	50	2	98	63	2	7	28
Insurance	40	60	2	98	63	5	11	21
Reporting	13	87	0	100	46	4	20	30
Planning	58	42	10	90	57	10	10	23
Passenger Service	58	42	5	95	56	7	7	30

STATISTICAL RELATIONSHIPS

In order to obtain greater understanding about what influences the occurrence of problems associated with regulation for both state agencies and shortline railroads, selected variables were chosen and analyzed in a multiple regression framework. More specifically, the occurrence of problems associated with regulation for a shortline railroad is considered to be a function of certain

descriptive variables which characterize features about the railroad such as size, age and type of railroad. Likewise, the occurrence of cases or rulings associated with regulation for a state regulator is considered to be a function of certain descriptive variables characterizing the railroads in that state. Hence, the statistical analysis is divided into two separate sections. The first section examines the causal relationships between descriptive characteristics of shortline railroads and problems associated with economic, safety and institutional regulations. The second section examines a similar relationship between descriptive characteristics of the railroads in an entire state and problems with regulation.

Data

The data employed in the current analysis were derived from two principal sources. The measure of problems associated with regulation for both state regulators and shortline railroads was obtained from the previously described mail survey. This value represents the dependent variable and is measured as either "0" or "1" for "no" or "yes" problems associated with regulation over the past five years. The explanatory variables corresponding to the shortline railroad responses were derived from the 1992 edition of *Profiles of U.S. Railroads* published by the Association of American Railroads. Hence, the response of a particular shortline railroad is associated with information specific to that railroad.

The explanatory variables corresponding to the state regulators responses (the independent variables) are also derived from the *Profiles of American Railroads*, but with some minor manipulation. The *Profiles* database contains descriptive statistics for all railroads in the U.S., but not on a per state basis. However, the *Profiles* database does list all of the different states each railroad company operates in. Thus, the explanatory variables corresponding to the state responses were derived by taking all railroads which operate in a given state, weighting the variables for each railroad within the state by a proportionality factor, and summing across all railroads in the state. The proportionality factor for each railroad depends upon the number of states the railroad operates in and assumes an equal distribution among the states. While there is no reason to believe that the resources or variables for given railroad are evenly distributed across the states which it operates in, this procedure was used as an approximation due to limited data availability.

The total number of observations for each of the shortline and regulator regressions can be calculated by multiplying the number of questions or responses associated with economic, safety or institutional regulation by the total number of shortline or regulator respondents. For example, the economic

model for shortline railroads has 1729 observations, which is calculated by multiplying 19 questions times 91 shortline respondents.

Model Description for Shortline Railroads

The model used to associate the shortline railroads' regulatory problems to the descriptive characteristics of the railroad is specified as follows:

Economic Model
$$SRPWR_{ECON} = a + b_0EMP + b_1YRS + b_2MLS + b_3LTH + b_4CAR + b_5PRV + b_6SHP + b_7SL + b_8LOCR + b_9LOCL + b_{10}REG + e$$

Safety Model
$$SRPWR_{SAFE} = a + b_0EMP + b_1YRS + b_2MLS + b_3LTH + b_4CAR + b_5PRV + b_6SHP + b_7SL + b_8LOCR + b_9LOCL + b_{10}REG + e$$

Institutional Model
$$SRPWR_{INST} = a + b_0EMP + b_1YRS + b_2MLS + b_3LTH + b_4CAR + b_5PRV + b_6SHP + b_7SL + b_8LOCR + b_9LOCL + b_{10}REG + e$$

Variables used in the three models are explained in Table 7.

The first five independent variables are descriptive of the age and size of the railroad. The next four independent variables are classification of different types of owners. The last two variables are two different classifications of railroad type.

Given that the dependent variable is discrete and not continuous, then the typical procedure of ordinary least squares is inappropriate. The procedure used in this analysis is a probit nonlinear estimation technique. While the parameter estimates of this procedure can have somewhat different meanings, the model is not being used for predictive purposes. Rather, the current analysis attempts to determine the significance of relationships for different variables.

Independent variables which are indicative of firm size are expected to be inversely related to problems associated with regulation. Generally, larger firms possess greater management and information capabilities which should minimize any violations or infractions involving state or federal regulation. The age of firms is also expected to be inversely related with problems associated with regulation since older, more established firms, by their own existence, have proven their ability to adhere to or survive regulations. Railroads which are owned by different types of owners generally have no a priori expectation concerning the type of relationship with regulation. However, one would expect that railroads which are owned by state and local

Table 7. Dependent and Independent Variables for Shortline Railroad Regressions.

Abbreviation	Description	Units
Dependent Variables:		
$SRPWR_{ECON}$	Problems associated with economic regulation {0 = no, 1 = yes}	0 or 1
$SRPWR_{SAFE}$	Problems associated with safety regulation {0 = no, 1 = yes}	0 or 1
$SRPWR_{INST}$	Problems associated with institutional regulation {0 = no, 1 = yes}	0 or 1
Independent Variables:		
EMP	The number of employees employed by the railroad	#
YRS	The number of years the railroad had been in operation	#
MLS	The total miles of road operated by the railroad	miles
LTH	The average distance in miles that each loaded car is hauled	miles
CAR	The total number of revenue freight carried carloads	units
PRV	A railroad which is owned by private investors	0 or 1
SHP	A railroad which is owned by a company which ships at least 50% of their rail traffic	0 or 1
SL	A railroad which is owned by the state or local government	0 or 1
LOCR	A railroad which is owned by a local railroad company	0 or 1
LOCL	Type of railroad which is neither class I or regional and provides mostly line-haul service	0 or 1
REG	Type of railroad which is neither class I or local and operates 350 miles of road or more and/or earns revenue of 40 million or more	0 or 1

*All indicator variables for yes or no responses are coded 0 = no, 1 = yes.

government would have an inverse relationship with regulation problems due to information access and availability.

Regression results for the three models of shortline railroads are presented in Table 8. One interesting conclusion from the economic and safety models is the lack of significance of variables associated with the size of railroads. Employees, miles of road, average length of haul and number of carloads variables are all not significant at the 5% level, implying size is not a factor in explaining problems associated with economic and safety regulation. However, two of the size variables are significant in the institutional model suggesting that problems due to institutional regulations are significantly influenced by length of haul and number of carloads. The sign for length of haul is positive while number of carloads is negative. Hence, the longer the average length of haul, the greater problems associated with institutional regulation, whereas the opposite holds for number of carloads. This seems completely logical, since longer hauls results in movement through more states

which implies increased and varying regulatory requirements for railroads. The number of carloads is more of an indication of amount of traffic and could reasonably be isolated to a relatively small geographic area, resulting in less exposure to regulations or simply a relationship between size of firm and less regulatory hassles.

Table 8. Estimated Coefficients and T-Values for Shortline Railroad Models.

Variables	— Economic Model —		— Safety Model —		— Institutional Model —	
	Estimated Coefficients	T-Value	Estimated Coefficients	T-Value	Estimated Coefficients	T-Value
Employees	0.0044368	1.0158	0.0009564	0.1975	0.00938	0.9389
Years	-0.0060068	-2.0889*	-0.005732	-2.33*	0.000934	0.2562
Miles of Road	-0.0019906	-1.1002	0.0006091	0.38179	0.000022	0.00788
Avg. Length of Haul	0.0025058	0.71159	0.003475	1.115	0.02170	3.264*
Number of Carloads	-0.0000074	-1.2237	-0.0000224	-1.424	-0.000084	-2.252*
Private Ownership	0.45167	1.4930	-0.11399	-0.4414	0.4734	0.86596
Shipper Ownership	-0.27680	-0.60708	0.41897	1.4995	0.0166	0.02405
State/Local Ownership	0.83842	2.4186*	0.31692	0.95703	0.6672	1.0701
Local Ownership	-4.9435	-0.00206	-5.4149	-0.0065	-5.119	-0.0038
Local Type of Railroad	-0.25912	-1.6993	0.26410	1.816	-0.22959	-0.9049
Regional Type of Railroad	0.85776	1.0411	0.49872	0.87375	-0.0082	-0.006
Intercept	-1.8284	-5.9617*	-1.344	-5.1591*	-2.074	-3.451*

* Represents coefficients which are statistically significant at the 95% level.

The variable years are significant with a negative sign for both economic and safety models which supports the contention that older, more established railroads experience less problems associated with these types of regulation. Of the three variables differentiating the type of ownership, only state and local ownership is significant in the economic model. However, the sign of the estimated coefficient is positive which indicates state and locally owned railroads are more likely to experience problems associated with economic regulation. This seems counter intuitive since a railroad which is owned by the state should be intensely aware of state and federal regulation, and the repercussions from violation but could also reflect the initially unclear regulatory status of these state and local railroads. The two variables measuring railroad type were insignificant for all three models. The estimated R^2's for each of the three models of shortline railroads ranges from 0.012 to 0.063. This is a small amount of variation being explained by the independent variables. However, given the range of factors which could influence problems associated with regulation, and the cross-sectional nature of the analysis, it is not entirely implausible to experience values this low.

Model Description for State Regulators Responses

The three models used to associate the state regulators perceptions to the descriptive characteristics of the railroad in their state is similar to the one for shortline railroads, with a few minor modifications. The models are specified as follows.

Economic Model $RPWR_{ECON} = a + b_0EMP + b_1YRS + b_2MLS + b_3LTH + b_4CAR + b_5FIRMS + e$

Safety Model $RPWR_{SAFE} = a + b_0EMP + b_1YRS + b_2MLS + b_3LTH + b_4CAR + b_5FIRMS + e$

Institutional Model $RPWR_{INST} = a + b_0EMP + b_1YRS + b_2MLS + b_3LTH + b_4CAR + b_5FIRMS + e$

The description of variables used in the three models for state responses is provided in Table 9.

Table 9. Dependent and Independent Variables for State Regulator Regressions.

Abbreviation	Description	Units
Dependent Variables:		
$RPWR_{ECON}$	Problems associated with economic regulation for state regulators {0 = no, 1 = yes}	0 or 1
$RPWR_{SAFE}$	Problems associated with safety regulation for state regulators {0 = no, 1 = yes}	0 or 1
$RPWR_{INST}$	Problems associated with institutional regulation for state regulators {0 = no, 1 = yes}	0 or 1
Independent Variables:		
EMP	The average number of employees employed by all railroads operating in the state	#
YRS	The average age in years that railroads in the state have been in operation	#
MLS	The average miles of road operated in the state	miles
LTH	The average distance in miles that each loaded car is hauled in the state	miles
CAR	The average number of revenue freight carried carloads in the state	cars
FIRMS	The total number of railroads which operate in the state	#

The variables employees, years, miles, length and carloads have similar interpretations as in the previous model description except here the values are

on a state level. Therefore, a positive relationship is expected for all size variables except years which should exhibit an inverse relationship with regulation problems by the same argument as before. The one additional variable is firms which is the total number of railroads which operate in the state. One would expect a positive relationship with this variable since the larger the number of railroads in the state, the higher the likelihood the state regulator has experienced problems associated with regulation.

As expected, the number of firms is statistically significant for all three models, as displayed in Table 10. However, size-related variables such as employees, miles of road, average length of haul and number of carloads were not significant indicating no relationship between the size of railroads in the state and problems with regulation for regulators. The variable years is also significant for all three models, but with a positive relationship. Thus the older the average age of railroads in the state, the more problems with regulation. While this may seem counter intuitive, and completely opposite from the shortline regression results, it may reflect the states institutional memory concerning problems with older, more well-known railroads.

Table 10. Estimated Coefficients and T-Values for State Regulator Models.

Variables	— Economic Model —		— Safety Model —		— Institutional Model —	
	Estimated Coefficients	T-Value	Estimated Coefficients	T-Value	Estimated Coefficients	T-Value
Employees	-0.00136	-1.6525	-0.00157	-1.3058	-0.00108	-0.4599
Years	0.02516	4.7394*	0.03026	3.778*	0.03659	2.1355*
Miles of Road	0.00212	1.5196	0.00224	1.1439	0.00201	0.49098
Avg. Length of Haul	0.00738	1.0285	0.00335	.34324	-0.00904	-0.41208
Number of Carloads	0.0000044	0.32693	0.00000001	-.00589	0.0000192	0.57690
Number of Firms	0.0130	2.812*	0.01717	2.4334*	0.02553	2.2416*
Intercept	-2.2873	-8.0141*	-1.864	-4.7115*	-2.8414	-3.553*

*Represents coefficients which are statistically significant at the 95% level.

SUMMARY AND CONCLUSIONS

The perceptions concerning regulation vary significantly from that of shortline railroads and state regulators. However some of the results on attitudes are to be expected since much of the differences in perceptions are embodied in the inherent conflict between the goals of effective regulation and the business goals of firms. Firms, when offered regulatory change, often went for a decrease in regulatory control while state regulators opted for an increase in control, as revealed in the general findings. Perhaps more alarming, however,

is the differences in perceptions as to what areas are under state regulation and which are not.

The statistical analysis also revealed some unexpected relationships between variables. There was little difference in the significance of variables across the regulatory categories of economic, safety and institutional regulations reflecting consistency in perspectives for the different types of regulation. Also, the variables reflecting the size characteristics of railroads was not significant for shortline railroads and state regulators indicating size is not a significant determinate of regulation problems. The age of firms was significant for both shortline railroads and state regulators. However, the nature of the relationship was different for each. The inverse relationship between the age of the firm and regulation problems for shortline railroads is indicative of the learning curve that exists for shortline railroads concerning regulations. The positive relationship between the age of firms and regulation problems for state regulators is more symptomatic of the lingering institutional memory of state regulators of older firms.

The misconceptions or conflicts do outline a need for a form of technology transfer where the technology being transferred is regulatory information, definitions and implementation. Resources are needed in regulatory agencies, based on this study, for educational efforts, not necessarily regulatory enforcement. Such educational transfer can occur productively in both directions between regulator and railroad.

EFFECTS OF TRANSPORTATION CHANGE ON A REGIONAL ECONOMY

by John Heads *

A transport institute located at a university is always called upon to do some work related to transport and the local economy. In recent years, the University of Manitoba Transport Institute has carried out two major studies of this type and also worked on a number of specific local issues, ranging from the problems of intraprovincial trucking to maximizing the economic impact of the Winnipeg International Airport. Over the years, requests for local transport analysis have been considerable and this is quite legitimate, given the inputs of provincial money into the universities. Other academic institutes in Canada are involved in similar activities, for example the University of New Brunswick with its extensive publications on transportation in Atlantic Canada.

Much of the analysis of local transport issues is too specific to be of interest to wider audiences. However, it is possible to draw more general conclusions on the changes over the years in local attention to transport issues. In a Manitoba context, this paper shows how major transportation concerns have changed from freight rates to employment and it is suggested that this change in emphasis is fairly typical of Canada as a whole.

1. RAILWAY FREIGHT RATES

For almost one hundred years, there were concerns in Manitoba and throughout the prairie provinces in respect of discrimination in railway freight rates. The complaints preceded the completion of the Canadian Pacific Railway in 1885 and were still expressed virulently during the Conference on Western Economic Opportunities in 1973. The prairie provinces felt that railway charges were excessive in the sense that products originating in or destined for the prairies had to contribute a disproportionate amount to railway fixed costs. Long run variable costs account for some 80% of total railway costs. While it was worthwhile for a railway to carry freight that covered long run variable costs and made at least some contribution to overhead, nevertheless total fixed costs had to be covered from railway traffic as a whole, requiring differential pricing according to the so-called "value of service principle."

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The prairie complaint was that the railways charged excessive freight rates on captive traffic originating in or destined for the prairies. However, the justification for complaint of discrimination in the overall railway freight rate structure was really wearing somewhat thin by the 1960s. This was mainly because the railways were then obliged to carry grain traffic from the prairies at the Crow's Nest Pass Rates, yielding revenues of roughly 0.5¢ per ton-mile which were far below the variable costs incurred.[1]

Complaints in respect of discrimination in railway freight rates were still rampant in the prairies in the early 1970s. By the end of the decade, the complaints were less vociferous and they became increasingly muted during the 1980s, especially with the redress provided in the National Transportation Act, 1987. Why did the issue of railway freight rates move out of the limelight?

In an overall policy context, transport became less of a concern to governments than problems of inflation, unemployment, increased international competition, burgeoning expenditure on education and social services, and budget deficits. In the transport field, changing markets for western Canada, with greater stress on U.S. and west coast trade, had reduced the importance of the role of transport on east-west links within Canada. Truck transport had become more important and the economics of a deregulated motor carrier industry do not allow cross subsidy of one type of traffic by another. Shippers had been given more competitive markets in which to buy transport services. The National Transportation Act, 1987, eliminated joint rate setting by the railways; it allowed shippers to enter into confidential contracts with railways for the transport of their freight; and, in an attempt to balance the bargaining power between shippers and railways, it provided competitive access provisions in the form of widened interswitching limits, competitive line rates and final offer arbitration.

Shipper attitudes towards freight rates and quality of service have improved greatly since the 1987 Act came into effect. Much of the evidence is on a national basis, but regional figures for Manitoba generally follow the national trends.

Manufacturers in Manitoba use truck transport to a much greater extent than rail transport. In fact, the main customer for rail transport in Manitoba is not manufacturing industry, but grain shipped under the Western Grain Transportation Act, which accounts for over 70% of railway tonnage loaded in the province. Nevertheless, a survey conducted in 1989 of 40 medium-sized companies in Manitoba showed that half the firms interviewed used rail transport for at least some of their shipments. The quality of rail service was not regarded as highly as that provided by the motor carrier industry, but there did not seem to be any widespread complaints on railway rates and service.[2]

The National Transportation Agency reports each year on shipper perceptions of rail transport, although the published figures do not give extensive breakdowns on a provincial basis. On a national basis, the Agency reports favourable impacts of

confidential contracts on shippers; modest increases in freight rates; the effect of rail-truck competition in helping to keep down rates, especially for large shippers; and shipper support for competitive access provisions in spite of limited use of these features.[3] The Agency has provided unpublished figures for Manitoba to the Transport Institute. In the case of rail transport, the sample size for Manitoba was very small, but the results appeared to reflect the national position.

Entry controls on extra-provincial trucking were relaxed under the Motor Vehicle Transport Act, 1987, and phased out completely in 1993. The National Transportation Agency has found general satisfaction with the level and quality of trucking services, together with freight rate increases less than the general level of inflation in the Canadian economy.[4] The sample size for responses from Manitoba was larger than in the case of rail transport. An example of the provincial response on one question is shown in Table 1 below, although the 1990 Manitoba figures are now slightly out of date.

Table 1: Percentage Distribution of Shipper Responses on Effects of Reduced Entry Controls on Extraprovincial Trucking

	Canada 1992	Manitoba 1990
Truckload		
Improvement	30	30
No change	66	67
Deterioration	4	3
Less than truckload		
Improvement	25	23
No change	66	75
Deterioration	9	2

Source: National Transportation Agency.

Table 1 shows that, on a national basis, far more shippers considered that reduced entry control on extraprovincial trucking had been an improvement rather than a deterioration. Responses for shippers using services in Manitoba were similar. Other data comparing Manitoban with Canadian responses on various service attributes confirm that the favourable ratings nationally were reflected on a provincial basis.

There is ample evidence to show that transportation change over the last twenty years, and particularly since 1987, has diffused the freight rate issue in Manitoba and

indeed in most parts of Canada. Thus, the National Transportation Act Review Commission was able to state in 1993 that:

> Our principal conclusion, after the past 12 months of consultation and investigation, is that the Act has had a positive impact on Canadian shippers and travellers, leaving them better off then they would have been without regulatory reform.[5]

2. TRANSPORT DEVELOPMENTS

The freight rate issue has been diffused. The major developments of the last few years, which impact on transport in the national and regional economies, are listed below and examined later in section 3.

- Canada is no longer a country of low unemployment. In 1961-70 the Canadian unemployment rate averaged 4.8%. In 1971-80, this increased to 6.9% and in 1981-90 to 9.4%. The unemployment rate has not been below 10% since January 1991 and it averaged over 11% in 1992 and 1993.[6]

- With the deterioration in employment opportunities throughout Canada, a major provincial concern in Manitoba has been transport employment. The downsizing of employment has been particularly severe in railway transport. While the need for railway rationalization is clear, the employment effects are very substantial in Manitoba because so much of Canada's railway employment is located in Winnipeg.

- The North American Free Trade Agreement (NAFTA), with its predecessor Canada-United States Trade Agreement (CUSTA) are leading to a realignment of trade north-south instead of east-west. This has repercussions on a province located in the centre of Canada, particularly in respect of large interprovincial motor carriers headquartered here.

- Intermodal transport is becoming increasingly important, with long distance truck movements being replaced by truck collection and distribution at origin and destination and rail transport over the line haul. This has obvious repercussions on employment in long distance truck transport.

- Resolution of the problems of the airline industry will have different effects on different regions, as the geographical distribution of employment offered by Air Canada is very different from that offered by Canadian Airlines International.

3. TRANSPORT EMPLOYMENT: CANADA AND MANITOBA

As a result of frequent changes in the definitions used in the relevant statistical sources, it is not easy to plot transport employment in Canada over any long period of time. Table 2 attempts to give comparable figures for three years - 1983, following the peak year of the recession of the early 1980s; 1989, which was probably the best year for the Canadian economy over the last decade; and 1993, which was hopefully at the bottom of the current recession.

In 1993, transport services accounted for 4.4% of total Canadian employment across the aggregate of all industrial activities.[7] Although this percentage share of total employment did not show any change between 1989 and 1993, over the long term the relative importance of transport is declining. The 1993 share was 0.7 percentage points less than in 1983 and, from examination of statistical series subject to frequent revision, it appears that the transport share also fell by over one percentage point between 1971 and 1981.

In absolute numbers, transport employment has remained fairly constant over the long term, but this has meant that its share of total employment has declined. Comparing 1993 with 1983 in Table 2, employment has fallen very substantially in railway transport. Water transport has been hit severely by declining traffic on the Seaway. Employment in trucking has fallen during the current recession to the figure of a decade ago. Employment in air transport was increasing until 1991, but has since declined.

Public passenger transit would appear to have been the most buoyant of the transport sectors in terms of employment, but there is some suspicion as to the accuracy of the figures shown in Table 2. The major component of public passenger transit is urban transit, but this also includes intercity buses and a number of miscellaneous services ranging from school buses to airport limousines.

The "other" transport group in Table 2 is very large and Statistics Canada provides only limited information on this sector. Approximately 15,000 jobs are in grain elevators and other storage activities and 8,500 jobs in pipelines, but no breakdown is given for the remaining 79,000 jobs. On more comprehensive information which Statistics Canada used to provide, some 50,000 of these jobs would be in highway and bridge maintenance. The balance covers a multitude of miscellaneous occupations from taxis, freight forwarding and pool car operations to crating and packing of goods, stockyards, snow clearing and toll bridges.

Table 2: Canadian Employment in Transport Services - thousands			
	1983	1989	1993
Air transport (a)	50.3	65.8	57.0
Railway transport	92.8	75.0	60.0
Truck transport	119.4	138.9	117.2
Water transport (a)	33.6	29.5	24.0
Public passenger transit	56.1	64.1	73.6
Other	95.3	101.5	102.3
Total	447.5	474.8	434.1
Transport services share of all Canadian employment	5.1%	4.4%	4.4%

(a) Including incidental services

Source: SC 72-002, as revised effective March, 1992, with historic data provided by Statistics Canada. Transport (SIC 451-479) includes storage, but excludes owner-operators in the trucking industry. Figures for 1993 are actually December 1992/November 1993, as December 1993 data were not available when the table was compiled. Railway figures for 1983 and 1989 from SC 52-212, as this is a more accurate source.

Two important points arise from Table 2:

(i) Although transport employment fluctuates with the general state of the Canadian economy, transport is not a growth sector in terms of total employment. Absolute numbers have remained fairly constant over the long term. There is no reason to think that this situation will change radically.

(ii) Very little transport employment is "footloose", with freedom as to its geographical location. Employment in public passenger transit and "other" transport is a function of demand by the population working in other economic activities in an area. Employment in water transport is obviously geographically constrained. Most of the employment in air, railway and truck transport is similarly determined by the geographical location of activities requiring transport, but in these modes the carriers do have some freedom in deciding where to locate major overhaul facilities and administrative functions.

Table 3 shows transport employment in the Atlantic Region and the other provinces. Given that much of the demand for transportation is tied to the location of other economic activities, the distribution of transport employment across Canada broadly follows the distribution of Canadian population. However, with a lower density of population in the west, the four western provinces together have a share of transportation employment (36.4%) which is higher than their share of Canadian population (29.0%). The rest of this paper is concerned with the Manitoba situation, where the share of transport employment (5.9%) considerably exceeds the share of population (3.9%).

Table 3: Transport Employment

	Average July/September, 1993		% distribution of Canadian population
	thousands	% distribution	
Atlantic	35	8.0	8.3
Quebec	106	24.2	25.1
Ontario	135	30.8	37.4
Manitoba	26	5.9	3.9
Saskatchewan	15	3.4	3.5
Alberta	51	11.6	9.3
B.C.	68	15.5	12.3
Total (a)	438	100.0	100.0

Source: Employment from SC 72-002. Population figures for third quarter of 1993 from SC 11-010.

The Manitoba share of transport employment in Canada was at a seasonal high in the July/September figures shown in Table 3. For the year 1993 as a whole, this share was 5.7%. The breakdown of this employment by mode is shown in Table 4.

Table 4: Manitoba Employment in Transport Services - thousands				
	1983	1989	1993	Manitoba as % of Canada 1993
Air transport (a)	3.1	3.5	3.1	5.4
Railway transport	12.2	9.5	7.6	12.7
Truck transport	6.0	6.9	6.5	5.5
All other (b)	6.4	6.4	7.7	3.9
Total	27.7	26.3	24.9	5.7
Manitoba share of Canada	6.1%	5.6%	5.7%	

(a) Including incidental services.
(b) Including water, public passenger transit and "other" as defined in Table 2.

Source: SC 72-002 and UMTI estimates. As in Table 2, 1993 is in fact December 1992/November 1993.

Manitoba has a very large share (12.7%) of Canadian employment in railway transport. Manitoba shares of employment in air and truck transport also exceed its 3.9% share of Canadian population. As already explained, other forms of transport are essentially located to cater for the population of the areas served, so that Manitoba's share of total employment here is the same as its share of Canadian population.

The importance of transport employment in Manitoba is well recognized by government and the community. This is particularly true in present times of heavy unemployment. In addition, transport jobs are well-paid and particularly valuable from that standpoint.[8] Railway transport is very important in Manitoba. The explanation is partly large employment in the transportation functions themselves, where both CN and CP have large yards in Winnipeg. Of even more importance, the Transcona Shops in Winnipeg are the major CN location for heavy overhaul of cars and locomotives for the whole of Canada, while CP provides substantial work on heavy maintenance of cars in its Weston Shops.

Railway employment in Canada has been declining rapidly, especially since the mid-1980s. Manitoba does not appear to have been affected more than Canada as a whole, but the problem is that Manitoba has so many railway jobs at risk. Generous labour agreements between the railways and the unions have ensured that individual workers have not suffered from the downsizing. However, the problem facing the provincial economy is finding jobs to replace those lost in rail industry. There has

been very little, if any, suggestion that the railways should not become leaner in order to compete with other modes and with U.S. railroads. Nevertheless, this problem is a very striking example of how a regional economy can be significantly impacted by changes in transportation.

Many years ago, Winnipeg was the national headquarters for Air Canada, but Winnipeg lost this pre-eminent position decades ago. Nevertheless, Air Canada employment is still an important contribution to the provincial economy, with Winnipeg home to Air Canada's finance branch, an important overhaul and maintenance base, and extensive employment of pilots and flight attendants. On the other hand, employment by Canadian Airlines International is quite modest in Manitoba, existing mainly to service demand that originates in the province. Winnipeg is an important centre for third level carriers, providing northern air services, and part of the Gemini reservation system is also located in the city.

In the early 1980s, Manitoba was losing out at a modest rate in its share of national airline employment. This probably reflected the more rapid growth of Canadian Airlines, which has its main functions further west than Manitoba. Since 1989, the Manitoba share of airline transport has been reasonably constant. The future roles of Air Canada and Canadian Airlines are not the subject of this paper. However, in addition to the effects of the outcome on the travelling public, there can also be a considerable impact on employment in different regional economies. While the location of the "footloose" activities of airlines are not immutably fixed in the long term, ceteris paribus, the success of an airline with heavy employment in a local economy tends to benefit that economy more than the success of an airline with a limited local presence. The effects of the competitive struggle between Air Canada and Canadian Airlines have been well documented in terms of service to the travelling public, the future level of air fares, the impact on national employment in air transport, and the need or otherwise for air carriers bearing Canada's flag. However, the impact of the airline struggle on the different regional economies has received less attention.

In truck transport, Manitoba has benefited from being the headquarters location of six of the largest twenty motor carriers in Canada - Reimer Express, Paul's Hauling, Kleysen Transport, Arnold Brothers, Atomic and TransX. The statistical series relating to employment in the trucking industry are difficult to interpret because of revisions over the last decade. In addition, the Manitoba figures are supposed to relate to employees resident in the province, as distinct from the employment of firms headquartered in Manitoba, but there are some doubts to whether this distinction has been rigorously followed in the statistical reporting. Nevertheless, it is clear that trucking firms headquartered in Winnipeg provide considerable employment in terms of head office administration, garage activities and the recruitment of line haul drivers.

The trucking industry has gone through considerable problems during the recession and Manitoba has lost two of its major carriers - Motorways and Imperial Roadways.

So far, the Manitoba share of the industry does not appear to have declined, but the industry will be faced over the next few years with the consequences of two major transportation developments.

Firstly, the implementation of CUSTA in 1989 and NAFTA in 1994 has reduced customs tariffs within North America and stimulated north-south trade, as compared to east-west trade across Canada. Manitoba developed its large interprovincial trucking industry on the basis of natural advantages from its location in the centre of Canada. These advantages do not carry over into a north-south movement, where the bulk of the traffic is from Ontario/Quebec to the U.S., with the main secondary movement from Alberta/B.C. to the U.S. So far, the Manitoba motor carrier industry has not been seriously hurt, as it has accommodated to the new realities through triangular truck movements, increased activity in other parts of Canada and establishment of U.S. subsidiaries.

Secondly, there is the increased development of domestic and transborder intermodal container traffic. The function of the truck is the collection and distribution of the product at origin and destination, while the line haul is performed by rail. In 1991, Canadian railways derived 13% of their total revenues from intermodal traffic, of which 9% was domestic and transborder and 4% export/import.[9] Increased use of intermodal transport is already reacting on the demand for long distance truck services and this will be more apparent as the decade proceeds.

Returning to Table 4, the Manitoba share of Canada's employment in transport fell from 6.1% to 5.6.% between 1983 and 1989. Market share was falling slightly in the individual transport modes, but the main problem was Manitoba's heavy commitment to rail transport, which is the mode most affected by downsizing. Between 1989 and 1993, the Manitoba share of Canadian transport employment increased marginally. The recession had hit air and truck transport and consequently the decline in rail employment was less pronounced, compared to the other two modes, than it had been in the earlier period 1983-89.

What will happen over the next few years to transport employment on a national basis? Railway employment will continue to decline and will probably be below 40,000 by the year 2000. The development of intermodal traffic is not sufficiently labour intensive to affect this downward tend significantly. Employment in truck transport may recover from the present recession, but it is unlikely to show any real growth to the end of the decade because of the effects of intermodal traffic on long distance trucking. Air transport could resume its role as the most buoyant mode; however, it would be rash to be overly optimistic here, given the continuing financial problems of the industry, together with the possibility that revolutionary changes in communications are having a permanent negative effect on the volume of business travel by air.

With its heavy reliance on rail transport, where employment is falling rapidly, it will be difficult for Manitoba to avoid a further decline in its share of transport

employment in Canada. Changes in transportation can have very different quantitative effects on the different geographical areas of Canada.

4. CONCLUSION

The main thesis of this paper is that the effects of transportation change on a regional economy can be magnified or muted, compared to the effects on the country as a whole. The prairie provinces have a tradition in which transport concerns are extremely important. For much of the history of the prairies, the major concern related to railway freight rate discrimination. This issue has almost withered away, gradually since the late 1970s and at speed since the late 1980s. Transportation changes - new markets, more effective truck competition and, especially, the National Transportation Act, 1987 - have largely taken the steam out of the freight rate issue.

Unemployment has become a major concern in Canada during the 1980s and especially during the current recession. Jobs are the pre-eminent need across the whole economy and this is evident increasingly in a regional concern for transportation employment. Winnipeg has always been an important transportation centre. This has been based on its role in operations and equipment maintenance for both major railways; the substantial presence of Air Canada in the city; and the headquarters of large extraprovincial motor carriers. These activities are under pressure as a result of rapid railway downsizing; uncertainty as to the future of the airlines, particularly the relative importance of Air Canada and Canadian Airlines; and the pressure of north-south trade and intermodal transport on trucking jobs. Many of these macro changes in transport are both desirable and inevitable. The effects are extensively analyzed in terms of transport services, fares and rates, carrier viability, competition and the Canadian identity. The flow-through effect of transportation change on regional economies is less frequently addressed.

ENDNOTES

1. For a fuller discussion of railway freight rate discrimination, see John Heads, "The Twilight of Transport and Regional Development", CTRF Proceedings, 1993, pp. 134-7.

2. Interviews were concentrated on manufacturing firms, which are best described as medium-sized in a national context. Results were reported in John Heads, Manitoba Transportation Action Plan to the Year 2000, University of Manitoba Transport Institute, Winnipeg January 1990, summarized at pp.220-7, with an earlier 1987 survey reported at pp. 228-36.

3. See, for example, National Transportation Agency, Annual Review 1992, pp. 73-86.

4. ibid., pp. 108-22.

5. National Transportation Act Review Commission, Competition in Transportation: Policy and Legislation in Review, Supply and Services Canada, Ottawa, 1993, Vol.I, p. 21.

6. Calculations from Canadian Economic Observer, Monthly SC 11-010 and Historical Statistical Supplement, Annual SC 11-210.

7. Source SC 72-002, where the industrial aggregate is employment in all economic activities in Canada except for agriculture, fishing and trapping, private household services, religious organizations and the military.

8. Changes in transport employment receive considerable media coverage in Manitoba. For example, the Winnipeg Free Press of February 5, 1994 gave an extensive report on a voluntary retirement or separation buy-out package being offered by CN to workers in its Winnipeg repair shops. In opposite vein, the Winnipeg Free Press of February 17, 1994 gave a headline welcome to 100 temporary new jobs provided at the Air Canada overhaul base in Winnipeg. High earnings in the transport sector are well-documented in SC 72-002. For example in September/October 1993, average weekly earnings in the Canadian transport sector were $673 against $562 for the aggregate of all industrial employment. Average weekly earnings in the transport sector in Manitoba were $655, much higher than the industrial aggregate of $496.

9. Calculations from National Transportation Act Review Commission, op. cit., Vol.II, p. 126.

L'AVENIR DES SERVICES FERROVIAIRES VOYAGEURS EN RÉGIONS ÉLOIGNÉES

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1. INTRODUCTION

Dans le contexte du désengagement financier du gouvernement fédéral vis-à-vis de l'ensemble des services ferroviaires voyageurs en régions éloignées au Canada ainsi que des futures coupures de services de Via Rail, la problématique de l'avenir des services ferroviaires en régions éloignées se pose avec beaucoup d'acuité. En effet, lors de la Conférence nationale sur les trains de passagers tenue à Ottawa les 19 et 20 août 1993, plusieurs intervenants, notamment du Québec, du nord de l'Ontario ainsi que du Manitoba, dont le maire de la ville de Thompson, ont souligné la nécessité de protéger les liaisons ferroviaires voyageurs dans les régions éloignées. Voici la déclaration de madame Cynthia Patterson, coordonnatrice nationale du groupe de pression Dignité rurale :

> «Cuts like these are unacceptable... Canada can no longer be said to have a national passenger train network if people living in the regions are to be denied service[1].»

2. SITUATION ACTUELLE DES SERVICES FERROVIAIRES VOYAGEURS EN RÉGIONS ÉLOIGNÉES

Vous trouverez, en annexe, une description détaillée des services ferroviaires voyageurs canadiens en régions éloignées.

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1 «Via Killing Remote Routes, Group Says», *The Globe and Mail*, mercredi 15 septembre 1993, p. B-2.

2.1 Position de Via Rail

Via Rail dessert au Québec trois liaisons ferroviaires de passagers en régions éloignées. Celles-ci sont Montréal-Senneterre, Senneterre-Cochrane (partiellement au Québec), Montréal-Jonquière. La position de Via Rail qui est de se départir de la responsabilité des services ferroviaires voyageurs des régions éloignées, est bien connue et rapportée de temps à autre dans les médias comme en 1993 :

> «While Via hasn't finalized its strategy, Keon Sirsly, vice-president (marketing), suggests it will again attempt to free itself from government orders to serve remote areas, like Churchill in northern Manitoba. Generally, those trains are little used, costly to run and massive money losers[2].»

Rappelons que le coût d'exploitation de l'ensemble des services ferroviaires en régions éloignées pour tout le Canada a été évalué à plus de 58 millions $ par Via Rail pour l'année 1988. Dans un contexte de restrictions financières, (coupures de 100 millions $) d'ici l'année 1996-1997, Via Rail doit obligatoirement considérer l'abandon de certains services ferroviaires en régions éloignées.

2.2 Position de la Commission royale sur le transport des voyageurs au Canada

La position de la Commission royale sur le transport des voyageurs au Canada est à l'effet que les pouvoirs publics ne doivent pas maintenir des subventions à des services de transport des voyageurs qui ne sont pas viables.

Cependant, dans les cas où les pouvoirs publics jugeraient opportun de verser une subvention pour un service voyageurs à une localité isolée, la Commission royale recommande :

«a) que l'on utilise le mode et le transporteur le plus efficient et, chaque fois que cela est possible, que l'on lance un appel d'offres;

b) que toute desserte subventionnée en régions éloignées (quel que soit le mode) soit conçue de manière à ne transporter les voyageurs que jusqu'au point de correspondance commode le plus proche avec un service commercial non subventionné; et

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2 «Via is again under siege», *The Gazette*, Montréal, samedi 28 août 1993, p. D-7 et D-8.

c) que les subventions et leur justification soient soumises à l'examen du public[3].»

Il est intéressant de noter que les membres de la Commission, en proposant le point «b», font preuve de souplesse en reconnaissant le principe général de subventions aux régions éloignées.

2.3 Position de Transports Canada

En 1992, le groupe de travail présidé par monsieur Douglas Smith, et dont le mandat était d'analyser les services ferroviaires voyageurs en régions éloignées et de proposer des recommandations précises, a déposé son rapport au bureau du ministre fédéral des transports. Ce rapport n'a pas été rendu public. Nous croyons fermement que ce rapport devrait être rendu public le plus tôt possible par le nouveau ministre fédéral des Transports afin d'alimenter le débat sur cette question capitale.

Dans son contexte de restrictions budgétaires auquel est soumis Transports Canada, la politique générale du gouvernement fédéral de procéder à une réduction draconienne de ses dépenses affectera vraisemblablement l'ensemble des différents services ferroviaires passagers en régions éloignées au Canada. La réduction des dépenses en matière de services ferroviaires passagers en régions éloignées n'est qu'un des volets de la politique fédérale de désengagement d'activités et du transfert des infrastructures de transport. Nous devons donc rappeler au gouvernement fédéral ses responsabilités envers les régions.

2.4 Position du ministère des Transports du Québec

Dans son mémoire sur la révision de la réforme de 1987 de la réglementation économique des transports présenté en juillet 1992 à la Commission d'examen de la *Loi sur les transports nationaux*, le ministère des Transports du Québec prenait cette position :

> «Finalement, Via Rail devrait être exempté de l'obligation d'assumer le coût de certains services ferroviaires en régions éloignées, lequel s'élevait en 1988 à 58,7 millions $. N'appartiendrait-il pas plutôt au gouvernement

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3 *Directions, le rapport final de la Commission royale sur le transport des voyageurs au Canada*, novembre 1992, p. 31.

fédéral qu'à Via Rail d'assumer le coût de tels services ferroviaires de voyageurs en tant que service public[4].»

La position du ministère des Transports du Québec rejoint donc l'approche retenue par les membres de la Commission royale sur le transport des voyageurs au Canada.

3. PORTRAIT DES SERVICES FERROVIAIRES VOYAGEURS QUÉBÉCOIS EN RÉGIONS ÉLOIGNÉES

Nous avons au Québec trois services ferroviaires passagers en régions éloignées : Montréal-Senneterre, Senneterre-Cochrane (partiellement au Québec) et Montréal-Jonquière. Le résultat des études réalisées par Transports Canada en coopération avec Via Rail montre la répartition de la clientèle de voyageurs pour ces trois liaisons. L'annexe contient des informations générales sur l'ensemble des services ferroviaires voyageurs en régions éloignées, soit la fréquence des trains et la distance. En ce qui concerne le service ferroviaire Montréal-Senneterre, le nombre de passagers est de 21 485 en 1992 et la répartition de voyageurs se résume ainsi : localité isolée, 41 %, localité accessible par chemin forestier, 19 % et localité générale, 40 %.

Quant au service Senneterre-Cochrane (partiellement au Québec), le nombre de passagers est de 2 392 en 1992 et la répartition de clientèle est de 30 % (localité isolée), de 59 % (localité générale) et de 11 % (groupe de voyageurs). Pour le troisième service Montréal-Jonquière, le nombre de voyageurs est de 21 485 en 1992, et la répartition de clientèle se résume ainsi : localité isolée (18 %), localité accessible par chemin forestier (8 %) et localité générale (74 %).

Cette répartition de la clientèle pour ces trois liaisons démontre que pour la liaison Montréal-Jonquière, 82 % des voyageurs utilisent cette liaison pour rejoindre une localité générale ou accessible par chemin forestier. Quant aux passagers de la liaison Senneterre-Cochrane (partiellement au Québec), 70 % d'entre eux n'ont pas pour destination une localité isolée alors que pour la liaison Montréal-Senneterre, plus de 40 % des voyageurs ont pour destination une localité isolée.

Quant au service ferroviaire Montréal-Gaspé, dont le nombre de passagers était de 40 409 en 1992, il peut être ajouté aux trois autres dans le contexte de futures coupures de services de 100 millions $ d'ici l'année budgétaire 1996-1997. Rappelons que le service ferroviaire Montréal-Gaspé constitue le seul service régional conservé au Canada lors des coupures de janvier 1990. Ce sont les pressions des groupes de la région ainsi que celles du ministère des Transports du

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[4] *Mémoire du ministère des Transports sur la révision de la réforme de 1987 de la réglementation économique des transports*, juillet 1992, p. 37.

Québec qui ont sauvé ce service ferroviaire vital pour les régions du Bas-St-Laurent et de la Gaspésie.

4. CONSÉQUENCES DE L'ABANDON ÉVENTUEL DES SERVICES FERROVIAIRES VOYAGEURS CANADIENS EN RÉGIONS ÉLOIGNÉES

Dans les années 60 et 70, la société britannique de services ferroviaires voyageurs (British Rail) a procédé à des coupures de services dans différentes régions rurales de la Grande-Bretagne. Une étude ayant pour titre *The Social Consequences of Rail Closures* démontre les effets néfastes de telles coupures sur la population des régions éloignées :

> «Our main conclusion is that, in the ten areas we have studied, many people have been considerably and adversely affected both in their travel and in their lives in general. The impact on them has taken a variety of forms ranging from curtailed and altered patterns of activity resulting in considerable inconvenience and even hardship, to the causing of minor inconvenience...
>
> ... The findings also show that the impact has been socially regressive, for it is the older people, those without cars and those in blue-collar households who have cut back most on their activity and thus who are the hardest hit. Women have been harder hit that men[5].»

Lors de la Conférence nationale sur les trains de passagers tenue les 19 et 20 août 1993 à Ottawa, madame Cynthia Patterson, représentante du groupe Dignité rurale, a souligné dans sa présentation *People and trains* les conséquences nuisibles de telles coupures sur des segments de la population vivant en régions éloignées :

> «Those passengers most affected by the trains shut-downs live in small towns and regional cities where public transport alternative are non-existent, scanty or priced beyond the capacity of the individual to pay[6].»

En dernier lieu, monsieur Marcus Garnet, auteur d'une étude visant à mesurer l'impact de l'abandon du service ferroviaire voyageurs entre Truro et Sydney, en Nouvelle-Écosse, conclut que malgré les coupures de services de janvier 1990,

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5 Hellman Mayer, Whally Anne, *The Social Consequences of Rail Closure*, Policy Studies Institute, London, 1980, p. 111.

6 Patterson, Cynthia, *People and trains*, Conférence nationale sur les trains de passagers, p. 3.

il existe dans cette région une demande substantielle pour un service ferroviaire passagers régional.

> «There was a broadly based demand for regional train service in the Cap Breton-Canso area[7].»

Rappelons que pour l'année 1989, le service ferroviaire entre Truro et Sydney a transporté plus de 115 000 personnes.

Donc, des études menées en Grande-Bretagne et en Nouvelle-Écosse se rejoignent dans leurs conclusions : les coupures de services ont des effets néfastes sur la population des régions éloignées.

Dans l'éventualité où le gouvernement fédéral déciderait de l'abandon total ou partiel des services ferroviaires voyageurs en régions éloignées au Canada, ces coupures de services auraient les mêmes effets néfastes sur la population de ces régions telles que vécues en Grande-Bretagne et en Nouvelle-Écosse.

À titre d'exemple, soulignons le cas du service ferroviaire voyageur Montréal-Senneterre et, plus particulièrement, la partie isolée La Tuque/Senneterre. Dans cette partie isolée, l'éloignement de cette région ainsi que les conditions climatiques souvent difficiles rendent impérieux le maintien du service ferroviaire voyageurs, l'unique mode terrestre de transport, soit le train, en l'absence de liaison routière de nature permanente.

En conclusion, nous estimons que les conséquences de l'abandon éventuel des services ferroviaires voyageurs canadiens en régions éloignées seraient dramatiques pour l'ensemble de ces régions éloignées pour la population et l'activité économique locale et que le gouvernement fédéral se doit d'assumer ses responsabilités constitutionnelles (paragraphe 10 a) de l'article 92 de la *Loi constitutionnelle de 1867*) à l'égard de celles-ci.

5. OPTIONS

Avant d'esquisser différentes options permettant d'assurer un service ferroviaire passagers aux régions éloignées, il serait bon de souligner le contexte actuel de crise du transport ferroviaire de marchandises. En effet, le projet de fusion CN-CP à l'est de Winnipeg illustre de façon convaincante les difficultés de nos deux compagnies de chemin de fer et leur volonté de rationaliser et d'éliminer la surcapacité. De plus, celles-ci précisent que les impôts et taxes en vigueur au Canada sont beaucoup plus élevés qu'aux États-Unis. À titre d'exemple, les taxes

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7 Garnet, Marcus, *Regional train usage in Cape Breton-Canso, an exploratory study*, January 25, 1993, p. 16.

sur le carburant font qu'un convoi de marchandises au Canada coûte 6 000 $ à 7 000 $ de plus qu'un convoi aux États-Unis sur un parcours comparable Toronto-Vancouver[8].

Un tel contexte de crise du transport ferroviaire de marchandises a des effets sur le trafic de passagers comme le démontre l'abandon en janvier 1995 du service ferroviaire passagers entre Montréal et Saint-Jean (Nouveau-Brunswick). De même, il faut souligner la situation nord-américaine de crise du transport par autocar dans les régions éloignées, ce qui fait craindre que ce mode ne soit pas tout à fait en mesure de combler la disparition du train.

De plus, nous n'avons pas retenu dans les options présentées celles du recours au transport aérien ou au transport routier (construction de nouvelles routes) en raison de leurs coûts astronomiques, en comparaison de celles du transport ferroviaire passager. À titre d'exemple, il en coûterait plus de 122 millions $, en 1991, pour construire une route pour la seule partie isolée du tronçon ferroviaire La Tuque/Senneterre[9].

Voici donc une présentation des quatre options susceptibles d'assurer le service ferroviaire passagers aux régions éloignées.

5.1 Contribution financière d'autorités publiques

Une autorité provinciale, régionale ou locale pourrait contribuer financièrement au coût du service ferroviaire passagers défrayé par le gouvernement fédéral. À titre d'exemple, la société américaine AMTRAK accepte de dispenser un service ferroviaire à une région donnée lorsqu'un État ou une autorité régionale ou locale accepte de participer financièrement au coût d'un tel service. Ainsi, l'État de New York contribue à plus de 70 % des pertes du train Adirondack (Montréal-New-York) en concertation avec AMTRAK. De même, huit États américains contribuent financièrement à des services ferroviaires ne faisant pas partie du réseau de base d'AMTRAK. Rappelons le cas récent du financement du service ferroviaire Brantford-Toronto par le gouvernement ontarien. L'avantage de cette option est de permettre, pour une région, l'obtention de services ferroviaires voyageurs adaptés à leurs besoins mais déboursés partiellement par une autorité provinciale, régionale ou locale.

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8 «Réseau de chemin de fer unique pour l'Est du pays», *Le Devoir*, le mardi 1er février 1994, p. B-2.

9 *Étude sur la liaison ferroviaire voyageurs pour la région éloignée Montréal-Senneterre*, Transports Canada, p. 25.

5.2 Soumettre l'examen des services ferroviaires voyageurs en régions éloignées à la seule discrétion de l'Office national des transports (l'Office)

Ce mécanisme d'examen existe déjà pour certains services ferroviaires passagers (à titre d'exemple, le service ferroviaire passagers du chemin de fer du littoral nord du Québec et du Labrador) où, en vertu de la *Loi sur les chemins de fer*, l'Office doit réexaminer tous les cinq ans la contribution financière fédérale à ce service ferroviaire voyageurs.

Cette option a l'avantage de confier à un organisme quasi-judiciaire la faculté d'octroyer ou non une contribution financière sur le fondement de critères précis d'intérêt public à un service ferroviaire voyageurs. Un autre avantage manifeste de cette option serait le fait que la faculté de donner ou non une contribution financière serait soumise non à un processus politique mais plutôt à celui d'un organisme indépendant.

5.3 Confier à Via Rail l'exploitation des services ferroviaires passagers en régions éloignées

Cette option implique que le gouvernement fédéral confie l'exploitation de ces services ferroviaires à Via Rail mais avec un mandat distinct de les exploiter à titre de service public. Dans un tel contexte, il va de soi que Via Rail serait appelé à tenir une comptabilité distincte entre les services ferroviaires réguliers et ceux des régions éloignées qui seraient financés par une enveloppe distincte de Transports Canada. L'avantage de cette option serait pour Via Rail d'assumer l'imputabilité des coûts d'un réseau de services réguliers, ce qui permet de comparer sa performance financière en relation avec d'autres sociétés ferroviaires de passagers telles AMTRAK.

5.4 Confier à CN l'exploitation des services ferroviaires voyageurs en régions éloignées

Cette option sous-tend de confier à CN la gestion exclusive des services ferroviaires passagers en régions éloignées.

Le financement de tels services serait assuré par Transports Canada qui négocierait un contrat de service public avec CN. De plus, cette option implique le recours éventuel à des trains mixtes. Rappelons qu'à ce sujet, les membres de la Commission royale sur le transport des voyageurs au Canada ont eu le commentaire suivant :

> «Les trains mixtes (trains de marchandises comprenant un wagon de voyageurs, ou même un wagon combinant voyageurs et fret local) pourraient être la façon la moins onéreuse d'assurer le service voyageurs dans certaines régions isolées[10].»

Le train mixte est la solution utilisée par le chemin de fer du littoral nord du Québec et du Labrador pour le transport des voyageurs entre Schefferville et Sept-Iles (près de 600 kilomètres dans une région sans accès aux routes). Il en est de même en Ontario (Cochrane-Moosonee) et au Manitoba (Wabowden-Churchill) qui ont recours aux trains mixtes.

L'avantage du recours aux trains mixtes serait une économie substantielle sur les frais d'équipage, de locomotives ainsi que de l'accès aux voies.

6. CONCLUSION

Nous croyons fermement que l'option 5.4, soit, en l'occurrence, confier à CN l'exploitation des services voyageurs éloignés et le recours éventuel aux trains mixtes, est celle qui devrait être privilégiée et qui mériterait à nos yeux une étude en profondeur. En effet, une étude précise sur le recours éventuel aux trains mixtes permettrait de mesurer le degré d'économie résultant de l'utilisation de ce mode de transport.

Quant à la position du ministère des Transports du Québec à l'effet que Via Rail devrait être exempté de l'obligation d'assumer le coût des services ferroviaires en régions éloignées, il y aurait lieu de réaffirmer dans le contexte actuel cette même position.

En effet, il appartient au gouvernement fédéral, et non à Via Rail, d'assumer le coût de tels services ferroviaires voyageurs en tant que service public.

De plus, nous croyons qu'il est impératif de doter Via Rail de l'encadrement législatif et de l'autonomie qui lui font défaut. En effet, le gouvernement fédéral devrait adopter une loi qui précise le cadre, les objectifs généraux des services ferroviaires voyageurs de même que le statut, les responsabilités et les droits de Via Rail, notamment en matière de relations contractuelles avec CN et CP.

Il y aurait lieu d'initier des pourparlers exploratoires avec les autres provinces concernées en vue d'un éventuel front commun. Ce front commun aurait pour but de rappeler au gouvernement fédéral ses obligations à l'égard des services ferroviaires voyageurs, plus particulièrement, en régions éloignées.

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10 *Directions, le rapport final de la Commission royale sur le transport des voyageurs au Canada*, novembre 1992, p. 319.

ANNEXE

SERVICES FERROVIAIRES VOYAGEURS CANADIENS EN RÉGIONS ÉLOIGNÉES

	Services ferroviaires voyageurs	Fréquence	Distance
Québec			
1.	Montréal-Senneterre	3 fois/semaine	703 km
2.	Senneterre-Cochrane (Ontario)	3 fois/semaine	296 km
3.	Montréal-Jonquière	3 fois/semaine	496 km
Ontario			
4.	Sudbury-White River	3 fois/semaine	483 km
5.	Capreol-Winnipeg[1] (Manitoba)	3 fois/semaine	1 498 km
Manitoba			
6.	Winnipeg-Churchill	3 fois/semaine	1 697 km
7.	The Pas-Lynn Lake	3 fois/semaine	398 km
Alberta			
8.	Jasper-Prince Rupert (C.-B.)	3 fois/semaine	1 160 km

[1] Desservi par le transcontinental de l'Ouest.

Lake Athabasca Region Road Access: Considerations for Federal-Provincial Cost Sharing

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Introduction

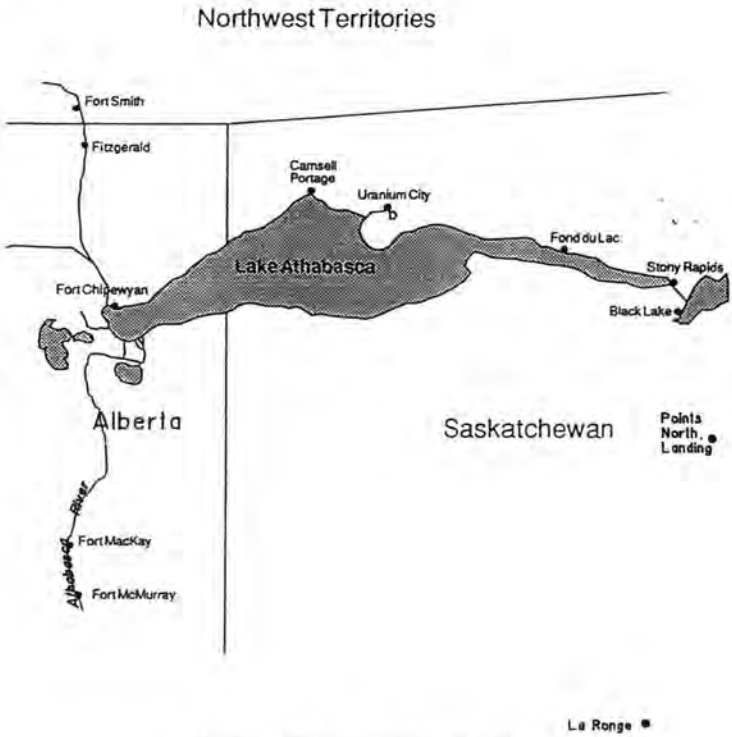
Saskatchewan Highways & Transportation (SHT) recently undertook a detailed cost/benefit analysis for a proposed road project to serve Lake Athabasca communities. This was done in preparation for federal-provincial cost share negotiations, which are in progress. The project background, study methodology and results are included in the following report.

Background

The isolated communities of Camsell Portage, Uranium City, Fond du Lac, Stony Rapids and Black Lake (see regional map on next page) have no road access. Their total population is about 2000 to 2500[1], with about 75% being First Nation residents living on reserves at Black Lake & Fond du Lac.

Settlements in the Lake Athabasca Region date back to the inland waterway fur trading routes of the early 1800's and beyond. Uranium City was formed in 1953 as a service centre for extensive nearby uranium mining activities. With a town population of nearly 3000, and its heavy industrial activity, Uranium City helped support regional services, including transportation. The abrupt closure of Uranium City mines in 1982 changed the nature of regional services dramatically. The emphasis shifted eastward, and today the Stony Rapids/Black Lake area is generally considered to be the hub of the Athabasca Region.

[1] Camsell Portage 61; Uranium City 197; Fond du Lac 754 (incl. 720 on-reserve treaty status); Stony Rapids 169; Black Lake 1073 (incl. 1010 on-reserve treaty status). Total estimated population = 2254. Statistics from 1992 Sask Health and Prince Albert Grand Council.



LAKE ATHABASCA REGION MAP

The above communities are presently served by private barge operators from Fort McKay, Alberta, scheduled and charter air services, and occasionally private winter roads constructed for special project hauls. Barge carriers haul the vast majority of "base goods[2]", about 4500 tons/yr. Since present barge volumes are only about 20% of those prior to mine closures at Uranium City, tariffs are very high. There is no direct subsidy on barge freight, but the Canadian Coast Guard (CCG) provides annual dredging and navigational aids on the Athabasca River Barge System.

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2 "Base goods" are those required for ordinary consumption, by the general public and government services. Average annual volumes used for freight saving calculations were obtained from recent surveys. The bulk fuel portion of barge volumes is 2850 tons (63% of 4500 ton total).

Perishable goods, mail and emergency supplies are handled by air services, primarily from road's end at Points North, Saskatchewan. Air freight accounts for about 1000 tons/yr of base goods. Canada Post subsidizes air freight in the Athabasca Region to a small extent. Air is also the only means of personal travel. SHT operates airstrips at all of these communities except Black Lake, which is connected by road to Stony Rapids.

The lack of all-weather road access places a burden on area residents because:

- The cost of living is nearly double that in the south
- There is virtually no chance for local economic development due in large part to the competitive barriers of inordinately high freight costs
- The only employment opportunities are in mines to the south, and in providing local services
- Approximately 80% of the region's residents are on social assistance
- Perishable foods, necessary for healthy diets, are neglected due to the extreme cost

Not surprisingly, local residents and leaders heavily support road access and have lobbied for a road for many years. All weather road access, along with improved education and training, will provide the foundation to enable this long term cycle of dependence to be broken.

Fort Chipewyan, Alberta enjoys public winter road access to Fort McMurray in addition to barge and air service. They are becoming more dependent on the winter road for cheaper freight. They too seek all weather road access, and until such time will require some level of barge service. Therefore, any decisions effecting the future of the Athabasca River Barge System must be made by the CCG, in consultation with SHT and Alberta Transportation & Utilities. Barge service for Fort Chipewyan alone should still be possible without CCG services due to the much smaller volumes required.

Project Proposal

During the mid-late 1980's, SHT, CCG, and Indian and Northern Affairs Canada (INAC) performed several studies concerning the Athabasca re-supply problem. Various combinations of all weather roads, winter roads, ATV tote roads and barges were examined. Study recommendations pointed to an all weather road connection as the ultimate solution.

For Saskatchewan communities, this would involve building a road between Points North and Black Lake. The Department of Northern Saskatchewan (DNS) performed office & field studies, and preliminary cost estimates for such a road in the late 1970's as part of an ultimate link to Uranium City. The province did not proceed with this project and DNS was dissolved in 1983.

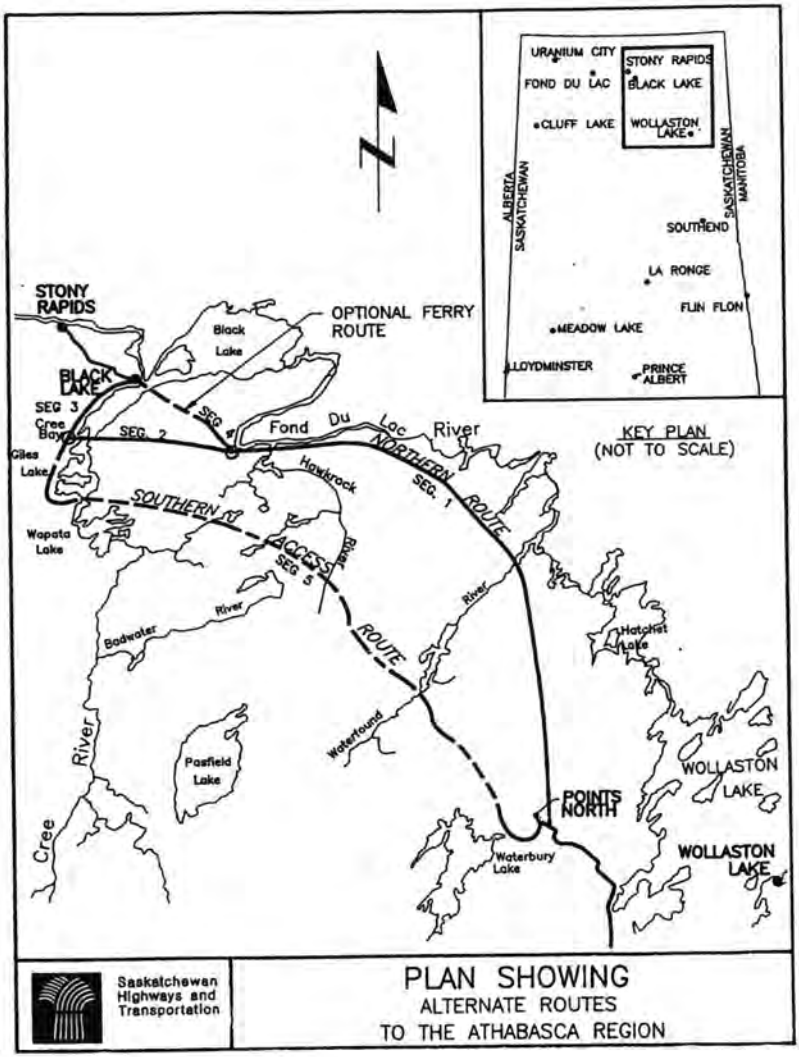
DNS identified the most feasible south and north route corridors with an optional northern route. These 3 routes are shown on the following route map and are referred to as the:

- Southern Access Route (segments 5 + 3, 180 kms)
- Northern Overland Route (segments 1 + 2 + 3, 190 kms)
- Northern Ferry Route (segments 1 + 4, 160 kms)

The Northern Overland Route is generally preferred over the Southern Route because of lower construction costs and the access it provides to scenic, and suspected uranium rich areas along the Fond du Lac River. The Southern Route crosses severely rugged moraine land forms perpendicularly, thus the cost would be considerably higher than the Northern Overland Route, even though it's 10 kilometres shorter. The disadvantage of the north route is that it crosses more environmentally sensitive land. On the other hand, the south route would likely promote far more uranium mining spur road activity to suspected sources along the Fond du Lac River.

The decision between the Northern Overland and Ferry Routes comes down to available capital funding vs. level of service. The ferry route is shorter and less costly, but service would be interrupted in the spring and fall during periods between ice road & ferry services. The more costly Northern Overland Route includes a major bridge over the Cree River and would be operational year-round.

If the final intension was to provide a seasonal gravel or winter road, the Northern Ferry Route would likely be selected due to its lower cost. A staged variation of the Northern Overland Route is the "Cree Bay Route". Stage I would involve road construction between Points North and the east bank of the Cree River. From there, ferry and ice road services would be provided on Black Lake. The cost and level of service for this stage would be similar to that of the Northern Ferry route. Stage II would involve construction of the Cree River Bridge, plus 20 km of road on the west side of Black Lake, and would occur when funds are available.


URANIUM CITY
STONY RAPIDS
FOND DU LAC
BLACK LAKE
CLUFF LAKE
WOLLASTON LAKE
ALBERTA
SASKATCHEWAN
SASKATCHEWAN
MANITOBA
SOUTHEND
LA RONGE
FLIN FLON
MEADOW LAKE
LLOYDMINSTER
PRINCE ALBERT
KEY PLAN
(NOT TO SCALE)
STONY RAPIDS
BLACK LAKE
Black Lake
OPTIONAL FERRY ROUTE
SEG 3
Cree Bay
SEG 2
SEG 4
Fond Du Lac River
NORTHERN ROUTE
SEG. 1
Giles Lake
Hawkrock
SOUTHERN ACCESS ROUTE
SEG 5
Wapata Lake
Badwater River
Waterfound River
Hatchet Lake
Pasfield Lake
Cree River
POINTS NORTH
WOLLASTON LAKE
Waterbury Lake
WOLLASTON LAKE
Saskatchewan Highways and Transportation
PLAN SHOWING
ALTERNATE ROUTES
TO THE ATHABASCA REGION

The final route location and design standard could be effected by the level of project funding available. DNS cost estimates were based on a "full standard" engineered road with the following standards:

- 8.0 m top width, 3:1 sideslopes, 1.0 m avg. grade height
- 90 km/hr design speed with local restrictions to 60 km/hr in rough terrain
- stabilized gravel surface

A lower standard "tote" road could be constructed at a much lower cost. A tote road would be built by eye in the field. It would be narrower and closely follow the terrain, thus providing poorer, less safe geometrics.

Fond du Lac and Uranium City would be linked to Stony Rapids by winter road and barge.

Federal-Provincial Cost Share Negotiations

The CCG has indicated a desire to contribute towards capital costs for the proposed road project. This road would enable them to discontinue barge support services on the Athabasca River, contingent on Alberta's consent. INAC also identified a contribution based on potential long term savings in serving First Nation communities. Cost share negotiations between SHT and the two federal agencies were initiated in 1991 and reconvened in 1993.

Project Costs

Project costs consist of: (i) capital construction, and (ii) operation & maintenance (O&M). Personal vehicle road user costs were not considered relevant to this study[3], but freight savings are considered later under benefits.

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[3] Very low anticipated passenger vehicle volume. Cannot compare costs to status quo, where there is no vehicular travel. Passenger vehicle travel cost would be far less than existing air travel cost, but some would still travel by air due to the arduous, time consuming trip.

All routes are approximately equal in this respect. The longest route (Northern Overland) would have better alignment than the south route, and would not involve delays at a ferry crossing.

(i) Construction Costs

For "full standard" road options, cost estimates developed by DNS in 1981 were indexed to 1993$ for bridge (60%), grading (20 to 30%) and engineering work. DNS unit cost estimates assumed construction by government forces with provision for training crews to facilitate northern employment. Separate contingency (risk) factors were added to the estimates for each type of work (i.e. earthwork, clearing) and each segment based on engineering judgement. "Tote road" costs were derived from the above by using 50% of the excavation and gravel stabilization quantities, and reducing engineering costs.

Estimated Capital Project Cost (million 1993$)

	North O'land	South Access	North Ferry	Cree Bay
Full Standard	29.9	34.6	24.2	n.a.
Tote Standard	18.5	n.a.	14.6	15.4

For the purpose of estimating capital cash flow, it was assumed the Environmental Impact Study would start in fiscal year 1 (1994-95) and finish in year 2. Winter road construction would start and finish in year 2 (1995-96). All weather road construction would occur over the next 3 or 6 years respectively for a tote or full standard road.

(ii) O&M Costs

Actual SHT maintenance costs were compiled for comparable northern gravel and winter roads. O&M costs for work in this region are uniquely high due to the location and difficult working conditions. The following O&M values were used:

All-Weather Gravel Roads (any standard)	$3,800/km/yr
Winter Roads	$2,500/km/yr

Total annual O&M cost estimates range from $1.2M to 1.35M/yr once the all weather road is complete. This includes operating costs for a barge to Fond du Lac & Uranium City, and a ferry at Black Lake where required. O&M costs are never ending, and can soon exceed the initial capital investment, especially for a low standard tote road. For a tote road there soon becomes public pressure to upgrade. There is no allowance made, beyond normal maintenance expenditures, for future tote road upgrading.

Benefits

There are many benefits to be realized from the proposed road project. Recipients include the general public, and the federal & provincial governments. Using only the following highly quantifiable benefits, it will be shown that total benefits exceed costs:

(a) Freight Savings (Public, Federal/Provincial Gov'ts)

Estimated freight costs for base goods from origin to destination were compared for the status quo (barge & air) and each road alternative. Some air freight would still be required after road construction due to seasonal access provided for Fond du Lac & Uranium City, and even Black Lake/Stony Rapids under the Northern Ferry and Cree Bay Route options. Conservative annual freight savings estimates range from $0.8M to $1.05M.

Roughly 80% of freight savings would be realized by area residents assuming retailers would pass their savings directly to customers. Provincial & federal agencies (i.e. INAC) would also benefit due to the lower cost of providing services. No estimate has been included for further cost reductions for consumer goods caused by potentially increased retail competition.

Volumes used in freight savings calculations reflect present regional consumption levels. The population of Athabasca communities is growing at a much faster rate than provincial and national averages. Therefore, estimates of future freight savings on base goods are again conservative.

(b) Road Construction/Maintenance Job Creation (Prov & Fed Gov'ts)

Based on labour expenditure estimates and average wages by sector, the person years of created employment was estimated[4]. This employment generates tax revenue and reduces government social assistance payments

[4] Example: For the Southern Access Route, $17.43M (roughly 50%) of road construction cost was in labour. The provincial average annual wage in the "heavy construction" sector is $33,903 (source: "Survey of Employment & Payroll Hours", Statistics Canada, Aug/92, includes overtime pay). This translates into 514 person years of direct construction employment. Government statistics on various forms of social assistance payments and taxation were used to calculate benefits. The same procedure was used for road maintenance, diversion of wholesale trade, and all spin-off benefits.

(SAP)[5]. No benefit was assigned to the federal government for road maintenance employment because there would be a comparable reduction in CCG dredging & navigational aid employment in Alberta. Federal SAP savings are shared between INAC, Health & Welfare Canada (HWC), and Employment & Immigration Canada (EIC).

The considerable public benefit from net wages (gross wages - income tax - reduced SAP) was calculated, but is not included in the total benefits shown later.

(c) Diversion of Wholesale Trade (Provincial Gov't)

Road construction will allow an estimated $2.5 million annual worth of wholesale goods, currently supplied from Alberta, to be supplied from Saskatchewan. The result is direct and indirect jobs creating tax revenue and reducing SAP. The benefit to the Saskatchewan work force and suppliers is not accounted for here.

This benefit was not assigned to the federal government because there would be a corresponding loss of jobs in Alberta. Alberta government losses were not considered in this study. Saskatchewan trucking industry benefits ($400,000/yr gross) would be offset by loss of air freight at Points North.

(d) Spin-off Benefits (Provincial & Federal Gov'ts)

Spin-off benefits from employment created in (b) & (c) above were estimated with the assistance of a computer program developed by Saskatchewan Economic Development.

Road construction and maintenance costs were split into expenditure components such as: wages, fuel, freight, heavy equipment & parts, and manufactured steel, concrete & timber products and entered as input. The value of wholesale goods diverted from Alberta was broken down into various types of dry goods and bulk fuels.

(e) Elimination of CCG Dredging & Navigational Aids

Dredging and navigational aids provided by the CCG are assumed to terminate the year after construction of the winter road. This will save the CCG a reported $0.9M/yr.

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[5] It's assumed that 75% of the jobs created will take someone off SAP.

(f) Infrastructure Savings (Provincial Gov't and INAC)

Savings will be realized due to lower costs for government construction and rehabilitation projects. With all weather road access, a conservative 10% saving is assumed for infrastructure projects based on lower material freight cost, and reduced contractor risk and operating cost. A more realistic value may be 25%. Government agencies were surveyed to determine what projects (i.e. hospitals, schools, sewer & water) are on the boards, and ball park project costs.

In addition to the above, there are many benefits which were not, or could not be included in the financial analysis. These include:

- Social benefits of de-isolation
- Job training opportunities
- General improvement in standard of living
- Economic development opportunities, primarily in:

(i) commercial fishing: A small quantity of Lake Trout is backhauled by air to Points North, where it's hauled by truck to Hidden Bay or La Ronge for processing & packing, and then to the Fresh Water Fish Marketing Corporation in Winnipeg. Even with a provincial subsidy, fish prices just cover costs. Substantially lower freight costs will make this operation profitable. It's estimated fish volumes could increase 5 fold, or more.

(ii) tourism: Potential for increased tourism is difficult to estimate. Fly-in outfitters believe business would improve with less costly and time consuming travel.

(iii) mining & exploration: Proven uranium reserves south of Points North are considered sufficient for at least the next 20 years. If and when the road project proceeds, there would likely be immediate exploration activity.

The drawbacks, which must be carefully mitigated, are:

- Effects of cultural changes

- Potential over use of resources (particular concern over caribou migration patterns, establish protected corridor controlled by native groups)

Cost/Benefit Analysis

A net present value (NPV) analysis was performed based on the above costs and benefits. A 25 year study period and 5% annual discount factor (7% interest - 2% inflation) were used.

NPV Cost/Benefit Summary (million 1994$)

Route	Northern Overland		Northern Ferry		Southern Access	Cree Bay
Standard	Full	Tote	Full	Tote	Full	Tote
Costs:						
Capital	25.0	16.5	20.4	13.1	28.9	13.8
O&M	13.8	14.7	14.0	15.0	13.4	15.9
Total Cost	38.8	31.2	34.4	28.1	42.3	29.7
Benefits:						
CCG	11.7	11.7	11.7	11.7	11.7	11.7
INAC	4.8	5.0	4.3	4.6	4.9	4.6
Revenue Canada	3.1	2.1	2.3	1.5	3.8	1.6
EIC/HWC	3.1	2.0	2.3	1.5	3.6	1.6
Total Federal	22.8	20.9	20.6	19.3	24.0	19.5
Provincial	7.0	6.4	6.1	5.6	7.5	5.8
Public (Freight)	10.5	11.8	8.9	9.7	10.6	9.3
Total Benefit	40.2	39.1	35.7	34.6	42.1	34.6
Benefit/Cost Ratio	1.04	1.25	1.04	1.23	1.00	1.16

Comments on Above Table:

1. The above study shows that tangible benefits marginally exceed project costs. When less tangible and intangible benefits are considered, this project appears to be a highly worthwhile initiative.

2. The cost/benefit analysis favours no particular route. The final decision on route location and road standard will be based on available capital funding, and public opinion expressed during the mandatory environmental review process.

3. The tote road standard appears to provide a better benefit/cost ratio. This may be misleading because:

   - Both standards are assumed to have equal O&M costs, but tote road costs could be higher and there would be long term pressure to upgrade.

   - Trucking tariffs were assumed equal for both standards for sections of all weather gravel road. This may not be totally accurate. Total freight savings are in fact estimated higher for the tote road options because the road would be finished earlier.

4. Federal-provincial cost share negotiations have not been successful, even though benefits apparently outweigh costs. There is presently insufficient capital commitment to proceed even with a tote road because:

   - The public benefit is not recoverable
   - Benefitting federal agencies other than INAC & CCG are not offering contributions
   - CCG & INAC insist on using less generous NPV factors to calculate their benefits (10 to 15 years & 7 to 10%)
   - There is no immediate potential for industry cost sharing

Closing Remarks

This is just one example of proposed road access to serve isolated northern First Nation reserve communities. This is a unique case because: (i) there are both First Nation reserve communities and off-reserve residents involved, (ii) there is the added benefit to Saskatchewan of diverting wholesale trade from Alberta, and (iii) the CCG is a recognized benefactor.

The federal government has responsibility for providing transportation services to First Nation reserve communities. The provinces must also recognize their economic benefit from local roadbuilding and maintenance activities. To the best of my knowledge, Manitoba is the only province having a working cost share arrangement with INAC for these roads. There is an urgent need for the federal government to negotiate similar arrangements with other effected provinces.

These projects cannot be justified based solely on government program savings, as has been the approach taken during cost share negotiations for the Athabasca Road. The public benefit and many intangibles must be weighed. In some cases, opportunities exist to include industry in the partnership. The uranium industry, which has, and is contributing to road development in Northern Saskatchewan, has shown no interest in the Athabasca Road Project because of existing reserves south of Points North.

Considerable savings could have been realized on recent past government projects alone, if this road had been constructed in the early or mid 1980's. These projects include two schools (roughly $12 million each) and sewer & water projects at Fond du Lac & Black Lake. In the near future, a new hospital will likely be built in the Stony Rapids/Black Lake area. This exemplifies the need to act fast.

Acknowledgements

Special thanks to Joe Kostka, co-author of the original internal SHT study "Athabasca Region Road Access: Considerations for Cost Sharing" (February, 1993). The effort of Stephen Johnson, Economist, Saskatchewan Economic Development, is appreciated for assistance in estimating economic spin-off benefits. The assistance of the many government agencies and individuals surveyed is also appreciated.

References

The following publications were referenced, in addition to various government statistical reports on: taxation, wages, unemployment, social assistance, etc.:

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Churchill: The Challenges, Rewards and Potentialities of North-South Trade Via the Bay

"Going the Distance" most certainly states the case for all who have been engaged in the long, long struggle to secure the retention and enhancement of Western Canada's northern ocean port of Churchill and of the railway to the Bay.

The theme of the CTRF Conference suggests being engaged in a race which continues to-day with the reward being the fullest possible use of the Port of Churchill over the longest possible season.

THE STRUGGLE STARTS

In 1619, Jens Munck son of a Norwegian nobleman, who had long served in the Danish navy, received orders from his king. He was to search by sea for a route from the Atlantic to the Pacific Ocean which would provide a shorter, quicker and cheaper avenue of trade between Europe and Eastern Asia. Sailing in two Danish naval vessels, the "Unicorne" and the "Lamprey", Jens Munck crossed the Atlantic and continued westerly across the wide expanse of Hudson Bay, which the English seaman Henry Hudson had discovered the year before in 1610. They dropped anchor in the estuary of a great river flowing from the west, today called the Churchill River. The vessels were secured for the winter and huts built for hunters, but winter took a terrible toll, for only Munck and two others were to survive to reach Norway in the Lamprey in 1620.

It was only after King Charles II of England in 1670 granted sole rights of "trade in lands watered by rivers running into Hudson Bay" that permanent fur trading posts appeared on the northern shores of Hudson Bay. The trading posts were needed to ensure the continued arrival of from ten to forty thousand furs and subsequent dispatch to London. So on June 10th 1717 three famous men of the Hudson Bay Company, James Knight - Churchill's rediscoverer after Jens Munck, Henry Kelsey - who reached the Saskatchewan River, and Richard Morton - travelled north from York Factory. And it was they who built the first of a long line of trading posts, later stores which have since served Churchill. The most famous of those trading posts is massive Prince of Wales Fort, now partially restored, still guarding the entrance to Churchill Harbour. Building had commenced on August 16th, 1731, took forty years to complete, only to be seized and pillaged when the French Admiral La Perouse captured it on August 9th, 1782, at the time of the American Revolution.

THE NORTH WEST FUR TRADING COMPANY

Competition for the fur trade became intense and became even more so when the North West Fur Trading Company appeared on the scene.

By the Treaty of Utrecht, 1713, France recognized English ownership of the Hudson Bay, while England recognized for France a wide area around the St. Lawrence River, the Great Lakes, the Mississippi and its tributaries.

The French and English had been hotly engaged in The Seven Years War, which was ended in 1763 by the signing of The Treaty of Paris, under which France withdrew from North America. This should have left the Hudson Bay Company with a monopoly of the fur trade, but that was not to be. After 1763 canny Scots and traders from New England came to engage in the fur trade, ignoring or disputing the monopoly of the Hudson Bay Company. Headquarters in Montreal, their canoes traversed the Great Lakes to Fort William, thence to travel and trade throughout North America, setting up trading posts even to the shores of the Arctic and the Pacific Oceans.

Thus was born the rivalry of today, the long Great Lakes Route from Eastern Canada and the short direct route via the Bay.

CHANGES OCCUR

But other forces were appearing to threaten the fur trade as predominate in the economy. Agriculture came to Western Canada when during 1811, 1812 and 1813 the Selkirk Settlers travelled from Scotland and the Orkney Islands through Hudson Straits, across Hudson Bay to Churchill or York Factory, thence upon the Hayes and Nelson Rivers, and then south down Lake Winnipeg to reach the land grants of their sponsor around Winnipeg, on the Red River.

Eventually fierce and ruthless competition between the inland posts of the Hudson Bay Company and its rival North West Company, and the much lower transportation costs for the H.B.Co. via Hudson Bay, forced the N.W.F.T. Co. to accept a merger with its rival to form a new Hudson Bay Company in 1822.

Significant changes were appearing elsewhere. The middle and far west of the United States was being occupied by people from various other countries, more and more hungry eyes looked northward to the vacant lands of the H.B.Company. At the same time Imperialistic Britain of the mid 1800's envisioned a transportation network which would start in the Far East, cross the North Pacific Ocean to British territory in North America finally to cross the North Atlantic Ocean to a destination on the United Kingdom.

This became easier after Canada's Confederation in 1867, and further

advanced when Canada agreed to purchase the lands and rights given to The Hudson Bay Company by King Charles II in 1670. This was done and Canada's size and shape largely determined.

LAND HUNGRY ACQUISITIVE EYES IN THE U.S.A.

Many in the victorious northern states of the U.S.A. felt that it was manifest destiny for the United States to be owner, occupier and exploiter of the whole continent of North America. Manifest destiny being encouraged by the victory in the Civil War, thousands of discharged soldiers, politicians and others crying "FIFTY FOUR OR FIGHT". This, along with land hungry settlers and farmers from the American mid and western states casting eyes on the empty Canadian west lands, forced the emergence of a Western Canada lying north of the 49th parallel of latitude.

Following the Confederation of 1867, and the surrender by the Hudson Bay Company of the Charter of King Charles II of England, Canada has developed to the country as it is know today.

The architect of modern Canada is generally recognized as being Sir John A MacDonald. His Conservative government formulated policies to ensure that Canada develop as a country, independent of the United States. So the Government of Canada, in 1872, commissioned:

1. the North West Mounted Police to enforce the demarcation of the 49th parallel of latitude, and as a bonus, to expel the American whiskey pedlars.
2. construction of the Canadian Pacific Railway through the south of Western Canada thus to emphasize the 49th parallel of latitude, and to provide transportation which would allow settlers to fill the empty lands.
3. development of the national policy of tariff protection which encouraged the development of Ontario as the industrial heart of Canada.

SETTLERS FLOOD IN - ANOTHER TRADE ROUTE IS SOUGHT

Immigration to Western Canada proceeded slowly at first. Following the Saskatchewan rebellion of 1886 and with the aggressive immigration and land settlement policies of the government of Sit Wilfred Laurier, the flood of immigrants became a torrent. Most of the available farm land was occupied and wheat crops of such volume produced that transportation, and trade routes to enable the produce of the West to get to market became of increasing importance and concern, in Canada, especially in Western Canada.

As grain production on the Prairies grew, so did the need for a short quick transport route to world markets. Some grain was moving south, and a trickle working through the Great Lakes to Atlantic ports. By the early years of the

20th century increasing quantities of Western Canadian grain were being exported, much via Portland, Maine. The opening of the Panama canal during World War I offered a new export route, serving old and new markets through Vancouver, something not always appreciated down east.

ON TO THE BAY

From the earliest years after Confederation, especially after creation of the postage stamp size province of Manitoba, some Western Canadians began thinking that as the short sea route via the Bay had served the fur trade so well, undoubtedly it could serve the farmers of Western Canada. As early as 1877 an application was made to Ottawa by the Winnipeg and Hudson Bay Railway and Steam Company which would permit the building of a rail line from Southern Manitoba to Port Nelson. In the years which followed many applications were sent to Ottawa for construction of railway lines from prairie points to Nelson or Churchill charters. Many of these charters with the grants and of land and money received by such companies as the Canadian Northern Railway, formed the basis of Canadian National, North America today.

Another basic argument given by supporters of the Hudson Bay Route is that Western Canada really paid for the construction of the Hudson Bay Railway as between 1908 and 1918 **fourteen million acres of western land were sold for the purpose of building a railway to Hudson Bay.**

In growing numbers, often donating their time and money, people of Western Canada began fighting against the monopoly of the eastern route via the Great Lakes and St.Lawrence, in favor of the short land route to the Bay. So it was with relief and some scepticism, that they received the announcement made by the Prime Minister Sir Wilfred Laurier in the House of Commons in September 1908 that a rail line to the Bay would be constructed, its destination whether the Nelson or Churchill yet to be decided.

NOW A START - THEN FRUSTRATION - FINALLY THE BAY

Rails of the Canadian Railways had reached the Pas by 1908, estimates for a start on the Bay Line had passed parliament. A bridge across the Saskatchewan River which has a section able to be opened to allow passage of river traffic constructed in 1912, and by 1915 80lb steel was being laid in the direction of the new port at Nelson. By 1915 steel had reached mile 214, trackage to mile 332 . By 1917 when construction ceased, trackage had been laid to mile 332 and a massive bridge over the Kettle Rapids constructed. At this time it was reported in Parliament $6,347,000 had been spent at the frustrating site on the estuary of the Nelson River, and $13,874,000 for the Hudson Bay Railway track and supporting facilities. The Federal government received constant representations for and against resuming construction of the line then asked the Senate to look into the whole situation.

THE SENATE REPORTS 1922

On June 4th, 1920 the Senate advised that the Hudson Bay Railway WAS feasible and possible, maybe even profitable, its season four months, with the potentialities of being made longer. It advised no further work be done until the potentialities of Nelson and Churchill were reviewed. The 1920's were years of outspoken support for the railway and a port on the Bay, while even more outspoken opponents made Ottawa very well aware of their position.

But Western Canada really united in battle for The Bay when word leaked out that a secret Order-in-Council had been passed authorizing removal of the steel from the Bay line, and that the Canadian National Railway had already removed the steel between mile 214 and 344 on recommendation of the Vice-President and General Manager of Canadian National Railways, and approved by the Board of Directors. This at a time when the Hudson Bay Railway was NOT a component of CN. Aroused as never before, Western Canadians rallied to the trade route through the Bay. Former Winnipeg Mayor C.F. Gray called a meeting of concerned Winnipeg citizens, who meeting in The Winnipeg Grain Exchange February 22nd, 1924 formed a voluntary non-profit organization whose purpose and title was "ON TO THE BAY!".

But it was POLITICS which decided that steel of The Hudson Bay Railway would finally reach the Bay and that the port of destination would be Churchill.

From 1921 to 1925 Liberal Prime Minister MacKenzie King held power only because of the support of members of Parliament from the Western Agrarian Progressive Party led by Robert Forke. If they had forced King into action to complete the laying of rail to Hudson Bay before 1925 the port would have been Nelson with all its hazard for the future.

The result of the Federal election of October 29th, 1925 saw King's Liberals fall from 117 to 101, Conservatives rise from 50 to 116 while the Progressives had fallen from 65 to 25, leaving King with a majority of only 11.

The budget had carried an appropriation of $3,000,000 towards further work on the Hudson Bay Route project, something reviled by many Conservatives, especially from Eastern and Central Canada. Then followed the political crisis of 1926 involving Prime Minister King, opposition leader Arthur Meighan and the Governor General Lord Byng of Vimy, to be followed by the federal election of September 24th, 1926 with King and the Liberals the big winners.

Part of King's victory can be attributed to the fact that many former Progressives had voted for the Liberals, partly because of the strong support for the completion of the Hudson Bay Railway given by the Liberal Government of Saskatchewan of Premier Charles Dunning. This Saskatchewan support was rewarded by the appointment of Honorable Charles Dunning to the federal

cabinet as Minister of Railways and Canals. Saskatchewan took this to mean that the new minister **would** see that the rail line **would** be completed to the Bay.

STILL GOING THE DISTANCE

With the appointment of Dunning, things took a turn for the better for the Hudson Bay Route. Dunning was a strong supporter, work began on renewing the neglected track still headed for Nelson. Because of money already spent, Dunning felt Nelson should still be the port. But, when the Conservatives, especially from Ontario raised a hue and cry against any further expenditures at Nelson, Dunning invited Frederick Palmer, a most experienced British naval and port engineer, to visit both Nelson and Churchill and to give Ottawa his report of recommendation as soon as possible. In 1927 Dunning twice visited both locations, once with Palmer, changed his opinion and fully agreed with Palmer that Churchill should be the terminus of the Hudson Bay Railway.

At this point "Going the Distance" began to produce favorable results for the Bay. Dunning, a strong man in the federal cabinet was determined that the Bay line should now be completed, but to Churchill rather than Nelson.

Airplanes were beginning to fly into the North. Two planes from Western Canada Airlines flew men and equipment to bore into the base of Churchill estuary, which proved that dredging would not have rock to contend with. Western Canada Airlines had been founded by Charles Richardson, father of businessman George Richardson, who is now President of Adjuit Aerospace, the company destined to make Churchill a world centre for space communications. To the North, planes of the Royal Canadian Air Force stationed at Port Burwell at the Hudson Straits, Wakeham Bay near the Center, and at Nottingham Island, flew through the winter of 1928-29 surveying ice conditions. From this challenging effort came the N.B. McLean Report that stated the straits to be acceptable for normal commercial vessels from mid-July to late October. The N.B. McLean Report deserves reading.

Throughout the bitterly cold winter of 1928-1929 hundreds of men "went the distance" laying tiles and rails over the frozen tundra, eventually to see the 80 lb steel reach Churchill on March 29th, 1929. The work of ballasting the track went on throughout the summer, until on September 10th, 1929, the Honorable Charles Dunning reported to the Canadian people that the Hudson Bay Railway from The Pas to Churchill was available for service.

Mighty bucket dredges Churchill No. 1 and No. 2 were at work deepening the channel to the Bay, only one mile away from the docks. A terminal elevator, able to handle 2,500,000 bushels, since increased in capacity to 5,000,000 bushels (140,000 tonnes) was constructed. The first commercial export cargo of wheat put together by James Richardson and Sons of Winnipeg and

provided by Pool elevators moved out of Churchill for London, England on the steamship SS "Farnworth" of the Dalgliesh Shipping Line of Newcastle on Tyne England on September 17th, 1931, to be followed three days later by the SS " Warkworth", both carrying about 250,000 bushels of wheat.

Fortunately a cairn stands in Churchill reminding us, in the words of Rudyard Kipling we" the sons of Mary who sat by the Lord's side", ride in the comfort of the train, the dream of a route to the Bay fulfilled, because of the sons of Martha, who served the Lord in lowlier ways, overcoming swamp, mud, mosquitoes, blackflies, heat, cold and isolation, completed their task.

To often it is forgotten that it is people who see visions and make things happen.

THE DIRTY THIRTIES

The dreams and hopes for Churchill were not yet to be achieved.

Grain, Cattle, flour, lumber, honey was exported while the Dalgliesh Company vigourously worked to secure import cargoes. Following the export of only two cargoes one in 1937 the second in 1938, it was with alarm the On To The Bay Association learned that Ottawa might close the Port down for 1939. Protests from the On To The Bay Association and others were so strident and forceful that 20 ships were promised for 1939. However, World War II intervened. Churchill bound vessels were lost, some like the SS "Firby" a frequent Churchill bound grain carrier, in the water between northern Scotland and the Orkneys, so that Churchill was closed down for ordinary commercial use from the rest of 1938 until 1946.

Over 1,800,000 tonnes of wheat remained in perfect condition through those years leading many to advocate that because of the cold temperatures throughout most of the year Churchill should be the location of a world food bank.

THE AMERICANS ARRIVE-CHURCHILL STILL FACES AN UNCERTAIN COMMERCIAL FUTURE

World War II brought the Americans to Churchill. Even after the opening of the Port in 1931 the community of Churchill still showed the characteristics of an isolated trading port. Ottawa's policy, if it had one, was to encourage as little development and use of the Port as possible. They brought in crews from outside (at one time bringing about 100 First Nations people from Northern Saskatchewan to work for the season) and then sent them back on the train as soon as the season's activities had ended. In contrast, most of the staff at the Port of Churchill today are First Nations people resident in Churchill.

Intended to be the reception for large numbers of wounded expected following D Day 1944, a military base and hospital with all the facilities was constructed, soon to be followed through the 1950's and 1960's by such a growth in population, that at one time combining the camp, town community which had developed and the Metis "Flats", over 7,000 people were living in the area at and around Churchill.

RE-ORGANIZATION, VIGILANCE AND PERSEVERANCE

During the war years very little had been heard from Ottawa as to its intentions regarding the Port of Churchill when peace would come. Officers and members of the On To The Bay Association were very apprehensive and so called on those officers and interested to meet with officials and members of the United Farmers of Canada, Saskatchewan Section to discuss how the two organizations and others could work to secure the re-opening of the Port of Churchill and to work to develop traffic through the Port on the Bay.

From this meeting of November 15th, 1944 emerged a new organization, to be called The Hudson Bay Route Association, dedicated to secure the re-opening of the Port of Churchill and to work for its maximum use over the longest seasons possible.

During 1945 little interest or assurance came from the Prime Minister W.L. MacKenzie King but following persistent efforts from the Hudson Bay Route Association, the governments of the three prairie provinces and representations from farm organizations and from individuals, the Port re-opened in August of 1946, when **about three million bushels of grain were shipped to England** which was still short of food following the deprivations of World War II. About 70 tonnes of imports for the prairies were landed.

At this time Mr. Peter Dalgliesh, of the R. S. Dalgliesh line of Newcastle commenced years of dedicated efforts to work up imports through the Bay.

MOST WESTERN CANADIANS ARE CONVINCED THAT PRESSURES ARE CONSTANTLY UPON THE GOVERNMENT AND BUREAUCRACY AT OTTAWA TO CLOSE CHURCHILL as an international port and to abandon all or part of the CN rail line to the Bay. One has to remember that it was a political decision that the Bay rail line and port be built and that the Port be built at Churchill rather than Nelson. This probability is ever present and so real, so much so, that already in 1994 The Hudson Bay Route Association Executive Officers have met with governments of Manitoba and Saskatchewan, The Canadian Wheat Board, Canadian National Railway and hope to have personal meetings with Hon. Ralph Goodale, The Federal Minister of Agriculture, Hon. Lloyd Axworthy of Human Resources, and Hon. Doug Young ,Minister of Transport.

CHURCHILL HAS THE ANSWERS - OR AT LEAST SOME OF THEM

For a commercial enterprise to be profitable, it requires the lowest transportation costs possible and frequently the least time required to transfer goods from one place to another. Churchill could offer those advantages for it is located near the geographical centre of Canada and mid way between the densely populated areas of Far East countries, and the Western countries of Europe.

Churchill is located at the north-south apex of lines of communication running straight through the countries of NAFTA- Canada, United States and Mexico and on down to the most distant areas of the continent of South America. Lines of communication spring out fanlike from Hudson Straits and out from the Atlantic to Eastern areas of Europe through the Mediterranean to the Near and Middle East and on to India. A short northern route could start in, say, Japan or Korea, cross the Pacific Ocean by the shorter and quicker route to Prince Rupert across the rail line of CN which already exist or could be constructed to Churchill and through the Bay and Hudson Straits to the North Atlantic and markets world-wide.

THE COST

Western agriculture is forever being told to cut costs or perish, but the costs of the Great Lakes and St. Lawrence Seaway remain. The following may suggest why.

In a letter dated December 1st, 1993, the Canadian Wheat Board stating in detail, gave the cost per tonne of moving grain from inshore Thunder Bay by water direct to C.I.F. and F.O.B. Montreal/Sorel/Quebec/Three Rivers/Baie Comeau/Port Cartier basis per tonne CW Red Spring Wheat 15.5% protein before Thunder Bay at $240.84

Cost per Tonne

C.I.F. Inshore $24.86 F.O.B. $27.74

This indicates that every tonne of grain shipped via the Seaway rather than via Churchill costs all the producers of that grade of grain an extra $24.87 or $27.74 per tonne as of date December 1st, 1993.

But it will become a best kept secret no longer, for a first step to secure for the public full information affecting grain exports via Churchill was made this January. The Convention of the Keystone Agriculture Producers passed a resolution, at a January meeting, requesting that the asking price for grain shipped via Churchill be included in the "Grains and Commodities" sections of weekly farm newspapers .

Tonnage	C.I.F. $24.87	F.O.B. $27.14
Churchill "Break Even" 600,000 tonnes	$14,922,000	$16,284,000
On 1972 Export 720,000 tonnes	$17,762,400	$19,540,800
Churchill Manager's Request one million tonnes	$24,870,000	$27,140,000
With 2 - 3 Weeks Extension two million tonnes	$49,740,000	$54,280,000

HUGE POTENTIAL SAVINGS VIA CHURCHILL
CANADA'S BEST KEPT SECRET!

BEWARE YOUNG FARMER BE AWARE

Our farmers are confused as they have to deal with: G.R.I.P., N.T.P., W.G.T.A., G.A.T.T., The Crow, and the Crow Benefit. But they **will** affect agriculture and transportation , on July1st, 1995 G.A.T.T. for one will have done much to determine the nature of Western agriculture, and our rail transportation system. Armand Le Sann, writing in 'The Opasquia Times" of the Pas, Manitoba, after discussing the topic concludes that changes to the method of payment of the Crow Benefit is inevitable which could result in considerably higher grain prices for Manitoba producers. Changes in farming practices, marketing and transportation if given complete disclosure of all transportation costs and practices could force changes in Manitoba's grain production from which north-south transportation links could evolve.

When shipping moves to Liverpool via Churchill, rather than the Great Lakes and Montreal **the mileage saving is;** from Regina 980 miles,
from Saskatoon 1,128 miles,
from Prince Albert 1,214 miles,
from Calgary 1, 044 miles and
from Edmonton 1,142 miles.

Using the shorter route from Churchill saves time, fuel, money and is environment friendly.

Masters of Russian vessels serving Churchill have recently pointed out that it takes three weeks to Montreal from the Baltic and Murmansk, but only two via Churchill. This eliminates all expenses of a week or of two on a round trip, giving an extra two weeks for working another commitment, hopefully meaning bigger profits.

CHURCHILL COULD BE THE MIDDLE COMPONENT FACTOR OF A GREAT NORTHERN TRADE ROUTE FROM ASIA TO EUROPE

A vessel leaving Hong Kong or Japan would take one day less sailing to Prince Rupert than to Vancouver. The North American Land Bridge from Prince Rupert to Churchill would eliminate about half the normal distance to cross North America. From Churchill many sea routes are then possible, a most interesting being the Arctic Bridge to link Churchill and Murmansk, Russia.

CN NORTH AMERICA THE NORTHERN TERMINUS OF THE NORTH SOUTH COURIER

Ocean routes terminate at the Canadian port of Churchill, served by the CN rail line carrying 100 lb steel. The Bay line is in good shape with VIA Rail operating three fully equipped trains a week from Winnipeg and three return, in addition to a "mixed". Freight trains of great variety follow the gentle decline from the Pas, Manitoba to the ocean at Churchill causing a jokster to remark "the chief wear could be on the brakes".

Under the Canada - Manitoba ERDA Agreement much work was done. About 2,000 grain box cars were rehabilitated for service to Churchill and Thunder Bay. During the winter they are stored "**out of sight of grain hauls**", a CN work order is said to have read.

Much maintenance work was done under the Prairie Branch Line Rehabilitation Act widening embankment, renewing ballast, building new bridges, renewing old wherever possible. A most interesting development is application of the heat exchangers as used for the Alaska Pipeline from Prudhoe Bay to Valdez Alaska. Sink holes rarely appear on the Tundra section of the line, but south of Gillam where long heat pipes are inserted into the trouble spots. The long heat stabilizers increase the extraction of heat from the ground during the winter and decreases heat into the ground in summer.

Suffice it to say, that the Bay rail line is there, it is fully operational and moved very heavy loads successfully over the line to Gillam during the construction of Manitoba's Kettle, Long Spruce and Limestone dams on the Nelson River. But powerful forces constantly are at work to eliminate all or part of the rail line to the Bay.

CHURCHILL'S AIRPORT HAS POTENTIAL

The airport was built by the United States in World War II with an especially long runway of 9.200 ft. x 160 ft. wide, making it the longest runway in Manitoba. Built for tanker planes that refuel fighter planes in mid air. Incidentally this runway a very few years ago saved the lives of crew and passengers travelling from Los Angeles to Copenhagen when the plane started to leak fuel and was safely able to land on Churchill's long runway.

THE SEASON OF NAVIGATION AND INSURANCE

The route via the Bay is deep, wide and direct requiring only three changes of course. In contrast a ship traveling the route from Thunder Bay to the St. Lawrence and finally salt water encounters many course changes on a route that requires constant dredging.

The route to Montreal is not free of ice often requiring icebreaker support. The winter of 1993 was very difficult in the St. Lawrence River and Gulf closing the Port of Montreal for days at a time, seriously delaying container ship traffic. The Regina Leader Post of February 12, 1994 carries a news dispatch from Halifax which advises that a deep freeze and steady wind have plugged the Gulf of St. Lawrence with ice trapping ships in any early freeze-up that could be the worst on record, with 40 ships in various stages of being freed in the Gulf. The writer of this paper recalls that the C.P. liner "Empress of Australia, bearing King George and Queen Elizabeth II to Canada for the famous 1939 visit, was delayed in the Gulf in early May, 1939.

The season of navigation is usually determined by Lloyd's of London. This allows passage of Cape Chidley midnight July 22nd and leaving Churchill before October 28th. Vessel owners can get even lowers rates negotiated on a company and ship by ship basis. Ordinary commercial vessels have left during the first week of November. Radar-plane-satellite viewing have greatly enhanced the making of safe,quickest and so most remunerative of vessel transit of the straits and Bay. On December 3rd and 4th, 1970 the Canadian Coast Guard "Louis St. Laurent" lay off Churchill as part of the celebration of Manitoba's one hundredth birthday.

Ice conditions can vary. A strong westerly current along the shore of Baffin Island takes any iceberg up the straits to return east with the current flowing along Quebec's northern shore. Icebergs rarely get into Hudson Bay. New ice formations form in the north west area, gradually developing until the Straits become ice covered. This infers that, could Churchill harbour be kept open longer, there are many ways possible for the Bay route to offer a six to eight month season. Airplane and satellite information, with possibly soon to come assistance from Spaceport Canada, now under development at Churchill, give promise of much longer seasons of operation. This would be supported by icebreaker back up - a service which has been available since the 1930's.

CHURCHILL HARBOUR ONE OF THE WORLD'S BEST

When Sir Frederick Palmer, in 1927, advised that Churchill rather than Nelson be developed as the terminal port of the Hudson Bay Railway, he had been impressed by one of the world's most expensive river estuaries, one connected to the open sea only a mile distant.

Ports Canada now operates at Churchill facilities which include; a berth 3,073 ft. long, five having depths of 9.5m increased by a 10 to 12 ft. tide. The Wolfe berth was improved in the 1980's to a depth of about 39 ft. greater with high tides thus allowing the operation of vessels up to 60,000 tonnes, once a grain loading gallery is constructed. The Port is served by a terminal railway, cranes, repair facilities, bunkering and two tugs.

The 140,000 tonne elevator (5,000,000 bushel) has four unload tracts, two able to serve hoper cars, two could also be adapted. Receiving capacity is 1,255 tonnes per hour and shipping 1,633 tonnes per hour.

But a port requires traffic. If not the statement of Honorable Don Mazankowski, of the Port of Churchill and C.N. rail line "USE IT OR LOSE IT" will become only too true. As mentioned earlier,a great variety of import cargo passed over the Churchill wharves between 1932 and 1939. For nearly forty years after the Port resumed service following W.W.II 2 tonnages of great variety, worked up by S.S. W. "Peter" Dalgliesh and his son Nicholas, were unloaded from vessels owned or chartered by the Dalgliesh company.

Cars including Austins and Volkswagon cars from Germany, farm machinery, which included Fordsons and Field Marshall tractors were among the many imports worked through Churchill.

Surely this recall of the imports which arrived through Churchill in 1969 should induce someone, somewhere in 1994 to revive imports via the Bay to equal or far exceed tonnages worked by the Dalglieshes in 1969.

Commodity	Tons	Commodity	Tons
Automobiles	152	Pipe	1,331
Belting	104	Pumps	51
Beta Napthol	79	Rolls, iron	55
Bonemeal	172	Segments	1,102
Confectionary	14	Sodium Nitrate	72
Curling stones	14	Steel roll shells	32
Liquor	1,244	Telephone equipment	26
Machinery, conveying	475	Tractors	956
Machinery, generating	154	Transmission towers	405
Machinery, mining	30	Valves	3
Merchandize, general	102	Zinc, Chloride	4

It should be noted that the imports went to cities, small centres and as far east to Winnipeg and as far west to Vancouver as listed; Flinn Flon, Man.; Saskatoon, Sask.; Winnipeg, Man.; Viscount, Sask.; Alwinsal, Sask.; Thompson, Man.; Yorkton, Sask.; Regina, Sask.; Edmonton, Alberta; Waboden, Man.; Yarbo, Sask.; Calgary, Alta.; Vancouver, B.C.; Lynn Lake, Man. and many other centres.

Churchill commodities exported other than wheat were:

Cobalt Oxide	174 tons
Nickel Slabs	3,306

All together Churchill non grain exports totalled 5,463 tons. Shipping handled 22,516,493 bushels of grain exports. Two vessels carried screenings for Eastern Canada, two tankers discharged 32,747 tons of fuel.

SPACE CRAFT

Probably the most exciting thing to come to Churchill, and which holds much promise to the Bay Route and Manitoba, is Spaceport Canada. This is a private venture financed by Akjuit, a Manitoba based firm with finances coming from the residents of Churchill, Northern Manitoba, Aboriginal sources. This is a civilian project whose Chairman is Winnipeg's Mr. George Richardson and President Ms. Siobhan Mullen.

Spaceport Canada will be used by the telecommunication industry to launch small networks of "constellations" of low polar orbit.

During its operation the Churchill Rocket Range fired over 3,100 rockets and is admirably located for its new role as the telecommunications industry shifts from big heavy satellites in orbit 22,000 miles above the earth to low cost satellites stationed only above the north.

Preliminary study and planning is now being done. Site preparation to start in June, followed by first firing late in 1994, with the project to be in full operation in 1996.

AT LAST THE NORTH

Exciting things are happening in Northern Manitoba and in the Keewatin of the North West Territories, which should be of great value to Churchill and the north-south transportation network.

The Golden Boy atop of the dome of the Manitoba Legislative Buildings faces North. So it was appropriate for the Deputy Premier of Manitoba, Hon. James Downey and Minister of Industry, Trade and Commerce to travel north with two other Manitoba cabinet minsters and officials to Rankin Inlet, a growing centre in the North West Territories on Hudson Bay. They met February 1st, 1994 with the government leader of the North West Territories, Hon. Nellie Cournoya and Mr. John Todd from Federal Northern Affairs and officials to discuss increasing communications and economic development between Manitoba and the Territories.

It appears that there is going to be a lot of development in the territories and

much greater commerce through Churchill by increased barge and ship service and by road - first a winter road and then a highway from Churchill. Import cargoes could come from mines in the territories south through Churchill for smelting at Flin Flon or Thompson.

Churchill has so much history, so much for nature lovers, with polar bears always a sure attraction. There is a big potential for tourism on land or by sea. Cruise ships began visiting Churchill in 1988. Last year cruise ships "Hanseatic" and "Polaris" handled 411 cruise passengers.

IN CONCLUSION

East-West, North-South and up into the skies. trade possibilities exist in all directions outreaching from Churchill. Possibilities for import, export and tourism abound. But it will take people of vision to maximize the potential that exists through the Port of Churchill. People of vision for whom the rewards will be great.

TAKING TRANSPORTATION TO SCHOOL

Few people involved in transportation and logistics today had the opportunity, as part of their schooling, to become aware of the role and impact of these sectors on society or the potential for careers within these sectors in society. Traditionally, the knowledge, skills and appropriate attitudes that relate to transportation are learned on-the-job — using both formal and informal apprenticeship (learning-by-doing) opportunities available within the various sectors of the industry and within government agencies. To the best our knowledge, no school jurisdiction in Canada is currently offering students a curriculum that addresses the transportation industry.

Transportation occupies a unique place in our society, and in particular, in our economy. Although transportation affects us all, its role and impact tend to be ignored except when people and goods need to be moved. The impact of transportation is described simplistically by the following statement, "Nothing is where it is wanted; nobody is where they want to be."

"Modern society," according to Ward (1983:4), "cannot exist without transportation." It may similarly be said that modern society will also fail without a dynamic and responsive educational system.

This paper describes the context and process being used to design and develop a new curriculum, Transportation of People and Goods (TPG). A description of the modular structure, content and outcome-based orientation is provided.

CONTEXT FOR CURRICULUM DEVELOPMENT

In response to the need for change and the need for students to graduate with basic, transferable and career-specific competencies, including an increased awareness of alternative career paths, Alberta Education is developing the Career and Technology Studies (CTS) program. This program is part of the Government of Alberta's initiative to assist students in making the school-to-workplace transition more effectively and to prepare them for emerging career fields.

> *People are Alberta's most valuable resource and their skills will be key to ensuring economic growth and stability . . . education must give Albertans competitive skills to succeed in the evolving world economy.*
> (Premier Ralph Klein, 1993)

The 1990 decision to develop CTS was based on the recognition by Alberta Education, school systems and secondary schools that there was a need to:

- *design and have access to programs that respond efficiently and effectively to individual student needs and rapid changes in society*
- *establish strategies that help students respond to the rapid changes in technologies . . . and to help educators take advantage of these technologies . . .*
- *have access to school curricula which support future occupational opportunities and better prepare all students for "learning a living"*
- *coordinate and facilitate the cooperation of education, community and business and industry to ensure excellent design and delivery of (career-related) programs.*

(Alberta Education, 1989)

The CTS program will be implemented in 1997–1998 and will consist of approximately 600 modules grouped into some 20 strands (Appendix 1). The content of each module will be stated in terms of student outcomes; that is, the knowledge, skills and attitudes that the average student should be able to demonstrate given access to at least 25 hours of instruction per module. Each module will also contain information about assessment standards that will guide teachers in responding to the question, "how well" when assessing student performance.

Central to both the development and implementation of the CTS curricula are school-workplace partnerships. An increasing number of employers and educators appreciate the value of linkages among school-business-industry.

Packer (1993:51) notes:

> *Employers are beginning to appreciate that schools are their most important suppliers and that their workers will be perpetual students. Educators are coming to understand that employers are one of their key customers and that students are the employees.*

It is through these partnerships that both students and teachers can see meaning in the curriculum. Students are given meaningful contexts in which to develop generic skills such as problem solving, communication and teamwork. In addition, teachers are encouraged to provide new and expanded learning environments in which to develop a "culture of practice" (Report on Educational Research, 1993:7); that is, environments in which students learn to apply both generic skills and academic knowledge.

The designers of the TPG curriculum believe the application of both generic skills and academic knowledge can be achieved through a study of transportation, which may include

> *. . . how people use the elements of technology to design and produce technical systems for the purposes of moving freight and passengers, safely and efficiently, in land, water, air, and space environments, and the impacts these systems have on (other) technological, societal and biological systems.*
> (Bolyard and Komacek, 1990:25)

CURRICULUM DESIGN AND DEVELOPMENT PROCESS

Developing a new curriculum is a process rather than an event and involves the following key stages:

1. Identifying the need
2. Designing the framework
3. Developing and validating the content
4. Implementing the curriculum.

The Need

The purpose of CTS and the decision to pursue the design and development of the TPG curriculum were addressed briefly in the previous section. Decisions are still pending on whether the TPG modules will remain in a distinct TPG strand or be included as modules within other CTS strands (see Appendix 1). Feedback received from members of a TPG communication network favour the retention of TPG as a distinct strand.

The Design

Designing a new curriculum involves research including identifying and accessing related literature, seeking out existing related curriculum, and making contact with persons having knowledge and expertise in the areas to be addressed in the curriculum.

Research indicates that no Canadian school jurisdiction currently offers a transportation and logistics curriculum. Available transportation-related curriculum focuses on the mechanics of transportation (e.g., propulsion, suspension, guidance, control systems). Research also indicates that the areas of transportation and logistics are not addressed extensively by Canadian colleges and universities.

A "taxonomy of transportation" (Komacek, 1992:53), provides a general framework upon which to consider how a TPG curriculum might be organized. An adaptation of this taxonomy is provided in Appendix 2.

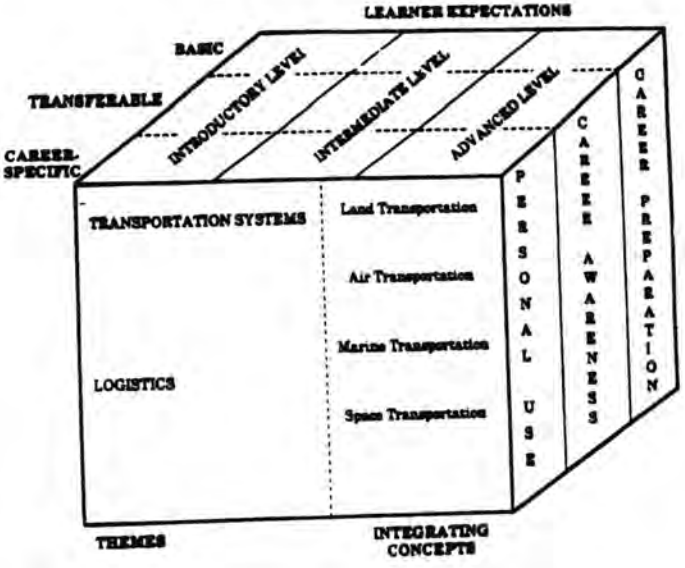
Considerable guidance, assistance and support were provided and continue to be provided by personnel from both provincial and federal government departments, from business, industry and professional organizations. Key contacts include Alberta Transportation and Utilities, Canada Employment and Immigration, Transport Canada, National Transportation Agency, Air Canada, Canadian Airlines International, Canadian National, Canadian Pacific, Canadian Professional Logistics Institute, Canadian Institute of Traffic and Transportation, Canadian Materials Handling and Distribution Society and the Canadian Industrial Transportation League. To date, there are in excess of 200 persons, including teachers, on the TPG communications network.

These and other contacts resulted in the construction of a framework, a model (Figure 1) to guide the development of the TPG curriculum and an outline of the proposed modular content. Further consultations resulted in the development of the scope and sequence for the curriculum (Appendix 3). This scope and sequence shows the title of modules to be developed and the prerequisite relationship among the modules. (The scope and sequence is still not "carved in stone." Considerable work will be done to validate the modules, their content and their relationship with members of the communications network.

Development and Validation

The model (Figure 1) is guiding the development of an outcome-based course of study which includes two major components; curriculum standards and assessment standards.

Figure 1



- Curriculum Standards — curriculum standards are the content of each module. They define what students should know and be able to do upon completing the module.

- Assessment Standards — are indicators that answer the question "how well." Assessment standards guide teachers when assessing students' performance competencies.

An outcome-based curriculum focuses on what students will be able to do after receiving instruction. (Most traditional curricula tend to focus on what the teacher is expected to teach.)

As noted earlier, the general scope and sequence of the TPG modules were developed through extensive consultation with the TPG communication network. The next challenge was to assign content (i.e., curriculum standards) and assessment guidelines (i.e., assessment standards) to each module. A variety of strategies were used to assign content, including the use of focus groups, task forces and private consultants and contractors. For the TPG strand, a private consultant possessing extensive knowledge and experience in transportation and logistics was contracted to work closely with Alberta Education to flesh out selected modules.

Concurrent with the content development, publishers were requested to submit resources appearing to be relevant to the TPG scope and sequence chart provided to them. The contractor had access to the resources submitted by publishers.

Validation of draft curriculum and assessment standards is ongoing. Revisions to these standards are based upon feedback received from validators.

Current time lines call for the field review of selected TPG modules and selected resources during the 1994-95 school year. The field review will involve a number of high school teachers reviewing the curriculum and resources and using them to instruct students who have expressed interest in learning about transportation and logistics. Both written and verbal feedback is sought throughout the field review process.

Implementation

Implementation of all CTS curriculum is planned for the 1997-98 school year. At that time, the new CTS modular-structured strands will replace the current practical arts courses. Key elements of the implementation process include:

- Inservice — the orientation of administrators, counsellors and teachers to the new curriculum framework, its content and resources and its relationship to other curricula.

- Preservice — working with universities to ensure that teacher training programs include at least an orientation to CTS and how CTS strands and modules relate to the core curriculum (e.g., language arts, mathematics, science, social studies).

- Marketing — CTS strands and modules must compete for the attention and interest of parents, teachers and students in a very competitive marketplace — the available curriculum. Available curriculum in Alberta schools is extensive. If TPG is to survive and prosper as a viable program offering, potential interest groups, especially counsellors and students, must be assisted to recognize the career potential within the transportation and logistics sectors of the economy.

- Monitoring — a final component of the implementation process involves the monitoring of how the curriculum is offered, how school-based and community resources (human and material) are utilized, and, of prime importance, monitoring what students who have completed TPG modules know and are able to do.

CURRICULUM CONTENT

As noted earlier, curriculum content must serve two masters. First, it must convey information that establishes an understanding of transportation and logistics; that is, its importance in Canada's economy, and its value as a career areas. Second, it must appeal and be meaningful to educators, parents and students. Without this appeal, the curriculum may fail to attract teachers to teach the TPG modules and students to take them.

With these points in mind, curriculum development proceeded within a conceptual framework of information and concepts to be included. However, planned delivery time, module fit and interim validation constrained the inclusion of all planned topics in the modules developed to date.

The modular framework and the content of each module was shaped using the following parameters:

- **The raison d'être of transportation** must be developed, and students provided with an understanding that transportation is important to people as individuals and to society in general, and holds a unique position as a major contributor to Canada's economic well being.

- **The scope of the transportation system** must be explained. Presentation should include its structural and geographic organization, the public and private infrastructure employed, the way in which it is segregated into modes and the resources, people and equipment utilized.

- **The intermodality concept** must be introduced, outlining the impact of its revolutionary introduction into international trade over the last three decades and its potential in the domestic market. Particular emphasis should be placed on its value to Canada in international competition.

- **Work area organization** structures and roles should be highlighted, drawing attention to the interrelationship among the conceptual functions of thinking, planning and designing, the ongoing management functions of controlling, developing, operating and maintaining and the delivery functions of doing and providing.

  The practical, hands-on nature of the industry should be emphasized, together with the need for well-developed employability skills such as problem solving, information processing, communication and teamwork.

- **Adaptability of transportation systems** must be made evident and assist students to recognize how transportation systems have adapted and continue to adapt to meet the requirements to transport people and the adaptations made to ensure efficient and effective transportation of goods, be they perishable, hazardous or require other special transport and/or delivery requirements.

- **Distance and market composition factors** and their influence on the types of equipment and transportation systems utilized should be developed. It should be made clear that transportation within an urban centre develops under one type of system/equipment configuration, whereas transportation between two centres utilizes different configurations based on the interplay of factors such as distance, volume, regularity of shipments and size of each centre.

- **Stakeholder group involvement** must be explored, including the involvement of the following:
  - Government(s) — their role(s) in the areas of funding, operational safety, environmental protection, facility provision and operation, regulation and management.
  - Personal users — their needs and wants.
  - Commercial users — for example, companies and organizations who make direct use of transportation and intermediate organizations who manage transportation as third parties.
  - Suppliers (carriers) — those agents and companies which provide transportation for remuneration.
  - Employees — including individuals employed by government, carriers or transportation users.
  - Citizens — persons who, in addition to their work roles, have a general interest in how transportation impacts cost of living, lifestyle, environment, quality of life.

- **Career pathways and options** should be included and facilitate a focus on opportunities that currently exist to start employment at entry levels, and to teach higher levels of income and responsibility while making significant contributions to society.

The curriculum should enable students to appreciate the transferability of the knowledge, skills and attitudes they will develop. Similarly, the curriculum may also address the fact that careers in transportation may offer opportunities for national and international travel for suitably qualified people.

Throughout development of the central transportation theme, the curriculum material was shaped to identify interactions between transportation and other business concepts.

Transportation is addressed as a distinct area of study and as an element of logistics. The latter focus is given emphasis in specific modules on logistics and other logistics elements, including materials handling, warehousing and distribution. In addition, marketing, finance, operations (production), communication, computerization (particularly EDI) are addressed in part as components of some modules and, in more detail, in specifically targeted modules.

MODULE STRUCTURE

The modules proposed for inclusion in the TPG curriculum are shown in Appendix 3. The modules are being developed at three levels: introductory, intermediate and advanced. Students may select three or more modules to create a course. A course may include modules from one, two or more strands of the CTS program. Dependent upon the entry age and maturity level of students, they may decide, for example, to explore a range of introductory modules in Grade 10 and then make a decision to further develop their knowledge and skills in the area of transportation by selecting additional modules to make 3, 4, 5 or 6-credit courses.

In the context of the TPG strand, it could be generally expected to attract students with relatively high levels of academic, intellectual and problem-solving ability. Students will take introductory TPG modules in Grade 10, intermediate modules in Grade 11 and advanced modules in Grade 12.

Multi-level grouping of modules will be possible, especially where teachers and students wish to explore and develop a modular theme in detail within an extended time frame. For example, modules Trends and Issues in Transportation 1, 2 and 3 may be taken concurrently.

An experiential, hands-on approach to learning is a critical instructional orientation and teaching strategy for all CTS modules and for TPG modules in particular. Theory must be introduced authentically. That is, as a foundation upon which students can find and see meaning in tasks that they may be asked to perform. Teachers must be prepared to answer effectively the often-asked question, "Why do I need to know this?".

CONCLUDING COMMENTS

The draft TPG curriculum is in a relatively early stage of development. Additional expert and lay feedback is critical to the development and validation process.

As a strand within the broad CTS program, TPG must compete for both teachers' attention and students' interests. An important question that both groups may ask is, "What's in it for me?". Feedback from the TPG communication network on drafts of selected TPG modules indicates reasonably good support for the content and strong support for retaining TPG as a distinct strand within the CTS program. Additional field validation will be followed by a field review of the curriculum and related resources by teachers using these materials to teach students. "The proof of the pudding will be in the eating." If teachers and students ask for more, we will know we have developed a viable and usable curriculum.

In today's society, schools are called upon to be many things to many people. The TPG curriculum opens up a new area of study and provides students an alternate pathway through which to explore technology, develop competencies and make career decisions.

> *The school prepares youths for the world in which they live . . . because (Canadian) culture is distinctly characterized as technological, it becomes the function of schools to give every student an insight and understanding of the technological nature of the culture.*
> (ITEA, 1985, p.25)

Appendix 1

Career and Technology Studies
Program Organization

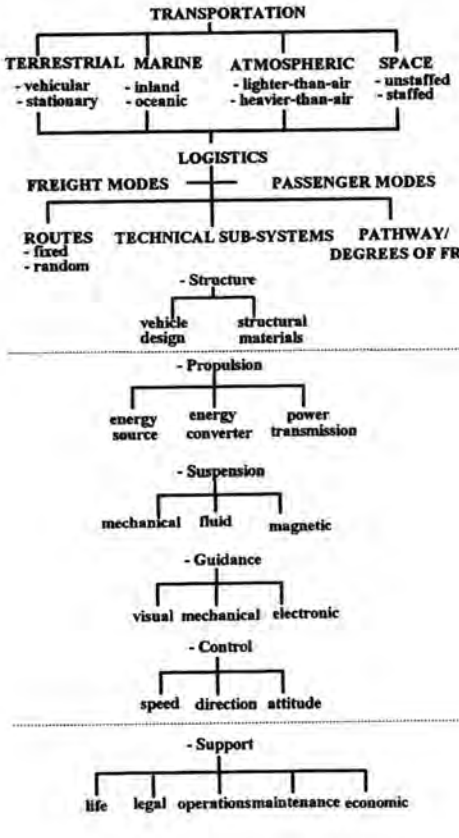
Areas of Study	Proposed Strands
Personal and Community Studies	Career Transitions Cosmetology Studies Foods Studies Legal Studies Tourism Studies
Communication Studies	Communication Technology
Management and Marketing Studies	Management and Marketing
Information Management Studies	Financial Management Information Processing
Design and Innovation Studies	Design Studies Enterprise and Innovation Fashion Studies
Construction Fabrication Studies	Construction Technologies Electronics Fabrication Studies
Transportation Studies	Mechanics Transportation of People and Goods
Natural Resource Studies	Agriculture Energy and Mines Forestry Wildlife

Areas of study — *grouping that involves similar basic, portable and occupation-specific skills.*

Strand — *grouping of modules within a career area (personal life and work life).*

Appendix 2

A Taxonomy of Transportation: Linkages Across CTS Strands



TPG CURRICULUM

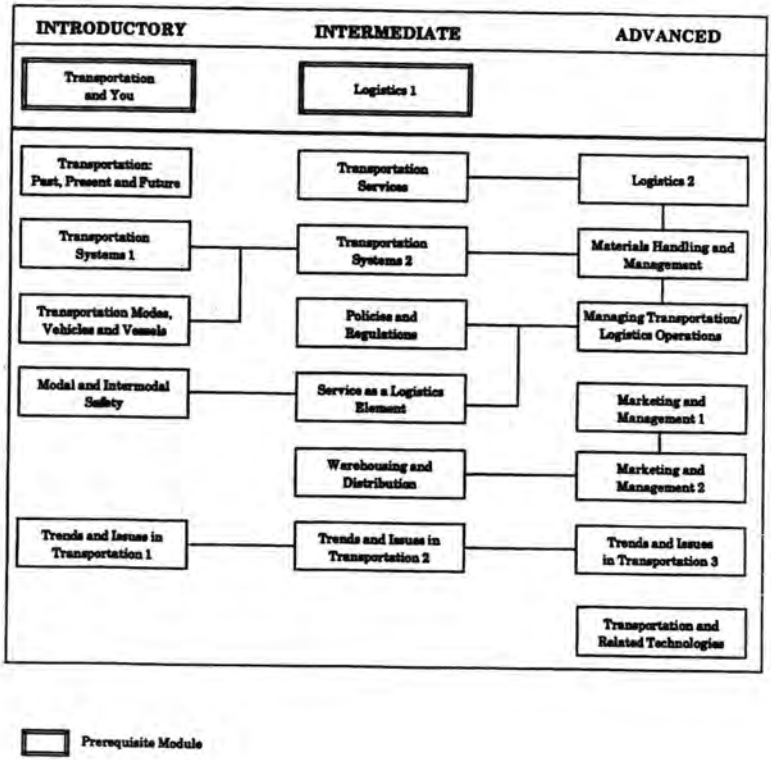
MECHANICS CURRICULUM

INTEGRATED FOCUS:
- Legal Studies
- Information Processing
- Management & Marketing
- TPG
- Mechanics
- Design Studies
- Enterprise & Innovation

Framework modified from Komacek, 1992:53

Appendix 3

Transportation of People and Goods
Scope and Sequence



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FINANCIAL PERFORMANCE OF CANADIAN AND U.S. MOTOR CARRIERS

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I. Introduction

Canadian and U.S. motor carriers will compete more intensely with each other as trade between Canada, the U.S. and Mexico increases due to both the Free Trade Agreement (FTA) and the North American Free Trade Agreement (NAFTA). The ability of Canadian carriers to compete effectively is dependent, in part, on their financial strength. A study performed for the Ontario Ministry of Transportation concluded that poor financial condition contributed to the inability of Ontario carriers to modernize equipment (Deloitte and Touche, 1991). A federally sponsored study of the financial performance of trucking firms showed that Canadian carriers are highly leveraged compared to their U.S. counterparts (Price Waterhouse, 1991). Debt to equity ratios of Canadian carriers are observed to be nearly twice those of U.S. carriers. This paper examines the potential impact that this capital structure has on Canadian motor carrier competitiveness by considering all of the traditional measures of financial performance. The paper explores the factors that have led to such a highly leveraged capital structure and concludes with recommendations for future research in the area of financial policy for Canadian trucking.

II. Financial Performance of Motor Carriers: Canada versus the U.S.

A federal study prepared for The Minister of Transport's Task Force on Trucking Issues found that Canadian carriers are more highly leveraged than their U.S. counterparts (Price Waterhouse, 1991). According to the results, for virtually every category of firm, the debt to equity ratio of Canadian firms is at least twice the debt to equity ratio of U.S. firms. For example, the larger carriers in the U.S. show a debt to equity ratio of 1.1 compared to 2.3 in Canada. The same is true of the long-term debt to equity ratio as displayed in Table 1.

These findings raised questions concerning the ability of Canadian carriers to compete with U.S. carriers in the transborder market. The Price Waterhouse study states "Canadian carriers are more exposed to high interest rates than their U.S. counterparts due to their higher debt to equity ratios" (Price Waterhouse, 1991). Two issues arise. First, the Canadian and U.S. samples represent carriers active at one point in time in the transborder market and not the trucking industries of each country in general. As NAFTA becomes more effective, a larger proportion of the U.S. trucking industry will become competitive with a larger proportion of the Canadian trucking industry. Second, the more leveraged capital structures of Canadian trucking firms may be an appropriate strategy given the environment in which they operate. We begin this investigation by expanding the financial comparisons to the total trucking industries on both sides of the border and examining other aspects of financial

performance that complement the capital structure dimension.

Table 1

Capital Structure Ratios: Canadian versus U.S. Carriers

Size of Firm (revenues)	Canada - 1988			U.S. - 1989		
	# Carriers	Total Debt to Equity	L-T Debt to Equity	# Carriers	Total Debt to Equity	L-T Debt to Equity
Large (> C$20 million)	58	2.3	1.04	61	1.1	0.54
Medium (C$4-$20 million)	176	3.5	1.48	32	1.6	0.69
Small (< C$4 million)	281	1.9	0.86	7	0.5	0.28

In order to establish that Canadian carriers are indeed more highly leveraged than their U.S. counterparts, financial ratios which reflected the capital structure of firms were compared over the eight year period from 1984 to 1991. Separate comparisons were made using information from Dun and Bradstreet (D&B), Statistics Canada (SC) and the American Trucking Associations (ATA).[1] These multiple sources of carrier financial information from each country were used to increase the robustness of the comparisons between the two countries. The D&B series that was available to the authors was from 1985 through 1991 while the SC data series covered the years 1984 to 1990, and the ATA data covered 1984 to 1986 and 1989 to 1990.

The total liabilities to net worth (total debt to equity) percentage computed from the two data sources is displayed in Table 2. The Canadian population in the D&B data source is shown for the total Canadian population (Can-All) and for the large carriers (Can-Lg) which are more comparable in size to the U.S. population in the D&B database. The perception of a higher reliance on external financing by Canadian carriers is supported by the data. The data also indicates that larger Canadian carriers are more highly leveraged than the Canadian trucking industry average. According to the D&B data, at the turn of the decade Canadian carriers reduced their financial leverage while U.S. carriers increased their financial leverage.

The return on assets of a firm is dependent on profitability as measured by the profit margin and productivity as measured by the turnover of assets. Asset turnovers for the Canadian and U.S. trucking industries are shown in Table 3. U.S. carriers appear to have used their assets more intensively over the period studied. Table 4 displays the estimated profit margins for the carrier groups. Here the different sources do not agree completely. Median profit margins (D&B data) for Canadian carriers appear to be more or at least as profitable as

[1] See Appendix for a discussion of the alternative data sources.

those of U.S. carriers but the aggregate data (ATA and SC data) shows that U.S. carriers had higher profit margins for every year except 1984 (data is not available for comparison in 1987 and 1988). This discrepancy suggests that larger U.S. carriers are more profitable than smaller U.S. carriers with respect to profit margins. Both data sources indicate that profit margins consistently decreased over the time period studied.

Table 2

Total Debt to Equity - Canadian and U.S. Trucking Industry

	Dun and Bradstreet			ATA and StatsCan	
Year	Can-All	Can-Lg	US	Can	US
1984	na	na	na	264%	132%
1985	178.9%	210.7%	109.8%	271%	133%
1986	170.2%	194.2%	117.0%	236%	128%
1987	191.5%	197.8%	119.2%	239%	na%
1988	192.9%	220.0%	106.3%	224%	na%
1989	184.5%	233.1%	109.2%	230%	122%
1990	178.4%	209.4%	113.9%	229%	121%
1991	164.6%	195.7%	128.6%	na	na

Table 3

Asset Turnover - Canadian and U.S. Trucking Industry

	Dun and Bradstreet			ATA and StatsCan	
Year	Can-All	Can-Lg	US	Can	US
1984	na	na	na	1.87	2.36
1985	2.04	1.93	2.56	1.82	2.25
1986	1.92	1.88	2.51	1.80	2.20
1987	1.84	1.83	2.62	1.79	na
1988	1.82	1.86	2.62	1.82	na
1989	1.83	1.83	2.68	1.81	2.06
1990	1.98	1.95	2.64	1.81	2.12
1991	2.10	2.01	2.86	na	na

The financial performance measure that combines both of these dimensions, asset turnover and profit margin, is the return on assets. Shown in Table 5, the median returns on

assets are more favourable to Canadian carriers, except during 1987 and 1989. The returns were noticeably higher in 1990 and 1991 for Canadian carriers. The aggregate data again presents a different story with Canadian rates of return on assets being less than U.S. returns for every year in which comparisons can be made.

Table 4

Profit Margin - Canadian and U.S. Trucking Industry

Year	Dun and Bradstreet			ATA and StatsCan	
	Can-All	Can-Lg	US	Can	US
1984	na	na	na	4.57	4.46
1985	3.60	3.61	3.00	4.25	4.37
1986	2.47	3.04	2.10	4.69	5.38
1987	3.10	3.26	2.90	4.02	na
1988	2.58	2.61	2.20	3.96	na
1989	2.40	2.23	2.40	3.18	3.51
1990	1.71	1.71	1.60	2.90	3.59
1991	1.72	1.61	1.40	na	na

Table 5

Return on Assets - Canadian and U.S. Trucking Industry

Year	Dun and Bradstreet			ATA and StatsCan	
	Can All	Can-Lg	US	Can	US
1984				8.6	10.5
1985	8.0	7.1	6.8	7.7	9.8
1986	5.6	6.2	4.8	8.4	11.8
1987	6.2	5.8	6.4	7.2	na
1988	5.3	5.5	4.8	7.2	na
1989	4.8	4.4	5.4	5.8	7.2
1990	7.0	4.0	3.8	5.3	7.6
1991	4.2	4.0	3.4		

The Price Waterhouse study recognized that as a result of a more highly leveraged capital structure, Canadian carriers are more exposed to interest costs. However, interest costs are deductible on corporate taxes. Interest costs are deducted from net profits and reduce the

return on equity. At the same time, the leverage increases the return to shareholders of the firm and therefore the return on equity. Table 6 shows that median rates of return on equity for Canadian carriers are consistently significantly above the returns for U.S. carriers. The returns on equity based on aggregate figures also indicate that Canadian returns are marginally higher than U.S. returns. However, these aggregate returns on equity calculations do not consider tax and interest payments which were unavailable.

Table 6

Return on Equity - Canadian and U.S. Trucking Industry

Year	Dun and Bradstreet			ATA and StatsCan	
	Can-All	Can-Lg	US	Can	US
1984	na	na	na	31.1	24.4 (13.6)
1985	31.4	24.5	15.9	28.6	22.9 (11.6)
1986	30.6	23.8	11.3	28.3	27.0 (14.0)
1987	26.8	21.2	15.8	24.4	na
1988	28.5	21.6	12.3	23.4	na
1989	21.0	16.2	13.1	19.0	16.1 (5.82)
1990	27.6	16.0	9.0	17.4	16.8 (8.29)
1991	18.6	14.3	10.0	na	na

Note: Figures in parentheses are true return on equity ratios net of taxes, interests and other non-operating transactions for the ATA population. All of the D&B figures are true return on equity ratios.

In summary, the financial performance of Canadian carriers relative to U.S. carriers appears to be reasonably good. Table 7 consolidates the financial performance statistics for the beginning and the end of the periods for which data was available from all three data sources. Based on the D&B median data, Canadian carriers are highly leveraged and turn over their assets less than U.S. carriers. However, they earn a higher profit margin which allows them to earn marginally higher returns on their assets. The higher degree of financial leverage benefits the median Canadian carrier and results in substantially higher returns on equity. Since profit margins were reduced substantially in 1990 versus 1985, the return on equity advantage was reduced commensurately. The aggregate data is consistent with respect to the leverage and turnover relationships. However, Canadian carriers show only a marginally higher profit margin in 1985 and a lower profit margin in 1991. The result is superior returns on assets for U.S. carriers. The return on equity for Canadian carriers still remains higher but the gap was substantially narrowed by 1990. The financial performance of Canadian trucking

appears to have been quite favourable relative to U.S. trucking during the latter half of the 1980s.

Table 7						
Financial Performance of Canadian and U.S. Trucking Industries						
Dun & Bradstreet Population						
	1985			1990		
	Can-All	Can Lg	US	Can All	Can Lg	US
Pop Size	529	321	2477	614	408	1841
Debt to Equity	178.9	210.7	109.8	164.6	195.7	128.6
Asset Turns	2.04	1.93	2.56	2.10	2.01	2.86
Profit Margin	3.60	3.61	3.00	1.72	1.61	1.40
ROA	8.0	7.1	6.8	4.2	4.0	3.4
ROE	31.4	24.5	15.9	18.6	14.3	10.0

StatsCan and ATA Population				
	1985		1991	
	Can	US	Can	US
Pop Size	3725	2102	1350	1629
Debt to Equity	264	132	229	121
Asset Turns	1.87	2.36	1.80	2.11
Profit Margin	4.57	4.46	2.90	3.60
ROA	8.6	10.5	5.3	7.6
ROE	31.1	24.4 (13.63)	17.4	16.8 (8.29)

III. Why are Canadian Carriers More Highly Leveraged than U.S. Carriers?

A. Theory

The analysis of the financial performance of the Canadian trucking industry in the

preceding section suggests that the high financial leverage of Canadian carriers has resulted in higher returns on equity to Canadian carriers. This section examines the various reasons firms choose a more highly leveraged capital structure and the applicability of these explanations to Canadian trucking vis-à-vis U.S. trucking.

Companies finance their operating and investment activities from equity sources or debt sources. Internally generated cash is the major source of funds in non-financial corporations. These sources of funds result in an increase in retained earnings, a component of stockholder's equity, when funds are needed to finance new investment. There is a decrease in retained earnings when the funds are needed to finance losses. The other component of shareholder's equity is stock holdings. Other relevant balance sheet items are short-term and long-term debt. Short-term debt includes accounts payable and other liabilities due in one year. For example, revolving loan accounts are structured for renewal each year and are considered short-term debt. Long-term debt includes notes payable over one year and capitalized leases. The largest asset group in the trucking industry is vehicles, much of which are financed with long-term debt over a four year or longer period (approximately the life of the vehicle).

Modern financial theory states that there is an optimal or shareholder value-maximizing capital structure that balances the risks and benefits of debt financing versus internal or equity financing. Some of the factors that affect the optimal capital structure are related to a firm's particular industry, while others are unique to a particular firm. Since some factors are common to all firms in an industry, we expect to find similarities in capital structures within a given industry but differences among industries. Although the U.S. and Canadian trucking industries compete to some degree in the transborder market and use the same technology, they face substantial differences in their domestic markets where the majority of their revenues are earned and face different regulatory environments. These factors may contribute to differences in capital structure policy.

The choice of capital structure is a function of both the firm which seeks a given structure and the capital market which supplies the debt or equity. On the assumption that both parties know the same information, both perceive the desired capital structure to be the same. The firm generally has a capital structure in mind. The benefit of externally financing a firm's operations and assets by issuing debt is primarily the tax deductibility of debt costs which makes debt financing cheaper than equity financing since equity returns are taxable. The firm will always seek to increase its debt since this will reduce the cost of capital and increase firm value. Offsetting these benefits are the risks induced in the earnings stream by increased debt.

Business risk "...is the single most important determinant of a firm's capital structure" (Brigham et al, 1987). Business risk is the uncertainty inherent in projections of future operating income or earnings before interest and taxes and is associated mainly with the industry in which the firm belongs and economic conditions. Business risk depends on a number of factors including variability in demand, sales price and input prices, and the ability to adjust output prices in response to changes in input prices. Business risk also depends on the extent to which costs are fixed or variable.

When a firm uses debt or increases its financial leverage, it concentrates (more of) its business risk on the shareholders of the firm. The use of financial leverage increases the sensitivity of the return on equity to changes in the return on assets. Thus, variability in the financial return to shareholders as measured by the rate of return on equity may increase but the potential financial returns increase as well.

Bankruptcy risk is the potential of the firm to go bankrupt when the firm's creditors seek liquidation of the firm in order to pay its debt obligations. The costs of bankruptcy include legal fees, accountants fees, administrative expenses, and other direct costs paid out during the liquidation and reorganization process. In addition, there are considerable indirect costs including the loss of earnings from foregone sales and the higher cost of doing business as suppliers perceive more risk in dealing with the firm. One study estimated indirect bankruptcy costs at more than 17 percent of the firm's market value and total bankruptcy costs exceeding 20 percent of firm value (Altman, 1984). A debt-free firm, of course, cannot be forced into bankruptcy. Therefore, the greater the use of debt financing and the larger the fixed interest charges, the greater the probability that a decline in earnings will lead to bankruptcy and the higher the chance of a bankruptcy related loss of value. Increased financial leverage increases financial risk and therefore business risk. A higher risk of bankruptcy leads to a lower amount of desirable debt. At some point the potential bankruptcy costs exceed the tax benefits of higher financial leverage.

B. Application

The discussion above suggests that the most important factors to examine are:

- differences in tax regulations between Canada and the U.S. that may encourage different capital structures; and
- differences in the economic and regulatory environments that impact the business risk inherent in Canadian domiciled versus U.S. domiciled carriers.

Tax Regulations

Varying tax laws between the two countries can affect firms' decisions regarding debt versus equity financing due to the implications of debt financing on tax shield advantages. Moreover, tax laws can affect firms' decisions regarding leasing versus buying equipment which in turn affect the debt to equity ratio.

Generalizations about the differences between corporate taxes in the two countries must recognize the constantly changing tax environments and the complex interaction between federal and state/provincial taxes. Prior to the U.S. Tax Reform Act of 1986, the federal corporate tax rate applicable to taxable income exceeding $100,000 was 46 percent in the U.S. as compared to the 36.9 percent in Canada. The federal corporate tax rate in the U.S. was higher than it was in Canada but when combined with the applicable state or provincial corporate taxes, Canadian corporate tax rates were typically higher. Provincial tax rates ranged from 10 to 16 percent in the mid 1980s and could change at any time. In Ontario, for example, the combined federal/provincial corporate tax rate was 43.8 percent in 1992 versus 47.4 percent in 1988. U.S. federal corporate taxes were reduced from 46 percent to 34 percent in 1987 after the passage of the Tax Reform Act of 1986. Studies have concluded that overall Canadian corporate tax rates were higher in Canada both before and after the revisions to federal taxes in both countries in the 1980s (McRae and Chow, 1987 and KPMG Peat Marwick Thorne, 1991). These tax comparisons suggest that Canadian carriers have a greater incentive to use debt than do their U.S. counterparts due to the greater benefit of tax deductibility of interest costs.

Research in the finance field has found that industries with higher tax shields (such as depreciation or depletion allowances) relative to total revenues, exhibit lower leverage ratios (Bowen, Daley, and Huber, 1982). U.S. carriers have more liberal depreciation schedules for their main asset, vehicles. For example, 90 percent of a vehicle can be depreciated within three years in the U.S. while it did take nine years in Canada and now seven years with recent tax changes. This depreciation allowance factor suggests that Canadian carriers would tend to exhibit higher leverage ratios.

Economic and Regulatory Environments

A number of factors that affect the business risk inherent in a firm were cited above. Low demand variability or high stability of sales and earnings increases the chances that a firm can meet its fixed charges and obligations. Sales price variability or volatility in prices increases the variability of earnings. Input price variability exposes the firm to a higher degree of risk. This is especially true when the ability to adjust output prices for changes in input prices is low. This factor is particularly important for industry during periods of high inflation in general and for trucking in particular during the 1980s due to fluctuations in fuel prices. Finally, the extent to which costs are fixed or variable is also important as fixed costs can increase business risk since they do not decrease when demand drops. The structure of assets plays an important role in this aspect of business risk in the firm. Firms with a high percentage of fixed assets cannot shift risks as easily as those with more operating assets in their capital structure. Some firms can sell their assets more easily to meet debt obligations. Therefore, some assets are better collateral for debt financing. In general, the greater the firm's liquidity, either from holding cash assets or from the convertibility of other assets to cash, the smaller its vulnerability to bankruptcy and the greater the willingness of such firms to undertake risks of leverage and for lenders to extend credit.

What technological environmental factors have affected these firm and industry specific sources of business risk? Both the Canadian and U.S. trucking industries use essentially the same technology. Vehicles are the main asset and vehicles have traditionally been viewed as suitable collateral for loans. However, the ownership characteristics of these assets may be different. Studies of transborder competitors indicate that Canadian trucking companies competing in the transborder market depend more on owner operators than U.S. carriers (Deloitte and Touche, 1991). For example, well-known U.S. transborder competitors such as J.B. Hunt and Schneider National, the so-called Advanced Truckload Firms (ATLFs), have operating strategies that use company-owned equipment and drivers rather than sub-contracted owner operators. The use of owner operators reduces the business risk of the carriers that use them since such inputs can be adjusted more easily when demand changes. In addition, the various methods of payment increase the ability of carriers to adjust input costs to match sales price variability. For example, when owner operators are paid on the basis of percentage of revenue, the price paid to owner operators is adjusted automatically when price competition drives rates down.

Perhaps the most important industry environmental factor that is significantly different between the U.S. and Canadian trucking industries is the regulatory environment. Regulation with respect to entry was relatively stable in Canada during the 1980s until the Motor Vehicle Transportation Act (MVTA) was implemented in 1988. In contrast, the U.S. trucking industry was in substantial turmoil during the 1980s as it adjusted to the newly deregulated environment that officially started in 1980. Thus, a crucial point is that the growing transborder market was

closed to new U.S. competition for the major part of the decade and U.S. carriers were prevented from providing single line direct service in the transborder market. The result was growth, high profits and earnings stability for the Canadian carriers in this market.

Rate regulation in Canada, particularly at the interprovincial level, has never been as formalized or as constraining as in the U.S. In fact, even after U.S. deregulation, the remaining rate oversight held by the Interstate Commerce Commission (ICC) still had some impact on the permissible rate increases that ICC regulated carriers could implement, for example, in response to changes in fuel prices. Canadian carriers did not have any of these constraints on rate flexibility.

In summary, the regulated environment in which Canadian firms operate has possibly led to a greater degree of sales stability and price and input cost flexibility and, therefore, to a greater ability to undertake debt. In contrast, creditors may have perceived future earnings variability to be higher in the U.S. than in Canada, so that the cost of debt was much higher or simply not available. Canadian companies, especially those in the transborder market in the mid 1980s, were perceived as growth companies that could reliably pay off debt-related obligations. In the end, firms that are viewed as having a high rate of profitability can undertake more financial risk as this profitability is an indication of the firm's ability to meet its debt obligations. Canadian firms, under the umbrella of regulation in the 1980s, certainly fit this description compared to U.S. trucking companies which continued to go through the turmoil of deregulation in the 1980s.

C. Future Research

There a number of other factors or explanations that could contribute to the pattern of financial leverage observed between Canadian and U.S. trucking industries. These factors are discussed here and recognize the need for future research in this area.

Carrier size

The typical carrier in Canada may be much smaller than the average U.S. carrier. As a consequence, the former may have greater difficulty in obtaining public equity and thus have to rely on debt financing. Equity financing, especially in the area of public stock offerings, involves significant transaction costs that are minimized by the size of the offering. Small firms may be more highly leveraged because the costs of issuing equity exceed those of debt financing or because access to equity markets is severely limited. In fact, few Canadian trucking companies have publicly traded stock.

Agency Costs

Agency costs arise because there is a separation of management from ownership. These costs arise and are incurred by shareholders or owners when the managers are not motivated to or do not maximize the value of the firm for the owners. One of the costs of bankruptcy is the risk that a manager might lose his job if the firm fails or performs poorly. A risk adverse manager might choose a safer degree of financial leverage than the shareholders might prefer. Thus, companies where management is different from owners may choose less

debt financing. Obviously, if managers and shareholders are the same (e.g. family owned enterprises), the agency problem is less since the interests of both coincide. In addition, if shareholders are concentrated, they are more likely to have the clout to effectively fire management and otherwise affect policy. We have little evidence about the differences in ownership patterns between Canadian and U.S. carriers other than anecdotal evidence that a larger percent of Canadian firms are managed by their owners than in the U.S.

Personal Taxes

The existence of personal taxes reduces the desire to use debt financing to provide a tax shield since residual profits are now taxed at the personal level. Canadian personal taxes are higher than U.S. personal taxes which lead to a bias towards less debt financing in Canada. As noted in Lusztig et al (1994) "(a)lthough interest typically is taxed as normal income, the effective tax rate on dividends is reduced through the dividend tax credit, and capital gains are often not taxed at all." Thus, the value of using debt is reduced in Canada by the presence of personal taxes. The impact of such taxes on reducing debt financing in the Canadian trucking industry is a future area for investigation.

Leasing Regulations

Leasing is another form of debt financing. One advantage for firms using leasing was that leases were at one time considered off-balance sheet financing because the lease contracts allowed the firm to leave both the asset and the liability off the balance sheet. This convention made the firm look less leveraged than it really was. This situation was corrected in Canada when the Canadian Institute of Chartered Accountants (CICA) issued, in December 1978, an acceptable treatment of leases. Section 3065 of the CICA handbook requires firms who enter into financial (capital) leases to report the leased payment as a fixed asset, and the present value of future lease payments as a liability. The U.S. has similar guidelines but it appears that the U.S. guidelines are recommendations rather than requirements.[2] Thus, many debt obligations in the U.S. may not be reported. It is possible that U.S. carriers have understated their financial leverage.

Unfunded Pension Liabilities

The Multi Employer Pension Plan Act become effective just as the U.S. trucking industry became deregulated. The effect of the act was to place new burdens on many U.S. motor carriers which had unfunded liabilities for their employee pension plans. These obligations had priority over most creditor liabilities and made business risk even higher for U.S. carriers, especially unionized carriers who tended to have the largest unfunded liabilities. The long-term debt of many U.S. carriers may have been understated but more importantly, the unfunded debt caused potential creditors to decrease availability of low cost or unencumbered debt financing.

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[2] See CICA Handbook (December 1978) Section 3065, and Certified Accountants-Canada GAAP Guide (1984) Section 3065, for more information on Canadian rules versus U.S. rules.

Financing Cycle and Bankruptcy Laws

Another explanation for the high debt levels of Canadian carriers is tied to the past and continuing poor financial performance of the Canadian trucking industry. The rationale is that profits in the industry have been so dismal that investors are reluctant to provide equity financing to carriers. Thus, carriers are forced to rely on debt financing and consequently pay premium rates to obtain such financing. Alternatively, Canadian motor carriers may be financing current losses from retained earnings (undistributed profits). However, U.S. motor carriers experienced the same problem during the 1980s. Instead of the amount of debt in the capital structure increasing, it decreased, as carriers exited the industry through bankruptcy or voluntary closure. A potential area for future investigation is how bankruptcy laws encourage firms to exit the industry in each country.

Economic Cycles

The economy affects earnings stability. The Canadian economy has generally mirrored the U.S. economy; thus, trends in capital structure should be similar between the two countries when other factors are held equal.

IV. Conclusions and Implications

The Canadian trucking industry is indeed more highly leveraged than its U.S. counterpart. However, this higher level of debt in the capital structure appears to have resulted from the expected response of Canadian trucking management to a tax environment that encouraged debt and a regulatory environment that reduced business risk and encouraged debt financing throughout much of the 1980s. Canadian carriers enjoyed substantially superior returns on equity over this period.

That environment changed with the passing of the MVTA which encouraged competition in the Canadian domestic trucking market and opened transborder trucking to U.S. entry. The high profit margins and returns that Canadian carriers enjoyed were reduced to levels approaching those of U.S. carriers. Canadian carriers will as a natural course of business reduce their financial leverage as the expected profits become less certain and lower. However, the tax environment, as it exists today, may still encourage Canadian carriers to hold higher levels of debt than their U.S. competitors.

How a highly leveraged capital structure affects the competitiveness of Canadian carriers versus U.S. carriers cannot be determined simply from the existence of higher debt financing costs. The relevant concern is the weighted cost of capital and as long as debt costs are lower than the cost of equity because of tax considerations, the firm is assumed to be better off with higher leverage than with lower leverage. Potential concerns such as the higher cost of debt as financial leverage is increased should be already factored into the decision of the firm to increase or decrease leverage.

These preliminary conclusions form the basis for future research in this area. A number of other factors that affect the capital structure decision were discussed and deserve consideration in future empirical analyses of this subject.

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Appendix A

Note on Alternative Data Sources for
Financial Data on Canadian and U.S. Trucking

Two different sources of data were used to make the financial performance comparisons. Dun and Bradstreet (D&B) maintains financial statements of many lines of business including trucking in both Canada and the U.S. The data for SIC 4213 Trucking, Long distance, was obtained for Canada and the U.S. The population sizes are shown in Table A.1. In addition to the total Canadian carriers listed by D&B, the number of Canadian carriers with assets greater than $250,000 (Cdn) are shown separately. Examination of the median net sales for each group shows that the average size of a U.S. carrier in the total U.S. sample is significantly larger than the average size of a Canadian carrier in the total Canadian carrier sample. Table A.2 compares the estimated revenues of the Canadian carriers with assets exceeding $250,000 with the median revenues of the U.S. sample. Considering the exchange rate difference, the median revenue sizes of both carrier groups are comparable. We note that the largest U.S. carriers are more than five times the revenue size of the largest Canadian carriers.

The advantages of the D&B data are:

- completely identical financial accounting procedures are used;
- the data on similar groups of carriers (intercity and long distance) are available for comparison;
- the data contains selected financial ratios dealing with equity and after-tax returns not available from other sources; and
- the data is collected independently of regulatory requirements although any publicly available data source may have been used.

The D&B information was only available in aggregate form with median values for all balance sheet and income statement figures and financial ratios. Financial ratios are true median figures and not estimated from the median balance sheet and income statement figures.

Statistics Canada (SC) and the Interstate Commerce Commission (ICC) collect income and balance sheet information annually in their respective jurisdictions. SC publishes aggregated summaries for intercity for-hire trucking annually while the American Trucking Associations Inc. (ATA) publishes individual and aggregate data series from the ICC data. For comparative purposes, statistics from the "Total All Carriers" grouping was used from the ATA source. The population sizes for both sources are shown in Table A.2. Two weaknesses are evident. First, the minimum size carrier in the SC data series is much smaller than that used by the ICC. Not until 1990 was a revision made in Canada to exclude Class III carriers from reporting and therefore from the data tabulation. This exclusion is reflected in the large drop in the population size in 1990. Second, the ICC minimum size classification for reporting purposes has been and remains higher than for Canadian carriers, thus eliminating many of the smaller U.S. carriers from the data series. Nonetheless, it is still a legitimate observation that most of the Canadian carriers that would compete with U.S. carriers for transborder traffic are smaller than their U.S. counterparts.

The data from SC and ATA are aggregated into total industry statistics. The combination of this data with the D&B data permits a more robust conclusion to be made if they are consistent with each other and provides a caution if they are inconsistent.

Table A.1

Population Sizes of Various Carrier Populations

	Dun and Bradstreet			ATA and StatsCan	
Year	Can-All	Can-Lg	US	Can	US
1984	na	na		3725	2102
1985	529	321	2477	4518	1905
1986	564	332	1732	4424	1778
1987	616	408	1881	4851	na
1988	552	344	2396	4245	na
1989	680	419	2343	4010	1567 (1390)
1990	614	408	1841	1350	1629 (1409)
1991	590	394	1763		

Note: Figures in parentheses exclude local carriers.

Table A.2

Median and Mean Revenues for Various Carrier Populations

	Dun and Bradstreet		StatsCan and ATA	
Year	Can-Lg	US	StatsCan	ATA
1984			1,717,975	19,485,834
1985	2,732,766	1,365,933	1,631,995	20,892,192
1986	2,326,748	1,698,859	1,748,446	23,150,805
1987	2,131,020	1,851,340	1,714,954	na
1988	2,214,259	1,919,448	2,017,712	na
1989	2,173,485	1,958,568	2,231,955	29,781,761
1990	2,330,880	2,139,200	6,239,704	31,726,605
1991	2,393,404	2,490,450		

Note: All figures in respective currency of country.

Owner Operators in Canada: Who are these guys?

Andrea Mathieson, Statistics Canada

Synopsis

The Canadian trucking industry has undergone a series of changes in the past few years. Through it all, owner operators have been an integral, if volatile, part of the industry. Since deregulation in 1987, it has been relatively easy to enter the trucking industry; put your money down, buy a truck and you are in business. While administrative (tax) data provide information on small carriers, it is not possible to distinguish an owner operator from a small for-hire carrier, using only this data source (1).

Trucking has evolved in recent years in response to a more competitive climate, and an owner operator now may operate more than one piece of equipment, take on other drivers, and generally appear to behave like a for-hire operation. Since the genesis of the owner operator cooperatives across Canada, there has been a shift toward more sophisticated business practices among owner operators (2).

This paper will present, through the use of administrative and survey data, a portrait of Canadian owner operator activity in 1991. Financial data gathered from tax files will be combined with operational characteristics gathered from a telephone survey of truck operations earning between $25,000 and $1 million in annual gross operating revenues. The methodology employed in this study is presented in the Appendix.

So, who are these guys?

The Canadian for-hire sector saw a shakeout in its ranks in the late eighties, as trucking companies struggled to cope with more new entrants competing for less freight. As the economy spiralled into recession, there were fewer shippers in the market, and they were wooed by both Canadian and American carriers. Despite tough economic times, owner operators remained significant contributors to road freight transportation, through their work for for-hire carriers as shown below (this does not include the expenses of private truckers on owner operators).

Year	Owner Operator Expenses, $'000
1991	1,926,855
1990	2,059,315
1989	2,299,601
1988	2,107,309

source: Statistics Canada, Motor Carriers of Freight Survey

While we know how much for-hire carriers spent on o-o's, there is precious little other information on this latter group of truckers. The "traditional" owner-operators were individuals who purchased or leased a truck and sold their services to carriers (for-hire or private), as opposed to a for-hire operation which hired drivers to operate its equipment; hence the name "owner-operator".

An important point to remember when interpreting these results is the survey respondents were asked whether they considered themselves an owner operator or a for-hire trucker. While respondents may interpret these terms differently, they (as opposed to the survey-taker) classified themselves.

In 1991, there were nearly 35,000 owner operators in Canada, generating over $4 billion in revenues. Most of these truckers (84%) hauled general freight for 80% of owner operator revenues (see Table 1). While owner-operators logged significant distances (4.7 billion kilometres in 1991), much of their earnings were generated by intraprovincial movements.

Of the 35,000 owner operators on the road in 1991, nearly 11,000 were incorporated. Given the significant capital investment required to purchase modern equipment, this is a wise move which limits the operator's liability in difficult times. These incorporated operations appear to be more serious undertakings, evidence of which can be found in the relative earnings of incorporated versus unincorporated owner operators.

Looking at both incorporated and unincorporated operations will reveal some basic characteristics of both. Many of the traditional one man/one truck operations are still going strong, but larger owner operators are picking up bigger chunks of freight through more aggressive practices.

Where's the big money?

Tables 2 and 3 demonstrate the composition of the unincorporated and incorporated components, using revenue groupings. As may be expected, the bulk of the unincorporated operations are in the bottom two revenue groups.

Unincorporated operations -
Some 63% of unincorporated owner operators earned between $25,000 and $100,000 from trucking in 1991 (see Table 2). While some of these are part-time truckers, the fact remains that most of these operators are barely making enough to keep a truck on the road.(3) The average earnings of this group ranged from $55,000 in the Territories to $63,500 in British Columbia. The proximity of British Columbia to the US market is likely a factor in this relatively bright picture on the west coast. Small British Columbia owner operators earned $22 million from transborder movements, second only to Ontario in this revenue group.

Over one-third of unincorporated owner operators earned between $100,000 and $250,000. These operations were located primarily in Ontario and the Prairie provinces. Average earnings ranged from $129,000 in Quebec to $179,000 in the Territories. These truckers travelled primarily intraprovincial routes accounting for 62% of revenues. Interprovincial activity generated 20% and transborder movements were also significant at 18%.

The high earners are distributed across the country, with the many in the Prairies. While the west coast operators benefited from transborder activity, the main source of income for high-end prairie operations was intraprovincial transport of commodities including petroleum and agricultural products.

Incorporated operations -
These operations represent only 31% of owner operators, however, they netted close to half of reported earnings. The distribution of these operations by size is somewhat different from unincorporated ones, with half of the operations in the $250,000 to $500,000 range. There were over 200 owner operators reporting revenues between $750,000 and $1 million, which would indicate phenomenal success for a "traditional" (one truck) owner operator (see Table 3), however, these operations are usually associated with small fleets of trucks.

While these high-end ($750,000 to $1 million) operators consider themselves owner operators, they had, on average, seven trucks on the road in 1991. These 221 operations generated $203 million in revenue, primarily from intraprovincial movements. The highest average earnings were chalked up by Ontario-domiciled owner operators, at $981,000, while Quebec and British Columbia were below the national average revenue of $918,000. While some industry analysts may consider these to be for-hire companies, it is important to remember that these respondents consider themselves to be owner operators. There may be regulatory or business reasons for this, but these are beyond the scope of this paper.

It is interesting to note that some 3,500 operators making between $25,000 and $100,000 chose to incorporate their business. The high degree of uncertainty associated with the trucking business is, no doubt, a factor behind this decision. Though it is easy to purchase a truck, it is by no stretch a small investment. Indeed, these small operators paid $40 million in interest charges in 1991, which represents 16% of their operating expenses.

Half of incorporated Canadian owner operators earned between $100,000 and $250,000 in 1991, with a national average revenue of $148,000. These were distributed across the country, with the largest component domiciled in Quebec. Quebec operators, while strong in numbers, earned the lowest average income at $138,000, mainly from intraprovincial movements. Transborder business netted $97 million, or 12% of total earnings for this revenue group.

What do they haul?

The owner operators responding to the telephone survey hauled mostly general freight. Definitions notwithstanding (general freight is commonly carried in dry vans), the perception of 84% of owner operators is that they carry general freight. Those who indicated the use of specialized equipment (e.g., reefers) were placed in another category. Incorporated and unincorporated operations are treated together in this part of the analysis.

The overall national average income for Canadian owner operators was $123,000 in 1991, however, when type of service is taken into account, the average ranges from $116,000 to $227,000 (see Table 4). General freight carriers earned 6% below the overall average, while transportation of household goods and bulk liquids paid well above the national average, at $227,000 and $175,000, respectively. A contributing factor to this

difference is the additional training required to handle bulk liquids such as chemicals and petroleum products, which allows these owner operators to command higher wages.

A similar situation is observed in for-hire trucking in recent years. Specifically, general freight carriers have not fared as well as their counterparts in the specialized trade. (4) This, plus the owner operator situation presented above, may point to persistent overcapacity in the general freight market, which should diminish as the less efficient carriers and owner operators are squeezed out of operation.

Intra- vs. Interprovincial Operations

The business of hauling commodities by truck in Canada remains regulated, in that a carrier or owner operator must adhere to safety regulations, and must carry a license to operate. Trucks that operate beyond their province of domicile require a different license than those that remain within their home province.

Intraprovincial carriers do business within their province or domicile, and can obtain trip permits to make the odd run into another jurisdiction. Extraprovincial carriers carry a variety of licenses to operate in various provinces or states. Obviously a carrier or owner operator with an extraprovincial license can offer a wider variety of services to shippers, and can therefore be expected to earn more.

Long hauls are seen as generating higher revenues than local routes, although there is a trade-off involved. A local driver can work in the vicinity of his home, whereas a linehaul driver is away from the home base and family a lot more. While not all intraprovincial routes are local, it can be safely assumed that all local routes are included in the intraprovincial estimates. It should follow, therefore that the intraprovincial owner operators will earn less than extraprovincial ones. In fact, this was the case in 1991, as can be seen in Table 5.

For both unincorporated and incorporated owner operators, the pattern is similar: intraprovincial carriers generally have lower revenues than extraprovincial ones.

While general freight is most evenly distributed between intra- and extraprovincial operators, forest products and dry bulk materials are predominantly hauled by intraprovincial truckers, presumably from an extraction or logging site to a smelting facility or sawmill within the

region. Owner operators transporting bulk liquids are also predominantly intraprovincial truckers. Since the most common materials carried in tanks include milk destined for local dairies and petroleum for local homes and gas stations, this is not surprising.

The "other" category saw more extraprovincial than intraprovincial activity; this category includes transportation of automobiles, agricultural products and other products requiring specialized equipment.

Why so many trucks on the road?

As a rule, the smaller owner operators operate a single truck, however, the larger, especially incorporated, owner operators appear to operate entire fleets of as many as eight trucks. In the case of dump trucking, it may be necessary for an operator to have more than one vehicle configuration for hauling different types of aggregates or other materials. This flexibility, however, comes at a cost.

The smaller operations (earnings between $25,000 and $250,000) had, on average, one vehicle on the road. One truck or tractor, therefore, generated average gross revenues ranging from $50,000 to $166,000 for incorporated owner operators and $55,000 to $179,000 for unincorporated ones (see Table 6).

Operators earning between $250,000 and $500,000 generally had two or three trucks on the road. The corresponding jump in gross revenues is significant; these owner operators brought in over $300,000 on average.

As the fleet sizes and earnings climb from this point on, one may wonder if we are still dealing with owner operators. The respondents call themselves owner operators, perhaps for lack of a better term, since they own and operate a fleet, most likely with the assistance of (company) drivers. There appears, however, to be a clear distinction at the $250,000 earnings mark between "real" owner operators and for-hire fleets. As this survey continues and the time series grows, this delineation may move upwards; it will be something to watch in the future.

What else can we learn?

Though it has its limitations (see Appendix), this data can reveal other characteristics of owner operators. While the financial (tax) data cannot be used in its present state for comparative costing or profitability studies, the combination of operating characteristics and selected financial data

can be instrumental in the increased understanding of and formulation of policy concerning owner operators.

The 1992 Trimac study on Ontario owner operators zeroed in on possible strategies for industry and government action. Further examination of this Statistics Canada data set and the addition of successive years' data will produce a better time series on owner operators. Breaking the data set into operators above and below $250,000 gross revenue should assist in targeting analysis and development-related decisions for Canadian owner operators.

Table 1.

Owner Operators in Canada, 1991

Estimated Number of Incorporated and Unincorporated Owner Operators, by Province and Territory

	Incorporated		Unincorporated	
Province/ Territory	**Number**	**Revenue $'000**	**Number**	**Revenue $'000**
Newfoundland	150	23,978	376	31,391
Prince Edward Island	48	8,852	144	15,786
Nova Scotia	196	40,336	945	102,421
New Brunswick	344	84,445	1,314	152,867
Quebec	3,024	465,480	2,428	206,398
Ontario	2,718	530,698	8,824	793,810
Manitoba	218	54,048	1,332	141,222
Saskatchewan	448	84,643	922	96,589
Alberta	1,839	338,232	3,379	339,185
British Columbia	1,912	326,763	4,094	416,571
Yukon	12	1,397	19	1,764
Northwest Territories	14	3,667	12	1,229
Canada Total	10,922	1,962,540	23,790	2,299,233

Table 2.

Owner Operators in Canada, 1991

Estimated Number of Unincorporated Owner Operators by Revenue Group

Revenue Group	Region	Number	Average Revenue $	Intraprov. Revenue	Interprov. Revenue – $'000 –	International Into Canada	International Out of Canada
25K-100K	Atlantic	1,452	62,904	70,630	11,281	1,964	7,461
25K-100K	Quebec	1,732	58,732	93,527	3,004	1,119	4,085
25K-100K	Ontario	5,913	60,102	297,000	16,674	10,880	30,412
25K-100K	Prairies	3,369	56,149	162,000	14,917	5,717	6,279
25K-100K	BC	2,429	63,489	125,000	7,301	12,102	10,141
25K-100K	Territories	21	54,543	1,031	96	14	-
Total		14,916					
Average			59,867				
100K-250K	Atlantic	1,208	140,011	87,461	43,924	16,347	21,362
100K-250K	Quebec	630	128,621	51,053	13,805	6,286	9,931
100K-250K	Ontario	2,681	129,992	204,000	61,327	40,880	42,265
100K-250K	Prairies	2,081	148,233	173,000	93,994	17,597	23,773
100K-250K	BC	1,565	141,380	181,000	16,629	8,178	15,133
100K-250K	Territories	10	179,261	1,316	258	118	160
Total		8,176					
Average			138,251				
250K-500K	Atlantic	101	317,029	23,042	5,990	1,251	1,672
250K-500K	Quebec	66	357,853	19,944	45	1,184	2,413
250K-500K	Ontario	210	376,510	46,372	23,678	5,342	3,707
250K-500K	Prairies	107	313,081	25,614	6,195	944	658
250K-500K	BC	72	335,873	23,092	877	96	207
Total		556					
Average			346,046				
500K-750K	Atlantic	18	558,171	9,212	497	99	199
500K-750K	Ontario	19	562,029	9,146	1,641	-	-
500K-750K	Prairies	72	570,728	39,447	725	404	422
500K-750K	BC	27	619,838	14,068	2,588	-	114
Total		136					
Average			577,614				
750K+	Prairies	6	900,193	4,906	89	-	-

Table 3.
Owner Operators in Canada, 1991
Estimated Number of Incorporated Owner Operators by Revenue Group

Revenue Group	Region	Number	Average Revenue	Intraprov. Revenue	Interprov. Revenue	International Into Canada	International Out of Canada
			$			– $'000 –	
25K-100K	Atlantic	190	59,703	10,664	128	105	476
25K-100K	Quebec	1,155	69,119	71,875	5,434	1,232	1,281
25K-100K	Ontario	887	65,452	46,945	573	3,190	7,352
25K-100K	Prairies	748	77,187	42,632	1,356	6,853	6,858
25K-100K	BC	577	67,567	35,625	1,002	1,080	1,259
25K-100K	Territories	6	49,208	278	-	17	17
Total		3,563					
Average			69,107				
100K-250K	Atlantic	383	162,400	37,560	13,664	5,292	5,743
100K-250K	Quebec	1,438	137,801	141,076	31,458	15,342	10,237
100K-250K	Ontario	1,250	141,946	127,900	10,032	11,591	27,881
100K-250K	Prairies	1,299	159,335	150,194	39,251	10,333	7,122
100K-250K	BC	1,028	147,806	138,806	9,441	1,815	1,946
100K-250K	Territories	13	165,733	1,712	379	8	14
Total		5,411					
Average			147,637				
250K-500K	Atlantic	74	362,627	19,655	6,195	495	519
250K-500K	Quebec	310	335,061	89,676	5,153	6,213	2,932
250K-500K	Ontario	318	332,621	87,084	8,669	3,679	6,252
250K-500K	Prairies	299	349,533	67,084	20,329	7,963	9,249
250K-500K	BC	235	341,674	72,974	4,850	570	1,956
250K-500K	Territories	6	411,958	2,602	40	-	-
Total		1,243					
Average			341,220				
500K-750K	Atlantic	72	560,766	13,917	9,296	7,340	9,658
500K-750K	Quebec	85	628,713	38,900	5,179	3,158	6,197
500K-750K	Ontario	182	602,048	87,901	17,034	2,200	2,323
500K-750K	Prairies	120	596,623	55,905	12,747	1,236	1,687
500K-750K	BC	26	600,732	9,637	5,533	-	225
Total		484					
Average			599,200				
750K+	Atlantic	18	952,207	15,950	916	-	38
750K+	Quebec	36	839,717	18,825	2,600	4,357	4,357
750K+	Ontario	82	981,052	59,324	18,070	1,344	1,344
750K+	Prairies	40	907,383	34,174	1,844	31	31
750K+	BC	46	862,959	37,958	1,353	-	735
Total		221					
Average			917,856				

Table 4.

Owner Operators in Canada, 1991

Estimated Number of Owner Operators and Revenue by Type of Service

Type of Service	Number	Total Revenue	Average Revenue
		$'000	$
General Freight	29,217	3,389,707	116,018
Household Goods	376	85,508	227,414
Bulk Liquid	841	147,609	175,515
Dry Bulk	1,815	260,353	143,445
Forest Products	2,087	324,764	155,613
Other	376	53,833	143,173
Total	34,712	4,261,772	122,775

Table 5.
Owner Operators in Canada, 1991
Estimated Number of Owner Operators and Average Earnings,
by Type of Service: Intra- and Extraprovincial

Type of Service		Incorporated		Unincorporated	
		Number	Average Revenue $	Number	Average Revenue $
General Freight	Intra	4,793	144,675	12909	80,286
	Extra	3,668	193,586	7848	121,127
Household Goods	Intra	119	357,758	130	73,713
	Extra	54	391,072	72	169,913
Bulk Liquid	Intra	371	238,587	360	101,513
	Extra	90	233,822	21	71,621
Dry Bulk	Intra	583	222,138	979	79,979
	Extra	152	282,977	101	94,398
Forest	Intra	772	191,599	989	121,621
	Extra	94	245,776	232	144,240
Other	Intra	70	210,603	125	76,281
	Extra	157	223,311	24	85,369

Table 6.
Owner Operators in Canada, 1991
Estimated Revenue and Number of Vehicles, by Revenue Group

Revenue Group	Region	Unincorporated Average Revenue $	Unincorporated Number	Unincorporated Average Vehicles no.	Incorporated Average Revenue $	Incorporated Number	Incorporated Average Vehicles no.
25K-100K	Atlantic	62,904	1,452	1	59,703	190	1
25K-100K	Quebec	58,732	1,732	1	69,119	1,155	1
25K-100K	Ontario	60,102	5,913	1	65,452	887	1
25K-100K	Prairies	56,149	3,369	1	77,187	748	1
25K-100K	BC	63,489	2,429	1	67,567	577	1
25K-100K	Territories	54,543	21	1	49,208	6	2
100K-250K	Atlantic	140,011	1,208	1	162,400	383	2
100K-250K	Quebec	128,621	630	1	137,801	1,438	1
100K-250K	Ontario	129,992	2,681	1	141,946	1,250	1
100K-250K	Prairies	148,233	2,081	1	159,335	1,299	2
100K-250K	BC	141,380	1,565	1	147,806	1,028	2
100K-250K	Territories	179,261	10	2	165,733	13	2
250K-500K	Atlantic	317,029	101	3	362,627	74	3
250K-500K	Quebec	357,853	66	3	335,061	310	2
250K-500K	Ontario	376,510	210	3	332,621	318	4
250K-500K	Prairies	313,081	107	3	349,533	299	3
250K-500K	BC	335,873	72	2	341,674	235	3
250K-500K	Territories	...	...	...	411,958	6	4
500K-750K	Atlantic	558,171	18	8	560,766	72	5
500K-750K	Quebec	...	...	...	628,713	85	4
500K-750K	Ontario	562,029	19	7	602,048	182	6
500K-750K	Prairies	570,728	72	5	596,623	120	5
500K-750K	BC	619,838	27	4	600,732	26	3
750K+	Atlantic	...	...	...	952,207	18	4
750K+	Quebec	...	...	...	839,717	36	7
750K+	Ontario	...	...	...	981,052	82	5
750K+	Prairies	900,193	6	7	907,383	40	9
750K+	BC	...	...	...	862,959	46	8

... = not applicable

Appendix

Methodology and Data Limitations

These data were gathered as part of the Annual Motor Carriers of Freight survey, conducted by Statistics Canada. While for-hire truckers earning $1 million or more in annual gross operating revenue are surveyed via an annual census, the smaller carriers and owner operators are sampled. The survey was first conducted for reference year 1990.

Small truckers are classified as earning between $25,000 (minimum income on Statistics Canada's Tax data file) and $999,999. These individuals or corporations are sampled using a two-stage sampling process, whereby estimates can be generated for both for-hire carriers and owner-operators at the provincial level.

Sampled tax records are transcribed by Statistics Canada staff and each tax filer is contacted by telephone to obtain operational characteristics not contained in the tax return.

Major variables on the **tax return** include revenues, salaries, interest paid and a number of other individual financial variables. Since the tax file is an administrative data source, these variables are not treated consistently from one trucker to another. For example, fuel may be reported as ***fuel*** by one taxfiler, and as ***other*** by someone else. For this reason, the present analysis was restricted to total revenues and expenses. Interest, however, appears to be consistently reported, and this variable was isolated in the analysis.

With owner operators, there is the additional complication of how they report their own remuneration. Self-employed truckers do not report a salary, but they pay themselves out of company profits. Expenses are understated as a result, and operating ratios cannot be relied upon for analytical purposes. Further study of the tax file may improve the treatment of these reporting issues.

The **telephone survey** collected information on the area of operation, type of service and equipment/employees in service, as well as distance travelled and fuel consumed. A computer-assisted telephone interview system scheduled interviews and edited data on-line to minimize call-backs. Since the operator himself was often on the road, the spouse was often the respondent.

Endnotes:

1. A previous study of taxation data pointed out that the tax source is not sufficient for identifying for hire truckers and owner operators separately, since this identification is not required for taxfiling purposes.

2. The business practices of "successful" owner operators that were observed are given on page 49 of the Trimac study entitled, "Success Strategies for Owner Operators"

3. ibid, pp. 44-48 for cost calculations

4. Statistics Canada's Quarterly Motor Carriers of Freight survey indicates a higher (i.e., worse) operating ratio for specialized carriers over a number of quarters dating back to late 1990.

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The opinions expressed in this paper are solely those of the author, and in no way reflect the policies of either Statistics Canada or Revenue Canada, Taxation.

THE STABILITY/EFFICIENCY REGULATORY TRADE-OFF: POLICY IMPLICATIONS FOR FOR-HIRE TRUCKING

Dr. Barry E. Prentice*

Introduction

Highway protests and border blockades were staged by Canadian truckers in 1990 and 1991 to highlight their complaints about low earnings and "unfair" U.S. competition. A Task Force that was created by the Federal Minister of Transport found no evidence of unfair competition or loss of market share to U.S. carriers, but the lack of profits in the Canadian trucking industry was confirmed (Heads, Prentice and Harvey, 1991). The events that created economic problems for the trucking industry were identified to be the severe economic recession which began in 1989, the rapid rise in the exchange rate value of the dollar after 1987, and the adjustment of the industry to changes in the regulatory environment.

The current economic recovery and the devaluation of the dollar have returned profitability to the Canadian trucking industry, but the prospects of adequate incomes may be short-lived for the carriers. The new regulatory environment that was introduced by the Motor Vehicle Transport Act (MVTA) of 1987, removed the restraint on supply that was critical to the trucking industry's stability. The change to a more perfectly competitive market structure makes the Canadian trucking industry more susceptible to the business cycle. Without regulation, the profitability of the truckload (TL) sector of for-hire trucking may be procyclical, like the airline industry where the expansion and contraction phases of the general economy amplify its instability.[1]

Regulatory reform has improved the efficiency of the motor carrier industry, but it has been introduced without establishing any programs or institutions to deal with the structural instability that the previous system effectively controlled. The purpose of this paper is to set out the conceptual framework for the examination of the change in the economic stability of the motor carrier industry. The paper begins with a conceptual model of the instability/efficiency regulatory trade-off frontier. Subsequently, stylized supply and demand models are used to outline the inherent instability/efficiency trade-off that confronts the regulation of the trucking industry. The policy implications of this trade-off are discussed and avenues for dampening the

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instability of the TL sector of the industry are considered. One of these alternatives, the development of an efficient information market, is described in the final section.

Instability/Efficiency Regulatory Trade-off Frontier

The conceptual model of the stability/efficiency trade-off is presented in Figure 1. The X-axis represents the range of regulatory options from zero intervention to complete control. At the extreme of zero intervention the rule of law would barely exist and the government would approach a state of anarchy. At the other extreme of complete control, the level of regulation would characterize the capitalist countries during periods of war, or the excesses of state planning exhibited by former Communist states.

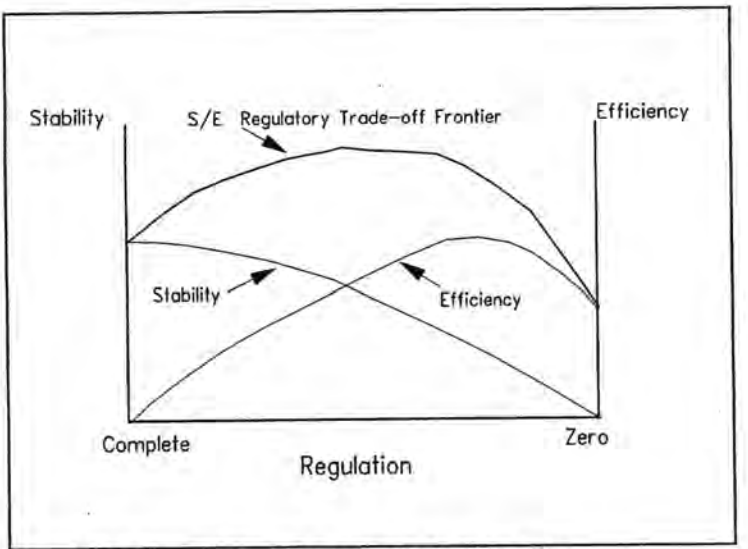


Figure 1 Stability/Efficiency Regulatory Trade-off Frontier

The left Y-axis represents increasing degrees of stability, while the right Y-axis depicts different levels of efficiency. Maximum stability can be assumed to occur with complete regulation. Over time however, too much stability can lead to stagnation and the capitalization of fixed factors of production. Therefore, complete regulation is also consistent with the point of minimum efficiency.

The point of maximum efficiency likely occurs with some level of regulation. Without regulation, the market participants can be confronted with the kinds of

"prisoner's dilemma" games as described in the case of truck weight regulation by Hildebrand, Prentice and Lipnowski (1990). At the extreme of zero intervention, the lack of regulation forces all players to chose defensive courses of action that reduces their efficiency. Stability also declines as the state reduces regulation and reaches its lowest point with zero intervention.

The relationship between the level of regulation and the corresponding stability/efficiency outcome depends on the institutional framework of the country. Both curves are hypothesized to be concave to the origin, but their exact shape is indeterminate. Changes in the underlying institutional framework and enforcement of regulations can alter the curvature and level of the stability and efficiency relationships. The stability/efficiency (S/E) regulatory trade-off frontier is formed by the vertical addition of the two curves.

The level of regulation is set by the government based on political perceptions of society's preferences. Social indifference curves are theorized to exist that represent the preferences of the public with respect to different levels of stability and efficiency. A family of social indifference curves I_1 to I_4, which represent the public's willingness to trade off stability and efficiency, is presented in Figure 2. The social indifference curves represent higher levels of public satisfaction (i.e. $I_4 > I_3$). The optimal amount of regulation, R_3, is determined at point A, where the highest social indifference curve, I_3, is tangent to the S/E regulatory frontier.

With the level of regulation at R', the public operates on the social indifference curve I_2. If the politicians correctly follow the society's mood,[2] the public will be happier with the change in circumstances from point B to point A. However, politicians are reluctant to make regulatory changes because the stability/efficiency trade-off is a long run relationship. In the short run, a move to reduce regulation may increase efficiency with very little change in stability. But, as the industry adjusts to the new competitive environment, the loss of stability is likely to become more pronounced. The next section examines the case of the change in the entry regulation of the truckload sector, and its likely impacts on the S/E frontier.

Entry Regulation in Trucking

Operating certificates have been the principal method of economic regulation used by governments to stabilize the for-hire trucking industry. Operating certificates are legal documents that specify each carrier's latitude to engage in for-hire trucking. The limitations imposed by operating certificates may include the types of equipment used, the range of commodities carried, the geographic boundaries of a carrier's market and even individual shippers served. Normally, any operation not specified in a carrier's operating authority is assumed to be prohibited. By controlling the scope of operations undertaken by individual truckers and restricting the total number of carriers serving each market, government regulation effectively stabilized the supply of for-hire trucking industry.

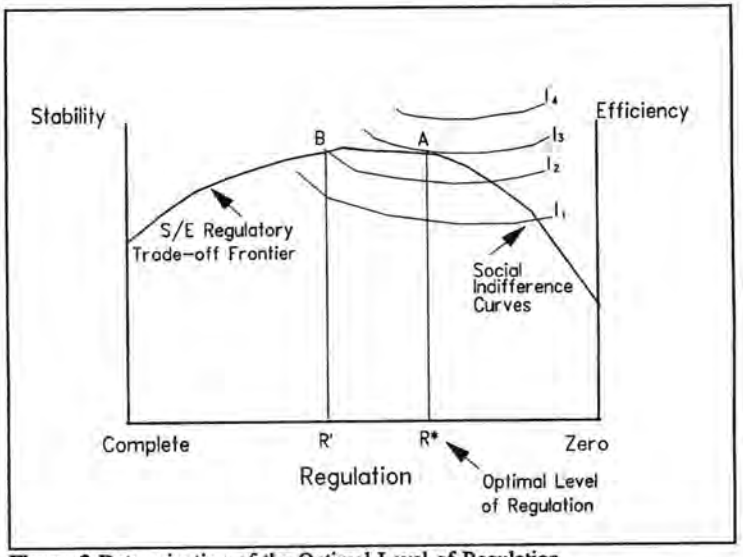


Figure 2 Determination of the Optimal Level of Regulation

The regulatory changes in the Canadian and U.S. trucking sectors, which are popularly referred to as "de-regulation", reduced the effort required to obtain, or amend these operating certificates. The relaxation of the barrier to entry in trucking has altered the supply decisions of the industry. The decisions of the industry members to expand, or contract the supply of services is a function of the level of freight rates and the carriers' expectations of profit. As individuals, the carriers can be assumed to react rationally to the market signals. The aggregate impact of their decisions however, can lead to unprofitable freight rates and ultimately bankruptcy for some operators.

The relationship between regulatory change and the income stability of the for-hire TL carriers is described with the use of stylized supply and demand models. The discussion begins with an examination of the effects of macroeconomic changes on the demand for freight transportation. Subsequently, the focus shifts to an examination of supply response for trucking services under open entry and a tightly regulated entry environment.

Demand for Freight Transport

Economics defines two levels of demand: primary and derived. The primary demand represents the consumption of the final product, while the derived demands are for inputs to the process. Most intermediate inputs and services can be classified as derived demands.

The demands for final goods and for transportation services are drawn in price/quantity space in Figure 3. In this case, the primary demand can be considered to be the consumer demand for all goods. The lower the price, the greater the quantity of goods demanded by consumers, and vice versa. The derived demand for transportation is parallel to the demand for goods, but lies to the left of the primary demand curve. When consumers purchase final goods,they also implicitly purchase some quantity of transportation services (Button, 1993).

The effects of changes in the business cycle are illustrated in Figure 4. When less goods are demanded (a recessionary period), the primary demand shifts to the left. The derived demand for transportation also shifts to the left because it depends directly on the primary demand for goods. An expansionary period (not illustrated), has the opposite effect: the primary demand would shift to the right and the derived demand for transportation services would follow.

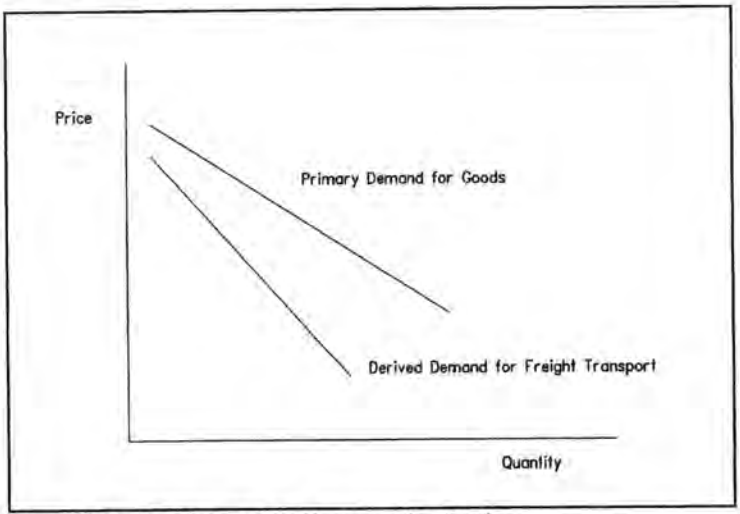


Figure 3 Derived Demand for Transportation Services

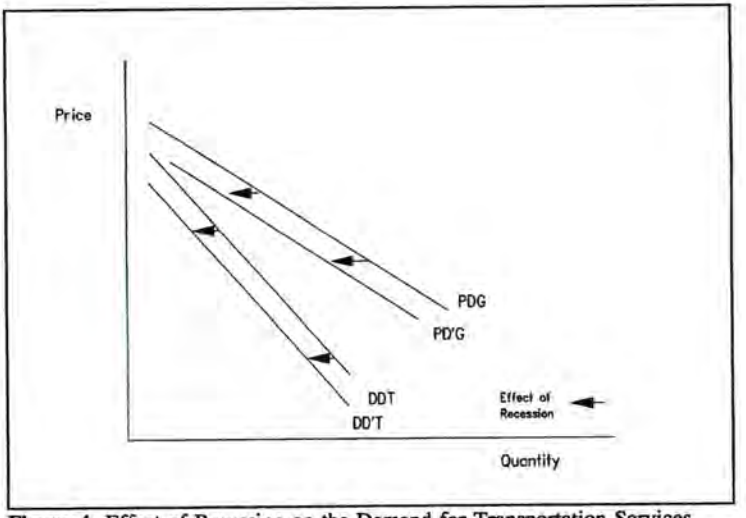


Figure 4 Effect of Recession on the Demand for Transportation Services

The derived demand characteristic of freight service has important implications for the for-hire TL industry. Unlike the goods producing industries, trucking firms have virtually no influence on the total quantity of transportation services demanded. The quantity of freight services demanded depends on the level of business activity in the macroeconomy. The individual TL carriers behave as price takers. As a result, the source of economic instability in the trucking industry can be traced to shifts in the demand for final goods and the group reaction of the TL carriers to price signals. The key determinant is the nature of the supply response. In the subsequent sections, the argument is made that TL carriers act as if the industry had a "kinked" supply curve.

Supply Responses

It is common in discussions of supply to differentiate between the longrun and shortrun supply responses. The general shape of the longrun and shortrun supply curves are illustrated in Figure 5. The longrun is considered to be the time period in which all fixed assets can be replaced. Consequently, the shortrun supply curve is much steeper than the longer run supply. Assuming that the industry has adjusted to a longrun equilibrium at point E, an unexpected increase in prices (from P to P") would cause the quantity of services supplied by the industry to increase to along the shortrun curve (from Q to Q"). If these prices were sustained for a sufficient time period, the industry would adjust (the supply curve would rotate to the right) until

prices (P") and quantities (Q') are finally determined at a new equilibrium (point E') on the longrun supply curve.

This representation of the TL sector, as a perfectly competitive industry, suggests that carriers react equally to increases and decreases in freight rates. A small rate increase brings forth a greater than proportional increase in the quantity of services offered, and vice versa. If the adjustment of the industry were this smooth, it is unlikely that TL carriers would stage protests or block the border, or that we would have ever had entry regulation in the first place. Observation suggests that the industry acts asymmetrically to increases and decreases in freight rates, and effectively has a "kinked" supply response.

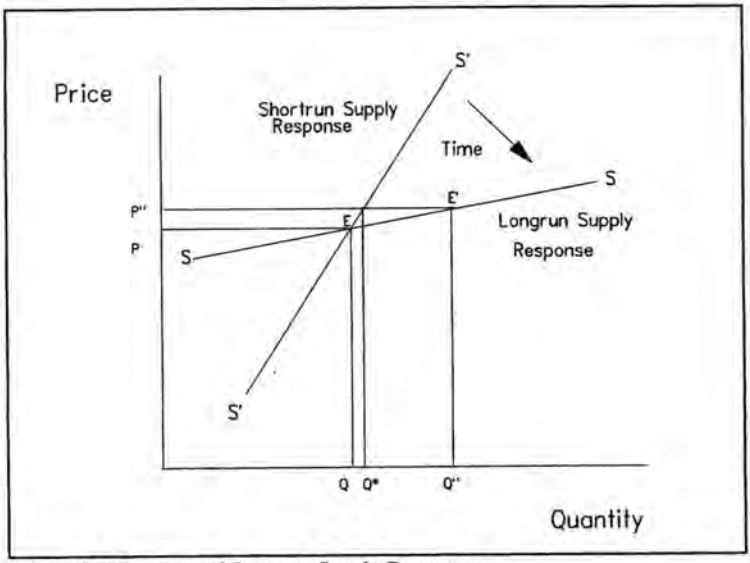


Figure 5 Shortrun and Longrun Supply Responses

Supply of TL Freight Services: Regulated Entry

The supply response of TL freight services in the regulated environment is illustrated as a "kinked" supply curve in Figure 6. During periods of rapid growth, the restrictive features of the operating certificates prevent existing carriers from expanding their service beyond the geographic boundaries they already serve. Similarly, new carriers are prevented from entering the industry because of the difficulty in obtaining operating certificates. The result is the expansionary path of the regulated TL industry approximates the shortrun supply curve: freight rates

expand more rapidly (from FR to FR") than the quantity of services demanded (from Q_t to Q_t").

To the extent that existing carriers have a protected duopoly, or oligopolistic competition, there is an incentive to "co-ordinate" prices and enjoy the excess profits during boom periods, and "co-operate" with other suppliers when an economic slowdown occurs.[3] During a recessionary period, the regulations protect the carriers from competitive rate cutting. Given that only a few carriers share any market under a regulated system, each will resist the temptation to cut rates and begin a "price war". Instead, as business slows the regulated carriers voluntarily idle some of their equipment and layoff under-employed drivers. This keeps the quantity of transport services in line with the needs of the market.

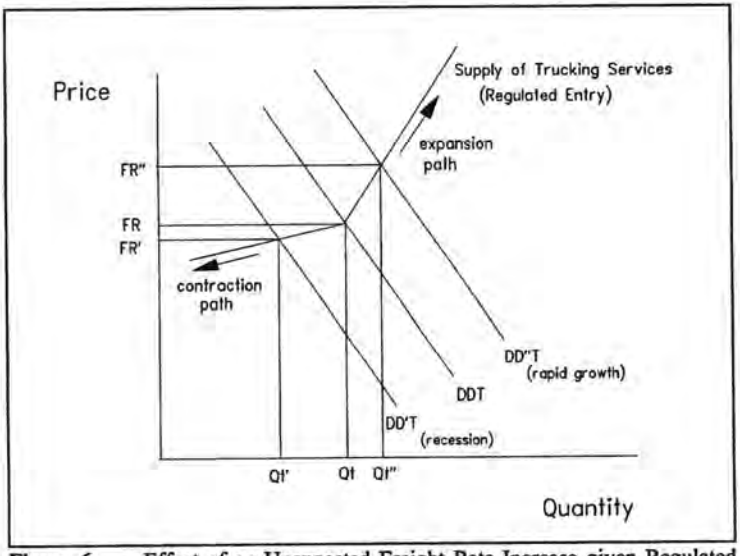


Figure 6 Effect of an Unexpected Freight Rate Increase given Regulated Entry into the Trucking Industry

The regulation of entry permitted the TL trucking industry to maximize its profits, and stabilize its earnings. During periods of growth, service could be expanded along the shortrun supply curve, while during economic recessions, the contraction could take place along the longrun supply curve. Although entry regulation enhanced the stability of the trucking industry, it did not foster efficiency. Aside from the problems of management lethargy, which tends to characterize all industries in non-competitive markets, the excess profits created by the regulatory environment tend to become capitalized and added to the cost base of the industry.

For example, the operating certificates in the trucking industry take on value that subsequently adds to the sales price of the business if changes hands. Similarly, regulated entry permits fixed factors, like unionized labour, to demand higher returns that ultimately are reflected in freight rates.[4] Finally, regulated entry in for-hire trucking can create external inefficiencies, such as the added costs of empty backhauls incurred by private carriers. Felton and Anderson (1989) pegged the social costs of U.S. trucking regulations in 1976, at $5.3 billion annually.

Supply of TL Freight Services: Open Entry

The supply curve of the open entry trucking industry is also "kinked", but is the mirror image of the regulated entry supply. During a period of "normal" economic growth, a de-regulated TL industry may shift immediately from the shortrun supply to an expansion path very close to longrun supply. Given the incentive of higher freight rates, existing carriers can operate their trucks extra hours, or press older trucks service. In addition, new entrants, who may have previously gained driving experience, would require only a small downpayment to finance the purchase of a truck in order to join the industry. Considering the relatively short time lag in the manufacture of new trucks, it is possible that under most conditions the expansion path of the TL sector would almost approximate the longrun supply curve.

During a recession, the contraction path of the TL sector is more likely to follow the shortrun supply response. First, there is no alternative economic use for a highway tractor-trailer unit that rivals its value in service. As a result, an undepreciated truck can remain in use for as long as freight rates exceed its variable costs of operation. Second, for many O/O and small carriers, exit from the industry carries a significant penalty. As independent businesses, they do not qualify for unemployment insurance benefits. Moreover, if they fail to continue payments on their vehicle, they risk the loss of their savings (the loan downpayment). As a result, it is rational behaviour for these carriers to accept lower freight rates and try to outlast the recession. The competitive rate cutting that results from rational individual behaviour however, accentuates the downside of the economic cycle for all carriers because the level of freight rates is forced to less than average total costs.

The impact of rapid growth, and recession, are illustrated in Figure 7, for a trucking industry with open entry regulation. The level of freight rates is determined by the intersection of the supply and the derived demand curves. Starting from an equilibrium point, with freight rate FR and Q_i quantity of trucking services, the derived demand is shifted left and right by equal amounts. In the expansion phase, a small increase in freight rates (FR"-FR) and a larger increase in the quantity of trucking services (Q_i"-Q_i) occurs. During a recessionary period, the opposite changes occur (a larger freight reduction (FR-FR'); a smaller quantity change (Q_i-Q_i')). The greater reduction of freight rates during the recessionary period however, is not compensated by the lesser reduction of supply. As a result, the magnitude of the

income loss during a recession are deeper than the corresponding gains of the expansionary period.

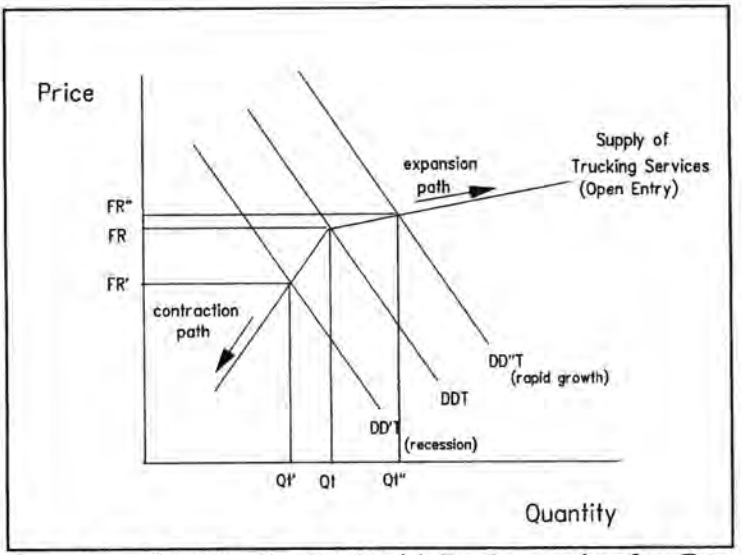


Figure 7 Effect of an Unexpected Freight Rate Increase given Open Entry into the Trucking Industry

The reduction of entry restrictions in the TL industry has had the effect of inverting the "kinked" supply curve of the industry. Consequently, there is a strong case for the view that the elimination of entry regulation has improved the efficiency of the TL trucking industry. In both recessionary periods, and during periods of rapid growth, freight rates of TL carriers are less under open entry than would be the case for a regulated industry.

The income stability of the TL carriers can be judged with reference to Figures 6 and 7 which were presented previously. The gross revenues of the industry equal the freight rate multiplied by the associated quantity supplied. During a recession gross revenues decline for both the regulated and open entry industry, but the negative impact on the open entry industry is far more severe. During a period of rapid growth, the industry revenues are similar. The difference is that these revenues are shared by more carriers in the case of the open entry industry.

The experience of non-regulated trucking industries, e.g. Alberta intra-provincial, provides evidence that the industry ultimately adjusts. This however, ignores the problems that income instability create for the members of the industry

and the costs that are borne by the rest of society if protesting carriers disrupt the economy. Finally, there are the efficiency implications of the "kinked" supply curve. Open entry can attract excessive investment to the trucking industry during the boom periods that is subsequently under-utilized when the boom ends. Such a waste of scarce resources is inconsistent with maximum economic efficiency.

Managing the Stability/Efficiency Trade-off

The trade-off between stability and efficiency cannot be averted, but it may be possible to modify, or dampen, its magnitude. Society has had some experience in other sectors of the economy that are subject to similar instability problems. In particular, the agricultural sector has an inherent instability and perfectly competitive market structure like the trucking industry with open entry. The primary difference is the source of the instability. In the case of the trucking industry, the instability is related to the fluctuating demand for services, while in agriculture, the instability arises from the weather-induced instability in the supply of food products.

Governments have used two methods to try to stabilize the agricultural sector. As in the case of the trucking industry, governments have tried to use supply regulation to stabilize food prices and farm incomes.[5] The results of economic regulation in agriculture are similar to the regulation of trucking: prices are observed to be higher than necessary, and the inefficiencies are obvious. These "regulatory" methods of attaining economic stability for agriculture are also under attack from consumers, and seem destined to be reformed.

The second method used by governments to help stabilize agriculture is to help generate and disseminate timely and accurate price information. Better market information generally leads to better management decisions which reduces instability. For example, price trends are extremely valuable in making decisions on when to expand, and when to contract. The availability of such price information helps to modify expectations and reduces the tendency for excessive expansion or contraction. Referring back to Figure 1, it is possible to modify the shape of the efficiency/stability relationships by increasing information. Theoretically, more information should cause both these curves to bend further away from the origin (become more concave).

Governments subsidize the dissemination of agricultural price information[6] and have taken an active role in building the institutions, like producer marketing associations and commodity futures markets where prices are determined publicly. On any day, one can look up the current farm prices for most major grains and types of livestock.

In contrast, the trucking industry is severely devoid of timely, accurate market information. There are no available price series published that are widely available to the public. The industry data that are published by Statistics Canada may be reliable, but are usually two or more years out of date. As a result, neither industry

members, nor financial intermediaries, have appropriate information on which to base capital investment decisions. Consequently, truckers may be purchasing trucks, and lenders providing finance, during periods when the market signals would indicate that the industry should already be contracting.

Truck Price Information

Collecting and disseminating price information on truck services is a lot easier said than done. There are indirect, or direct, methods that might be considered. The indirect method is to conduct surveys of the rates that trucking firms charge on different routes. Several problems confront this approach. First, there is the question of accuracy. The trucking firms are more likely to provide their "asking" prices, rather than "actual" prices. Second, the public and private costs of collecting and recording sufficient data to provide reliable price information could be prohibitively expensive. Third, the time required to collect and disseminate the data would diminish the benefits to the industry. Finally, the value of data that is derived from averaging of high and low prices is questionable. These considerations are probably sufficient to abort any concepts of indirect price data generation.

The direct generation of price data requires a new paradigm for the trucking industry: the development of an electronic market for truckload freight. The concept of an electronic freight market has been discussed by Prentice (1992). Briefly, the development of such a market would be akin to the creation of commodity markets for agricultural goods. The electronic freight market would generate "real time" prices and publish opening and closing daily prices. The information, which would be based on actual transactions, would be an accurate indicator of the market's price level and changes in the volume of movements.

The ability to create an electronic market for freight services is being enhanced by the such developments as the "electronic" highway concept, and the evolution of a more established freight brokerage industry. The ability to move information quickly and cheaply over vast distances means that dispersed offices can now be linked to central information bases. This would help the freight brokers to broaden their reach, while providing the telecommunications industry with a market for their services. The computer systems to facilitate these trades have already been developed for other commodities and require relatively minor modifications to adapt to an exchange of truckload freight.

Prentice (1992) has identified a number of economic and operational benefits to the development of an electronic market for truckload freight that should make it appealing to individual carriers and shippers. The public benefits can also be very significant, but are the secondary consequences of the information generated by the market. The creation of price information would help to stabilize and increase the efficiency of the truckload industry in Canada.

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1. "The airline industry is procyclical in the sense that its expansion and contraction is more pronounced than that of the economy as a whole. Income elasticities for this industry are approximately 2.0, indicating that for every one percent expansion in the national income, air transport expands by two percent, and for every one percent contraction in national income, air transport contracts by two percent." Tretheway and Oum (1992, p.113)

2. A decision to change the level of regulation implicitly assumes that the public's highest social indifference curve is not tangential to the S/E frontier.

3. This does not suggest that the industry participates in illegal collusion, but rather that in a market of few competitors, each participant recognizes the undesirability of price competition and implicitly avoids it.

4. In terms of the supply curve in Figure 6, these capitalized benefits would slowly shift up the supply curve so that over time less services would be offered at every price level.

5. Specifically, the Canadian Government introduced supply management marketing boards for milk, eggs, chicken and turkey.

6. The noon hour radio broadcast of agricultural commodity prices is an example of this activity.

Acknowledgement

The author wishes to thank Dr. John Heads for helpful comments on a previous draft of this paper, and to exempt him from any culpability for its errors and omissions.

ECONOMIC IMPACT OF INTRODUCING LONGER TRAILERS IN ONTARIO

by

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KPMG Canada

This paper assesses the economic impact on Ontario shippers of introducing longer trailers. Ontario held off until 1993 to introduce 53' semi-trailers and at the time of writing this paper, Quebec still had not passed legislation to accept such trailers. Further to the east, New Brunswick, P.E.I. and Newfoundland have recently accepted longer trailers. This paper considers the impact on Ontario shippers of accepting longer trailers in Ontario and forecasts the impact of acceptance in all of eastern Canada.

This paper is based on research conducted on behalf of the Ministry of Transportation, Ontario (MTO)[1] in its consideration of the economic and safety considerations associated with introducing longer trailers in Ontario. Our research included interviews and surveys with shippers, shipper associations, carriers and government representatives.

A. Introduction

In February 1988, the Council of Ministers of Transportation and Highway Safety endorsed a Memorandum of Understanding to encourage more uniform weight and dimension regulations. Under the terms of this agreement, provinces and territories allow vehicles to travel on a designated highway system in their jurisdiction if the vehicles comply with certain Transportation Association of Canada standards.[2] However, each jurisdiction retains the authority to allow more liberal weights and dimensions or different vehicle types.

Prior to our study, 53' semi-trailers were permitted in all provinces west of Ontario and in almost all U.S. states. In 1990, the Ontario Government introduced an amendment to the Highway Traffic Act to permit 53' semi-trailers, and issued approximately 2,400 interim permits. Legislation permitting 53' semi-trailers was finally introduced in 1993. In the intervening time, some Ontario shippers waited impatiently for the required changes in legislation.

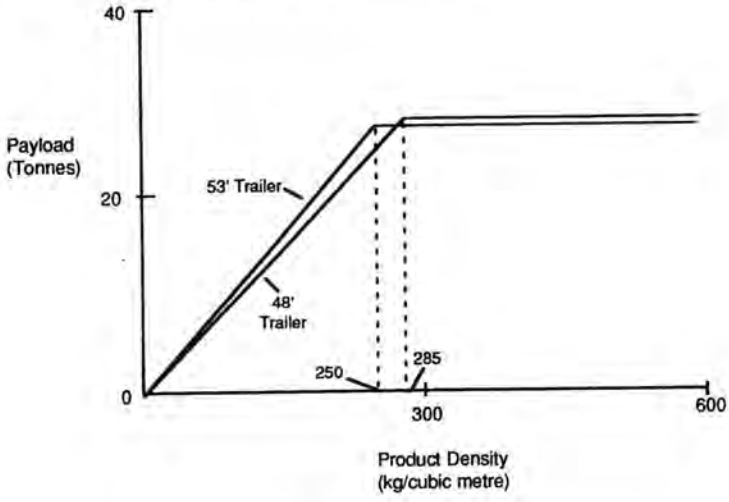
Quebec still has not passed legislation to accept 53' semi-trailers. However, officials of the Ministère des Transports du Québec expect that interim permits for 53' semi-trailers will be introduced later in 1994, and also expect that 53' semi-trailers will be permitted generally in Quebec by early 1995. Further to the east, New Brunswick, P.E.I. and Newfoundland have recently accepted longer trailers. Nova Scotia is preparing for legislation to permit the use of 53' semi-trailers in that province.

The push for longer trailers does not stop at 53' semi-trailers. According to recent reports from the U.S.,[3] at least 14 states accept 57' trailers.

When evaluating the introduction of 53' semi-trailers in Ontario, we considered the following factors.

- Trailer length, gross vehicle weight and overall vehicle length—the proposed changes included some modifications to trailer length and overall vehicle length but no adjustment to the gross vehicle weight.
- Use of equipment in other jurisdictions.
- The incremental payload—cube-out freight (e.g., cereals) and some dimensional loads (e.g., carpets) are constrained by the cubic capacity of 48' trailers. Exhibit 1 puts the payload issue into perspective.[4] With a 48' semi-trailer, the transition density from cube-out to weigh-out is approximately 285 kilograms per cubic metre. The transition occurs at about 250 kilograms per cubic metre for a 53' trailer. As a result, for products that weigh less than 250 kilograms per cubic metre, 53' semi-trailers offer about 10% more payload capacity (i.e., the vertical distance between the sloping parts of the lines).

Exhibit 1
Payload capacity of 48' and 53' semi-trailers



- For some heavier products, the 48' semi-trailer has a small weight advantage because of its lower tare weight.

- Other adjustments required to accommodate longer vehicle lengths—these adjustments cover a combination of transportation and logistics considerations.

B. Objective and Methodology

The objective of this paper was to assess the economic impact on Ontario shippers of introducing 53' semi-trailers.

Our methodology consisted of the following major steps.

1. Identified industries likely to benefit from longer vehicles

First, we identified commodities and industries that were likely to benefit from the introduction of 53' semi-trailers (e.g., automotive parts, clothing, shoe manufacturing, food, beverage, pharmaceutical, wholesale, retail, and others). We used input from several sources: results of our previous research; input from MTO; and companies already holding permits for 53' semi-trailers.

2. Conducted industry and shipper surveys

We surveyed Ontario shippers, shipper associations and carriers. The purpose of the shipper survey was to estimate the likely savings in transportation and logistics costs for the companies contacted. The shipper survey was not intended to be statistically representative of all Ontario shippers. Rather, our objective was to target companies that were likely to benefit from introducing 53' semi-trailers. We targeted 139 shippers and some 65 responded to our survey (a response rate of 47%).

The survey covered areas such as current traffic volumes, cube out vs. weigh out products, truck transportation savings, logistic savings or costs, and potential benefits of introducing 53' semi-trailers.

3. Estimated economic impact on Ontario shippers of accepting 53' semi-trailers in Ontario and western Canada

Our estimate of the economic impact on Ontario shippers of introducing 53' semi-trailers involved two steps.

In step one, we estimated potential savings based on the data collected from the shipper survey and our own estimate of truck costs. This estimate considered truck transportation savings, logistic savings or costs, and operational adjustments.

We estimated truck transportation savings considering six market segments:

- long haul (greater than 800 km) TL
- medium haul (between 400-800 km) TL
- short haul (less than 400 km) TL
- long haul (greater than 800 km) LTL
- medium haul (between 400-800 km) LTL
- short haul (less than 400 km) LTL.

Shipments were costed with both 48' and 53' semi-trailers. The difference between the two results represented potential savings for cube-out freight.

We estimated logistic savings or costs, and operational adjustments considering materials handling, purchasing decisions, inventory levels and other relevant items.

In step two, we projected the results of step one to the provincial level using data from MTO's commercial vehicle survey,[5] Statistics Canada[6] and economic forecasts. We estimated the potential savings for all Ontario shippers using a four-step methodology:

- estimated the size of the six market segments (dollars)
- estimated the percentage of freight that could be affected for each segment
- estimated the percent reduction in trucking costs for affected freight (i.e., potential benefits to shippers)
- calculated the expected transportation savings (dollars).

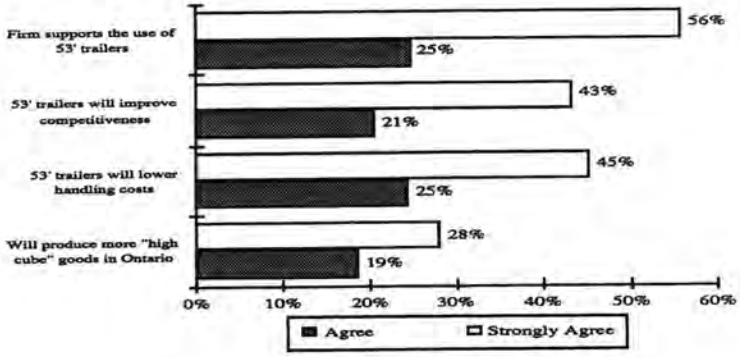
4. Estimated economic impact on Ontario shippers of accepting 53' semi-trailers in Ontario and all of Canada

Our estimate of the economic impact on Ontario shippers of accepting 53' semi-trailers throughout Canada used the same methodology described above. In this case, we assumed that shipments to or from *any* jurisdiction could potentially benefit from the longer trailers. This increased our estimate of the percentage of freight that could be affected for each market segment, and thus increased the expected transportation savings.

C. Results of shipper survey

Over 80% of the shippers surveyed in Ontario supported the use of 53' semi-trailers because they believed that these longer vehicles would lower their transportation and handling costs and improve their competitive position. Exhibit 2 shows the per cent of shippers who agreed or strongly agreed with a series of statements on their support for longer trailers, improvements to their competitive and cost positions and potential for using 53' semi-trailers in the future. The results shown in Exhibit 2 were not surprising given that we targeted companies that were likely to benefit from introducing longer trailers.

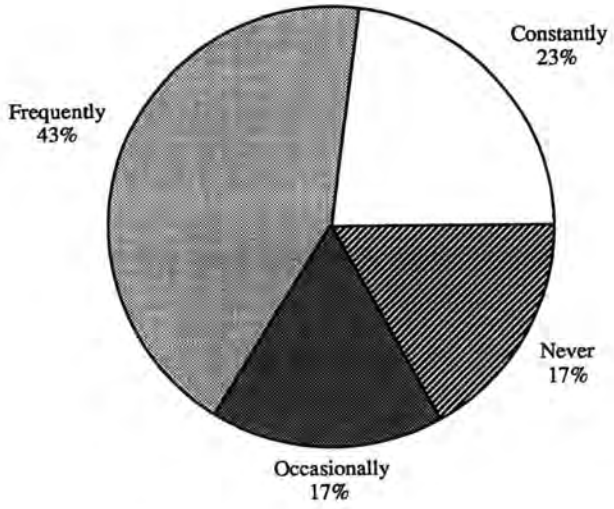
Exhibit 2
Support for 53' semi-trailers



Transportation costs are an important input factor for Ontario manufacturers. Many shippers believed that other manufacturers such as those located in the U.S. enjoyed a competitive advantage. Most shippers expected carriers to pass along all of the potential savings. Many shippers commented that increased use of 53' semi-trailers would reduce the number of trucks on Ontario highways and improve safety as a result.

Exhibit 3 shows the expected frequency of use of 53' semi-trailers by survey respondents. Some shippers did not expect to use 53' semi-trailers for a variety of reasons such as they did not expect gains from LTL movements, weight of product, and difficulty in handling longer trailers in their shipping yard.

Exhibit 3
Expected frequency of using 53' semi-trailers



For the shippers surveyed, potential annual savings from truckload shipments totalled $12 million assuming that longer trailers were accepted in Ontario and western Canada. This represented 2.2% of their freight bill for shipments to, from and within Ontario. Savings from less-than-truckload movements totalled $0.4 million or less than 0.1% of their freight bill. Total annual savings for the shippers surveyed were thus $12.4 million or 2.3% of their freight bill for Ontario movements within Ontario and to points west.

D. Truck transportation and logistics savings

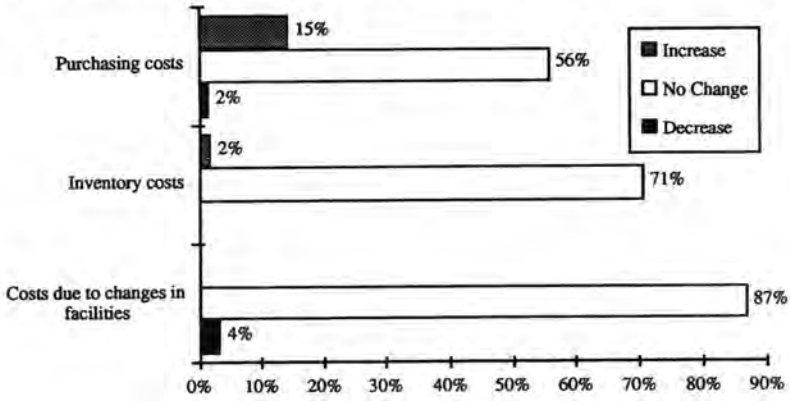
Potential truck transportation savings depended on several factors including the type of operations (i.e., truckload or less-than-truckload), the ability of carriers to maximize the cubic capacity of longer trailers, the geographic area being served and the ability of motor carriers to productively use new trailers. We estimated average truck transportation savings to be between 8.0% and 8.4% for TL movements and between 0.5% and 1.8% for LTL shipments. These estimates were supported by the experience of motor carriers currently using 53' semi-trailers. The results of our truck cost analysis are summarized in Exhibit 4.

Exhibit 4
Estimated transportation savings

Description	Cost reduction (%)
Long haul TL shipments	8.4%
Medium haul TL shipments	8.3%
Short haul TL shipments	8.1%
Long haul LTL shipments	2.5%
Medium haul LTL shipments	1.7%
Short haul LTL shipments	0.8%

Logistics costs covered a range of activities including materials handling, purchasing decisions, inventory management, waiting time at shippers' dock, time for loading and unloading, number of orders, and facility lay-out. Based on the shipper survey, Exhibit 5 shows the expected impact on logistics costs that would occur due to 53' semi-trailers. After balancing all logistics factors, we expect that the net impact of longer trailers was negligible.

Exhibit 5
Expected effects on logistics costs from 53' semi-trailers



E. Estimated savings for Ontario shippers

We estimated the savings for Ontario shippers considering two scenarios. In our original study for MTO, we assumed that 53' semi-trailers would only be accepted in Ontario and western Canada. For this paper, we also considered the impact on Ontario shippers of introducing 53' semi-trailers in eastern Canada as well.

1. Impact on Ontario shippers of accepting 53' semi-trailers in Ontario and western Canada

Assuming that 53' semi-trailers would only be accepted in Ontario and western Canada, we estimated that introducing such trailers would reduce trucking costs by approximately $100 million annually. Exhibit 6 outlines the estimated annual transportation savings.

Exhibit 6
Annual transportation savings

Market Segment	Size ($ millions)	Affected Portion	Cost Reduction	Savings ($ millions)
Long haul TL	2,067	34%	8.4%	59
Medium haul TL	1,081	12%	8.3%	11
Short haul TL	790	24%	8.1%	15
Long haul LTL	1,528	34%	2.5%	13
Medium haul LTL	664	18%	1.7%	2
Short haul LTL	322	25%	0.8%	1
TOTAL	6,452			101

Our savings estimate was based on 1989 traffic volumes. Volumes have declined somewhat since then due to the economic recession. On the other hand, average rates have increased slightly over the past four years when we consider inflation.[7] Given the counter-balancing effect of these two developments, we believed that the $100 million figure was valid for 1993.

More than 80% of the savings were generated by truckload shipments. Motor carrier revenues for traffic to, from and within the Province of Ontario were approximately $6,452 million. Thus a $100 million savings represented 1.6% of revenues. Many shippers surveyed expect all of the cost savings to be passed along through lower freight rates.

We found that the full savings would not be realized immediately because carriers must replace equipment to take advantage of the proposed change. There was some pent up demand for longer trailers, though. We expected the phase-in period to be no more than 5 years.

Several factors suggested that future savings for Ontario shippers could exceed $100 million annually. These factors included an economic recovery in Ontario, more north-south trade due to the Canada–U.S. trade agreement, and greater traffic volumes due to reduced transportation costs.

2. Impact on Ontario shippers of accepting 53' semi-trailers in all of Canada

As discussed, there has been continued pressure for 53' semi-trailers in eastern Canada. Using the same methodology and data as that used in our original work, we estimated that introducing longer trailers in all of Canada would reduce costs to Ontario shippers by approximately $139 million annually.

Exhibit 7 compares the affected portion and savings for each market segment under our two scenarios: 53' semi-trailers accepted in Ontario and western Canada, and 53' semi-trailers accepted in all of Canada.

Exhibit 7
Annual transportation savings: 53' semi-trailers accepted in part versus all of Canada

Market Segment	53' semi-trailers Ontario and West		53' semi-trailers throughout Canada	
	Affected Portion	Savings ($ millions)	Affected Portion	Savings ($ millions)
Long haul TL	34%	59	41%	72
Medium haul TL	12%	11	29%	26
Short haul TL	24%	15	32%	20
Long haul LTL	34%	13	38%	15
Medium haul LTL	18%	2	45%	5
Short haul LTL	25%	1	36%	1
TOTAL		101		139

When we assume that 53' semi-trailers are accepted throughout Canada, the proportion of increased savings to Ontario shippers generated by truckload shipments remains relatively unchanged at 85% of the total savings. Savings of $139 million to Ontario shippers represented 2.2% of motor carrier revenues for traffic to, from and within the Province of Ontario.

F. Summary

The potential impact of introducing 53' semi-trailers varied depending on the type of product moved, origin and destination of traffic, availability of equipment and physical constraints. The following highlights our findings.

- We estimated that Ontario shippers would save approximately $100 million annually assuming that 53' semi-trailers were accepted in Ontario and western Canada. As a percentage of the total Ontario truck transportation freight bill, this represented a savings of approximately 1.6%.

- We estimated that Ontario shippers could save approximately $139 million annually assuming that 53' semi-trailers were accepted in all of Canada.

- The benefits of introducing 53' semi-trailers will be phased in over time (possibly five years) as the motor carrier industry replaces its trailer fleet.

- Ontario industries expected to benefit the most from introducing 53' semi-trailers include the following: automotive industry; food, beverage and tobacco products; furniture and large appliances; machinery, fabricated metal and electrical products; and the wholesale and retail industry.

- The greatest savings were estimated for low density, high cube products moving in truckload quantities over long distances. No savings were anticipated for high density products and minimal savings are anticipated for LTL service.

- Transportation costs are an important input factor for Ontario manufacturers. Longer trailers and the savings that can result, could help Ontario manufacturers and processors be more competitive in the North American marketplace.

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SCHEDULE TIGHTNESS AND WORK HOURS OF LONG-DISTANCE TRACTOR-TRAILER DRIVERS IN THE UNITED STATES

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Introduction

Fatigue is recognized as a major factor contributing to accidents involving heavy trucks. Since the mid-1930's, all interstate drivers of commercial vehicles have been subject to hours-of-service rules (HSR), which prescribe limits on driving time and total on-duty time However, violations of HSR are believed common. Moreover, HSR, themselves, have come under increasing criticism. Some contend that adherence to HSR may actually impair safety as the rules do not account for the driver's circadian rhythm, the body's internal clock (e.g., Office of Technology Assessment, 1991).

The objectives of the study reported in this paper were to estimate: 1. the frequency of schedule-induced HSR and/or speed limit violations by long distance drivers of tractor-trailers and 2. weekly work hours.

Previous Literature

In a real sense, the study is the fourth in a series of efforts to gauge the propensity of long-distance drivers to violate HSR and/or speed limits. Beilock and Capelle (1987) and Beilock (1990) attempted to measure schedule tightness by interviewing drivers about the origin and destination and expected arrival time for current trip. Their findings indicated that for between a fifth and a third of drivers, meeting their current trip schedules would require violations of HSR or speed limits or both. These studies had two main shortcomings. First, no information was collected regarding the hours driven prior to the current trip. Second, both studies occurred when states were beginning raise Interstate and comparable roadway speed limits above 55 MPH, making it difficult to calculate legally feasible transit times.

Hertz (1989) also attempted to gauge violations during the current trip. Along U.S. 90 eastbound in Washington State, tractor-trailer drivers were questioned to determine which were heading to or through Minnesota and had no interim pickups or drops. Information regarding hours since the last 8-hour break, and whether there were one or two drivers was also collected. In Minnesota, rigs were identified (by their trailer license numbers) and transit times calculated. Based upon the transit times and the other information collected, schedule tightness estimates were derived. Hertz's approach had the dual advantages of observing actual transit times and incorporating some information regarding prior driving times. The percentage of drivers assumed to have violated HSR and/or speed limits depended upon the assumed legally attainable average trip speed. At 40 MPH average trip speed, 91 percent of the drivers appeared to have been in violation, while if 60 MPH average trip speed was assumed, 30 percent were in violation during the Washington-to-Minnesota trip.

The Hertz approach was not without problems. First, it is difficult to record accurately trailer tag numbers. The checkpoints in Minnesota were along the two most likely routings (U.S. I-90 and U.S. I-94, which branches off from U.S. 90). However, only 43 percent of the vehicles identified in Washington State as travelling to or through Minnesota were identified in Minnesota. Hertz notes that this may, in part, be due to recording errors. It seems reasonable, therefore, to assume that some incorrect matches were made due to the same cause. Second, Washington State Patrol officers collected the initial information, including self-reported hours since the last 8-hour break. The potential for response bias is obvious. Third, measurements were over a portion of a movement, rather than from one origin to one destination. Finally, while there are advantages to holding trip distance essentially constant (at about 1,200 miles), it is unfortuneate that the influence of variations could not be examined.
The third effort was by Braver et al. (1992). Rather than attempting to determine violations during the current trip, drivers were questioned more broadly to determine the overall pressures to which they are subjected. Thirty-one percent of the drivers reported that they typically exceed the 60 or 70 Hour Rules and an additional 36 percent admitted to exceeding total work (but not driving) hour restrictions. Finally, 6 percent did not indicate the nature of the infraction, but stated that they had violated HSR during the previous month. The primary weaknesses of the study were the potential for response bias and incorrect recall of remote events.

In the current study, current-trip schedule tightness is estimated by a variation of the approach used by Beilock and Capelle (1987). Following Hertz, estimates of previous driving times are incorporated and, following Braver et al., non-driving work hour estimates are also made. The former is particularly important in accounting for the HSR's 60 hour and 70 hour rules, which stipulate that a

driver cannot drive more than 60 hours in any seven day period or more than 70 hours in any eight day period. The latter will be used to estimate total driver work times.

Response Bias

Two measures were employed to mitigate the response bias problem. First, the interviews were conducted in a non-threatening manner. The survey sites were Florida Agricultural Inspection Stations. The primary function of these stations is to record movements of agricultural products. The inspectors have no role in nor authority over safety enforcement, hence drivers tend to be relaxed. Moreover, the inspectors normally were not within hearing of the interviews. The enumerators were University of Florida students. They introduced themselves as students, made clear that the survey was anonymous and voluntary, and held the questionnaire so that the respondent could observe the questions and notations. Second, the questions were designed to make it unlikely that drivers would realize that HSR adherence calculations would be made. This was done by: 1. having a very limited number of questions (5), which related to the current study, 'buried' in a much larger questionnaire (40-50 responses); 2. having the most crucial questions deal with future, rather than past [and, therefore, self-incriminating] events; and 3. not requesting sufficient information to conclusively determine HSR adherence. No comments by respondents indicated awareness of the purpose of or unease about these questions.

Schedule Tightness Estimation

Distance travelled is simply the product of the average speed and driving time. A driver may increase distance by increasing either the average speed or driving time or both. An index of schedule tightness is developed which is the estimated average speed a vehicle would need to maintain to reach the next destination without being late and with the driver obeying the driving times mandated by HSR.

Drivers were interviewed on-the-road, during a movement. Schedule tightness estimates were developed for that movement. To accomplish this, the following information was requested from drivers:

1. Location of the origin point for the current movement.

2. Location of the next pickup or drop point for the current movement.
3. Time and date by which the next pickup or drop point must be reached not to be considered late.
4. If there is a co-driver in the truck.
5. The number of miles driven over the previous seven days.

Enumerators also recorded the time, date, and location of the interview.

Three basic assumptions were made:

1. No extended rests were taken prior to reaching the interview site.
2. Those indicating that there was no expected arrival time at their next destinations had very loose schedules.
3. A driver with (without) a co-driver at the time of the interview had (did not have) a co-driver over the previous seven days.

Previous driving time was estimated by determining the time required to complete the driver-reported mileage driven over the previous seven days. It was assumed that the same distance was driven each day. In the analysis, three scenarios were examined which assumed three average road speed limits: 55 MPH, 60 MPH, and 65 MPH. Corresponding to these, it was assumed that over the period previous to the current trip, drivers averaged 45 MPH, 50 MPH, and 55 MPH, respectively. These are the maximum speeds the U.S. Department of Transportation considers possible for a vehicle to maintain, over an extended trip, without being suspect of violating HSR or speed limits:

Average Legal Speed Limit on all Roadways	Minimum Average Trip Speed For a Schedule to be:	
	Violation-Suspect	Violation-Inducing
55 MPH	45 MPH	50 MPH
60 MPH	50 MPH	55 MPH
65 MPH	55 MPH	60 MPH

Weekly Work Hours Estimation

In the development of the schedule tightness index, driving time was constrained, by forcing adherence to HSR, and the necessary average speed determined. The process was essentially reversed to estimate weekly driving time. First an average speed was assumed, and then the driving time necessary to cover the

driver's weekly mileage determined. The time period for which mileages were estimated was the seven days ending with the driver's arrival at the destination he/she travelled to after being interviewed. The arrival time was assumed to be the latest time, reported by the driver, that he/she could get to that destination without being considered to be late. For that part (if any) of the seven day period prior to the current movement, it was assumed that mileage was covered at the rate indicated by the driver's estimated distance travelled over the previous seven days.

Non-driving tasks are an integral and unavoidable part of the work for virtually all drivers. Among these tasks are included: filling out logbooks, vehicle inspections, fueling, loading/unloading, on-duty waiting to be dispatched, etc. To avoid raising the respondents' apprehension by asking too many questions related to HSR, drivers were not questioned regarding non-driving work hours. However, during the week following the survey, a separate survey of tractor-trailer drivers was conducted at the same sites (see Braver, et al.). The drivers in that survey were questioned about their weekly driving and non-driving work hours. The average ratio of non-driving to driving work hours was .26. Several breakdowns of drivers (e.g., carrier types, regular/irregular route) were examined to determine if there were marked variations in this ratio across identifiable groups. None were found. Therefore, for the current study, non-driving work hours were assumed to equal 26 percent of driving hours.

Data

On January 25 and 26, 1991, interviews were conducted with 500 long-distance truck drivers as they exited the Florida Peninsula. Three Florida Agricultural Inspection Stations, located on U.S. I-10, U.S. I-75, and U.S. I-95, served as interview sites. All interviews were conducted on the outbound (i.e., northbound or westbound) sides of the highways, from 6:00 PM to 1:00 AM, which tend to be the heaviest traffic times.

The number of available spaces at each Station was limited, necessitating suspensions in the selection process until parking spaces became available. As the probability of being skipped because of no room was essentially the same for all drivers, this was unlikely to introduce bias into the sample.

The overall refusal rate was 16 percent. Three questionnaires were improperly completed and were discarded.

Schedule Tightness - Overall

Depending upon the average speed limit scenario, between 17 and 30 percent of the drivers were found to have violation-suspect schedules and between 14 and 26 percent had schedules sufficiently demanding to also be judged as violation-inducing. As would be expected, the slower the assumed average speed limit, the more difficult it is to stay on time without violating speed limits or HSR. In Table 1, the percentages of drivers with violation-suspect and violation-inducing schedules are presented and, in addition, broken down between those whose schedules are tight due to the current trip and/or due to the 60 or 70 hour rules. For example using the 55 MPH average speed limit, an estimated 26 percent of all drivers had violation-inducing schedules. Ignoring the 60 and 70 hour rules, 15 percent of the drivers would have had such schedules due to the demands of the current trip. For 13 percent of the drivers, neither the 60 nor the 70 hour rules could be adherred to without violating speed limits. For one percent of the drivers [((13 + 15) - 26)/2], both the current trip and the 60 or 70 hour rules result in violation-inducing schedules. These findings, while disturbing, suggest much lower incidence of violations than was found by Hertz. The differences, however, are largely due to differences in current trip distances, as will be discussed below.

Schedule Tightness - Team and Solo Drivers

A driver may acquire off-duty time by resting in the tractor's sleeper berth. With a co-driver (team driving), one driver may be off-duty while the vehicle is moving. As such, there may be considerable differences in the incidence of tight schedules between teams and solo drivers. Indeed, this was found. Solo drivers were markedly more likely than team drivers to have violation-suspect or violation-inducing schedules (Table 1 and Figure 1). Depending upon the average speed limit assumed, these differences were significant at the .05 level and, in most cases, at the .01 level of probability.

Due to the dramatic differences between solo and team drivers with regard to schedule tightness, in the balance of the paper only the former will be examined.

Schedule Tightness - Refrigerated Loads, Solo Drivers

The need to deliver refrigerated cargos quickly and on-time is likely to be greater than for unrefrigerated cargos. This follows for three primary reasons: 1. some refrigerated cargos, such as produce, ornamentals, and chilled meats deteriorate over time; 2. the additional cost of refrigeration during transport; and 3. due to the high costs of refrigerated storage, many receivers adopt just-in-time

approaches to avoid holding the product for extended periods. It seems likely, therefore, that time pressures on drivers of such cargos would be greater, on average, than on other drivers. The results strongly suggest that this is the case. Depending upon the average speed limit assumed, drivers with refrigerated loads were between 50 and 80 percent more likely than other drivers to have violation-suspect or violation-inducing schedules (differences statistically significant at the .01 or .05 levels, see Table 1). Braver et al. also found that drivers of perishable cargoes were more likely than others to be HSR violators.

Schedult Tightness - Regular and Irregular Route Carriers, Solo Drivers

As the name implies, regular route carriers are those with established, scheduled routings. Irregular route carriers are those with variable routings. Due to the variation in their routings, drivers for irregular route carriers are commonly assumed to be more likely than other drivers to violate HSR and speed limits. Indeed, Braver et al. found that a significantly larger percentage of irregular route drivers than regular route drivers reported they have violated HSR in the past. The results of the current study suggest the opposite.

For all three average speed limits, drivers for regular route carriers were significantly more likely than drivers on irregular routings to have violation-suspect schedules (i.e., at the .01 or .05 levels, see Table 1). Except for the 55 MPH average speed limit scenario, drivers on regular routes also were significantly more likely than others to have violation-inducing schedules. These differences are primarily, though not solely, due to current trip schedules, rather than the 60 or 70 Hour Rules. The results, though counter to the common wisdom of the industry, are believeable. It seems likely that a carrier with regular routings would, at least at the corporate level, establish schedules to which drivers can legally adher. However, like an airplane with connecting passengers, a late truck can create problems throughout a large part of the system. It can be argued, therefore, that regular route carriers have larger stakes, on average, than irregular route carriers, on maintaining on-time performance.

Schedule Tightness - Current Trip Distance, Solo Drivers

There is a very strong and positive relationship between current trip distance and schedule tightness. For all three average speed limit scenarios, the simple correlation between DRVSPD and trip distance is positive (ranging between .31 and .35) and significantly different from zero at the .01 level. In Table 1, three current trip distance ranges are compared: up to 500 miles, over 500 mile up to

1,000 miles, and over 1,000 miles. As can be seen, for all average speed limit scenarios and for current trip, the 60/70 Hour Rule, and total; the longer the journey, the greater the frequency of violation-suspect and violation-inducing schedules. In all cases, the differences were easily significant at the .01 level. Moreover, the absolute sizes of the differences are large. For example, depending upon the average speed limits assumed, drivers with current trips over 1,000 miles are between five and seven times more likely to have violation-inducing schedules than are drivers with trips not over 500 miles (Table 1 and Figure 2).

The current trip length 'over 1,000 miles' category corresponds most closely with the Hertz study. Hertz assumed the same driving speed for both the current trip and previous driving; while in the current study, previous driving speeds were assumed to equal the highest possible average speed for which the U.S. Department of Transportation would not automatically assume that a speed violation had occurred. Using Hertz's violation estimation method, the following percentages of drivers would be assumed to be in violation:

	Average Speed (MPH) for Current and Previous Driving			
	40	50	56	60
Percent of solo drivers in current study with current trip:				
500 miles or less	13	8	5	4
501 to 1,000 miles	36	24	24	15
Over 1,000 miles	**61**	**43**	**34**	**27**
ALL	34	23	19	14
Percent of all drivers in current study with current trip:				
500 miles or less	12	7	5	4
501 to 1,000 miles	34	22	22	12
Over 1,000 miles	**59**	**38**	**30**	**24**
ALL	33	21	17	13
Percent of drivers in Hertz study	91	58	41	30

Weekly Work Hours, Solo Drivers

In Table 2, for various assumed average speeds, the estimated mean total weekly work hours are presented as well as the work hours at each quartile. The prodigious work schedules of solo long distance drivers is evident. Assuming 50 MPH average speed, the average driver works 58 hours in total and drives 46 hours weekly. Seventy-five percent of these drivers work over 49 hours and drive more than 39 hours per week. Half the drivers exceed 65 hours total work and, of that, drive over 52 hours. Finally, a quarter of the drivers work more than 81 hours and drive over 64 hours per week (which is not legal under HSR).

For each driver, a fixed number of miles per week was assumed (as indicated by their responses). There is a tradeoff between speed and driving time. For example, at 45 MPH average speed the average driver must drive 51 hours per week, compared to 38 hours if 60 MPH is averaged. For about two percent of the drivers the estimated work hours did not appear to leave time for attending to the most Spartan of sleeping/eating/personal hygine regimens. These and other drivers may resort to excessive speeds to secure additional needed or desired free time.

Summary and Conclusions

In this study, the tightness of schedules for long-distance drivers of tractor-trailers has been estimated. Drivers were interviewed enroute, and schedule tightness was calculated for their current trips. Information was solicited from driver in a manner likely to minimize response bias. The results suggest that a disturbingly high proportion of drivers must violate Hours-of-Service Rules or speed limits or both in order to maintain their schedules. For example, assuming the average roadway travelled has 55 MPH speed limits, over a quarter of all drivers must violate HSR or speed limits.

In addition to determining overall schedule-induced violation rates, sub-groups with high and low incidences of such schedules were identified. Such information may be of value in directing research, law enforcement, and company safety efforts. Solo drivers were found have much higher frequencies of violation-suspect and violation-inducing schedules, than do team drivers. Among solo drivers, groups with higher incidences of violation-inducing schedules were those: with longer trip distances, with refrigerated loads, and driving for regular route carriers.

The total hours worked of solo drivers was also estimated. The findings indicate that the very large majority of long-distance drivers have more than 40 hour work weeks (82 percent, assuming average maintained speeds of 50 MPH) and very lengthy work weeks are common. For example assuming 50 MPH average maintained speed, half the drivers work more than 65 hours weekly and a quarter work over 81 hours.

These results are disturbing and may in part explain why these professional, long-distance drivers have markedly higher accident rates, per mile driven, than the general population. However, before such conclusions can be conclusively made, in future research linkages must be established between accident rates, on the one hand, and, on the other hand, schedule tightness and hours worked.

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Table 1: Frequencies of Violation-Suspect and Violation-Inducing Schedules Among Long Distance Drivers of Tractor-Trailers

	Violation-Suspect Schedule			Violation-Inducing Schedule		
	Average Speed Limit					
	55	60	65	55	60	65
All:						
Current trip	21	15	11	15	12	8
60/70 Hour rules	14	7	7	13	6	6
Total (N=498)	30	21	17	26	17	14
Team						
Current trip	14	8	8	8	8	4
60/70 Hour rules	4	0	0	4	0	0
Total (N=71)	17	8	8	11	8	4
Solo						
Current trip	22	17	12	17	12	9
60/70 Hour rules	15**	8**	8**	14*	7**	7**
Total (N=427)	32**	23**	19*	28**	19*	16**
With Refrigerated Loads - Solo	28	20	16	20	16	12
Current trip	19	9	12	18	7	11
60/70 Hour rules	40	28	24	36	23	21
Total (N=188)						
With Unrefrigerated Loads or Empty - Solo						
Current trip	17**	14	9*	14	9*	6*
60/70 Hour rules	13	7	7	11	7	6
Total (N=239)	25**	19*	15*	22**	15*	12**
Work For Regular Route Carriers - Solo						
Current trip	30	24	16	24	16	13
60/70 Hour rules	15	9	15	11	8	13
Total (N=124)	39	32	28	32	24	24

Table 1: Frequencies of Violation-Suspect and Violation-Inducing Schedules Among Long Distance Drivers of Tractor-Trailers

	Violation-Suspect Schedule			Violation-Inducing Schedule		
	Average Speed Limit					
Work For Irregular Route Carriers - Solo						
Current trip	19**	14**	11	14**	11	7
60/70 Hour rules	16	8	6**	11	7	6*
Total (N=303)	29*	20**	15**	26	16*	12**
Trip up to 500 Miles - Solo	9	7	5	7	5	4
Current trip	4	1	1	4	1	1
60/70 Hour rules	12	8	5	10	6	4
Total (N=187)						
Trip Over 500 and No More Than 1,000 Miles - Solo	24	19	15	19	15	10
Current trip	15	7	15	14	5	14
60/70 Hour rules	36	24	24	32	18	18
Total (N=103)						
Trip Over 1,000 Miles - Solo	38**	28**	20**	28**	20**	15**
Current trip	31**	18**	16**	28**	*	14**
60/70 Hour rules	56**	43**	34**	49**	17**	28**
Total (N=137)					36**	

NOTE: **, * denotes that drivers are significantly different at the .01, .05 levels of probability, respectively, from those not having that characteristic (such as having versus not having a perishable load).

Table 2: Estimated Total Weekly Work Hours For Solo Long-Distance Tractor-Trailer Drivers				
	Average Speed			
	45 MPH	50 MPH	55 MPH	60 MPH
1st Quartile	54 (43)	49 (39)	45 (36)	41 (33)
2nd Quartile	72 (57)	65 (52)	59 (47)	54 (43)
3rd Quartile	89 (71)	81 (64)	73 (58)	67 (53)
4th Quartile	144 (114)	131 (104)	119 (94)	99 (79)
ALL (Average)	64 (51)	58 (46)	53 (42)	48 (38)

NOTES: In the body of the table, the total weekly work hour estimates are presented and, in parentheses are the estimated driving hours.

Calculations based on 423 respondents. Four respondents were removed as their total estimated work weeks exceeded 168 (the number of hours in a week).

INTERACTION BETWEEN EXTENDED DUTY HOURS AND CIRCADIAN RHYTHMS: CONSEQUENT EFFECTS ON LONG HAUL DRIVER ALERTNESS AND PERFORMANCE

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PART I - Introduction

A major Canadian rail disaster in 1986 resulted in the loss of 26 lives and $30 million in property damage. The investigation demonstrated that severe disruptions to the engineer's circadian rhythms caused by erratic schedules and extended duty hours impaired engineer performance resulting in the rail disaster. This finding is supported by GAO studies (1992; 1993) on rail safety which showed similar results. The purpose of the present study is to determine whether the work/rest patterns of long haul truck drivers are similar to those of train engineers and the consequences for safety in the trucking industry.

PART II - Literature Review

a) The concept of circadian rhythms and work-rest patterns

The human body functions on 24 hour cycles called circadian rhythms (Webster's; 1989). Circadian rhythms are generated by an internal 'clock' in the brain (Liskowsky; 1992) which produces fluctuations in blood pressure, heart rate, body temperature, and hormones. Psychological processes and mental functions such as memory, reaction time, manual dexterity, and feelings of alertness also are impacted by dramatic fluctuations in circadian rhythms (Office of Technology Assessment; 1991).

Circadian rhythms are evident in our daily sleep and wake cycles or work/rest patterns. Circadian rhythms influence total sleep time; uninterrupted sleep becomes deeper in each of four progressive stages leading finally to rapid eye movement (REM) sleep with the greatest restorative power.

b) Relationship between extended duty/irregular hours and driver fatigue

There are jobs where the daily work period is of such long duration that there is a significant reduction in normal sleep; these are known as *extended duty hours* (12 + hours). There are also work/rest patterns without a regular cycle in any twenty four hour period; these are known as *irregular duty hours*. Both work situations cause disruptions to circadian rhythms.

The nature of long haul trucking is that of *extended* and *irregular duty hours*. Long hauls necessitate extended driving with reduced sleep periods. Irregular routing introduces great variation in work/rest periods. Extremely long working days and very short sleep periods disrupt normal circadian rhythms.

Work/rest periods which are out of phase with the body's regular circadian rhythms produce a state of chronic desynchronization. Irregular work patterns and instances of sleep deprivation result in serious fatigue and performance decrements (Glenville and Wilkinson, 1979; Tilley et al, 1982). This makes it difficult if not impossible to be in an optimum state for work (Smiley; 1990). This is manifested in slow reaction time, delayed response, failure to respond when appropriate, false response, and slowed cognition (Office of Technology Assessment; 1991).

c) Relationship between fatigue and road safety

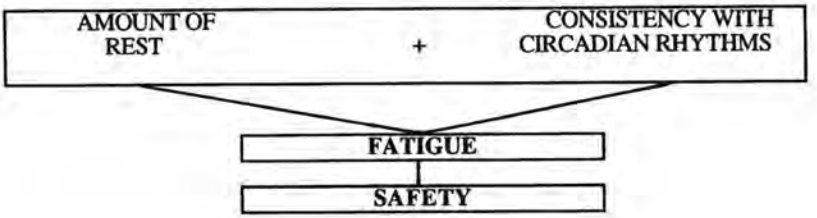
Studies demonstrate a causal link between fatigue and safety. Decrements in driving performance from fatigue result in increased accident rates (Cauter et al; 1990). Fatigue was the most probable cause of 182 crashes in which the truck driver was killed (Sweedler et al; 1990). The National Highway Transportation Safety Administration (1990) estimated that sleep-related crashes constitute 2% of all crashes but 10% of all heavy-vehicle crashes. The probability of vehicle crashes increases with hours behind the wheel and the number of consecutive days on duty (US Bureau of Motor Carrier Safety, 1972; Hamelin,1980; and Transportation Research and Marketing, 1985). As well, there is a higher probability of vehicle crashes from midnight and 6 AM when fatigue is the greatest (Stein and Jones, 1987; Harris, 1977; Hamelin, 1987; and Mackie et al, 1987). Other factors appear to be the combination of driving and non-driving time on driver fatigue (Transportation Research Board; 1978) with fatigue often the product of an irregular schedule (Mackie et al; 1987).

d) A Performance Model

A performance model derived from the literature suggests that fatigue is a function of increased incongruity between work/rest patterns and circadian rhythms, or

F= f (incongruity W/R patterns and CR's)

where F = fatigue levels, W/R = work/rest patterns, and CR's = the body's normal circadian rhythms. The literature also suggests that fatigue is an intervening variable between work/rest patterns and circadian rhythms, and safety. As fatigue increases, there is an increased probability of reductions in safety. This interrelationship is shown below.



Part III - The Exploratory Study

a) The Hinton Rail Disaster

In February of 1986, a westbound CN Rail freight train was in collision with an eastbound VIA Rail passenger train on the CN main line near Hinton, Alberta. The collision occurred because the freight failed to obey signals calling for it to stop. A Commission of Inquiry suggested the collision could have been averted if the engineer had observed and obeyed the signals. The Commission concluded that crew fatigue contributed to a series of human errors which resulted in the collision. The train crew may have been asleep or inattentive for approximately 30 seconds which resulted in missing each of two signals.

Dr. A. Smiley, a Canadian expert in the science of ergonomics, examined the work/rest patterns of the train engineer. She concluded that the sleep obtained by the train crew on the night preceding the crash was so short as not to effect an improvement in their vigilance capacity and that the engineer had insufficient time off to recover from the sleep deficit arising from the previous 30 days. The erratic nature of the engineer's work patterns (Figure 1) produced a state of chronic fatigue which had consequent effects on his alertness and performance. She concluded that without limits on shift lengths, total hours worked in a month, and the erratic nature of work hours, accidents resulting from fatigue would continue.

The inquiry recommended guidelines for rail scheduling

- consider that longer off periods increase the probability of REM-type sleep, the deepest and most restorative form of sleep
- consider that the threshold at which productivity decreases and absenteeism increases is approximately 170 hours per month for workers on long variable shifts without scheduled days
- modify crew scheduling to reduce lengthy irregular work/rest patterns

b) Exploratory study

This exploratory study adopts the performance model described above and compares the work/rest patterns of long haul drivers with that of the train engineer. The logic is that if we can determine when long haul drivers are approaching the critical point of reduced vigilance and impaired performance, we are in a better position to predict the likelihood of an accident and more importantly, to take steps to prevent that accident.

Two owner operators running the Interstate 5 corridor between Victoria, Canada and California were selected. Data from their log books were extracted for a thirty day period. Driver 1 records (Figure 2) for the period 19 October - 17 November, 1992 and driver 2 records (Figure 3) for the period 31 October - 29 November, 1992 were used. This information was then compared with the work/rest patterns of the train engineer using factors such as total daily hours worked, number of consecutive work periods, and work/rest placement.

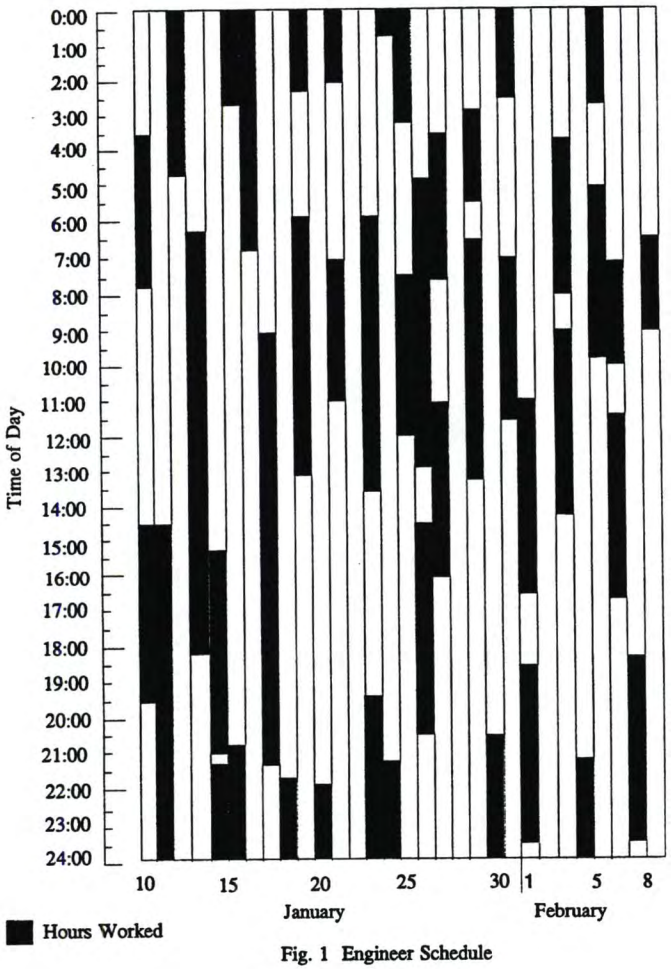


Fig. 1 Engineer Schedule

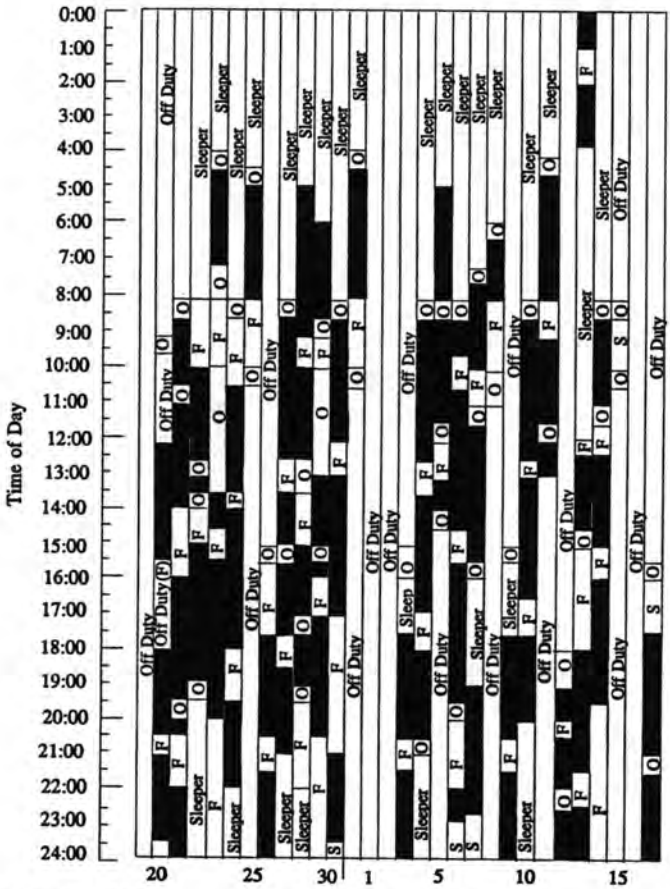


Fig. 2 Driver 1 Schedule

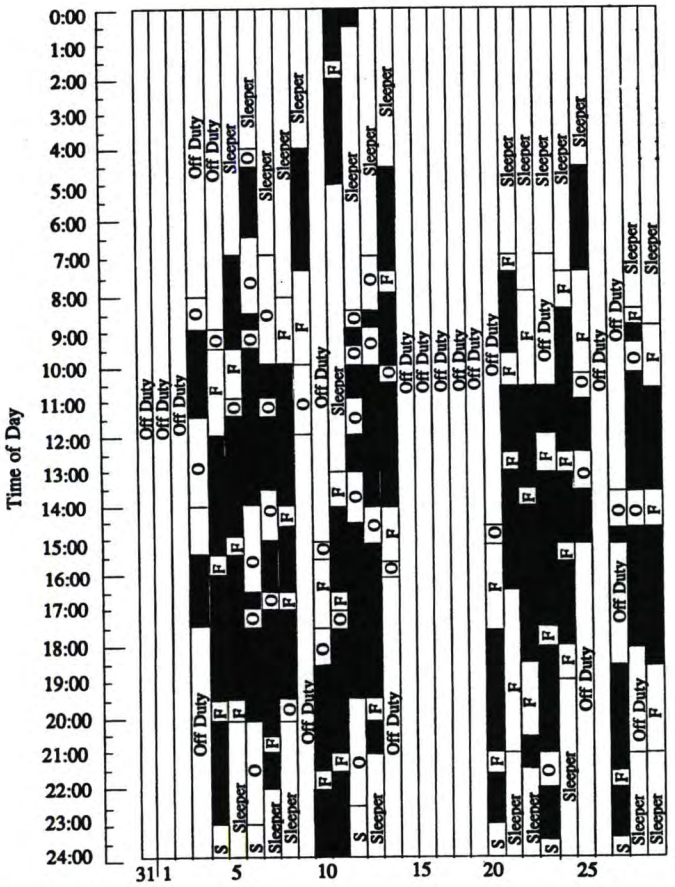


Fig. 3 Driver 2 Schedule

Results

Table 1 compares the work/rest periods for two long haul drivers with those of the train engineer. Our principal concern is the comparison of "on-duty" hours by both the train engineer and the two long haul drivers. While we do not have the actual hours spent by the engineer "driving" the

Table 1. Comparison work/rest periods engineer/long haul drivers

Status	Engineer			Driver 1			Driver 2	
	Hours	%		Hours	%		Hours	%
Off duty	519	72.1		339	47.1		369	51.3
Sleeper				157	21.8		149	20.7
Driving				190	26.4		163	22.6
On duty	201	27.9		34	4.7		39	5.4
	720	100	720	100		720	100	

train, we do know he was on duty for a total of 201 hours during the 30 day period. The results show that work (driving plus on-duty) consumes 224 and 202 hours for drivers 1 and 2, respectively in a thirty day period. Thus, in terms of absolute hours worked in a 30 day period, *total driving and on-duty hours for the two long-haul drivers were equal to or exceeded total hours for the train engineer.* Now, the threshold at which productivity decreases and absenteeism increases is approximately 170 hours per month for workers on long variable shifts without scheduled days (Smiley; 1990). The results show that *the number of hours worked by both highway drivers and the train engineer exceed this guideline by 32% and 19% for drivers 1 and 2, respectively and by 18% for the engineer.*

Actual sleep time for the engineer and two drivers for the thirty day period was examined and compared with sleep for persons working regular day shifts. Assuming a day worker sleeps 240 hours in a thirty day period (8 hours x 30 days), driver 1 slept 189 hours (includes 8 hours for "off duty" status) or 21% fewer hours than a day worker. Driver 2 slept a total 221 hours or 8% fewer hours than a day worker. While further investigation is required to determine the actual amount of sleep the train engineer obtained for the same period, we assume the required number of hours (240) is possible within the total off time hours (519). *What is significant, however, is that there are irregular sleep patterns for the engineer which appear to produce an accumulated sleep deficit resulting in severely impaired performance.*

The number of continuous work days in a 30 day period was examined and is shown in Table 2.

Table 2. Number of continuous work days in a 30 day period

Number of days	Engineer	Driver 1	Driver 2
3			1
4	1		
5	1		
6	1		1
12	1	2	1

There are similarities between the engineer and the two long haul drivers with respect to the number of continuous work days in their respective 30 day work periods. It is obvious from this limited sample that *numerous consecutive work days for some long haul drivers are similar to the extended work periods of the train engineer.*

The number of consecutive days of continuous sleep between midnight and 6 AM in a 30 day period was examined and is shown in Table 3.

Table 3. Number of consecutive days of sleep between midnight and 6 AM

Number consecutive sleep periods	Engineer	Driver 1	Driver 2
1 day	4		
2 days	4	2	1
3 days	1		
4 days			1
5 days		3	2

The results show that in a 30 day period, the number of consecutive days of sleep between midnight and 6 AM for the train engineer tend to be fewer, namely, one and two days.

The data were analyzed by examining the number of days in a 30 day period that both drivers and the engineer were working between midnight and 6 AM. There were 14 days, 7 days, and 5 days when work was undertaken between midnight and 6 AM by the engineer, driver 1, and driver 2, respectively. *Hence, there was a higher percentage of times when the train engineer was working between midnight and 6 AM.* Similarly, *there was a higher percentage of times when the train engineer commenced work between midnight and 6 AM than either drivers 1 or 2.* The engineer started 8 shifts during the period midnight to 6 AM; driver 1 started six shifts during this period while driver 2 began four shifts.

With the exception of driver 2 who had an extended break, the percentage of days worked in a 30 day period is approximately the same for the engineer (86.7%) and driver 1 (83.3%).

An analysis of the hours of service for the two drivers was carried out to check conformity with hours of service regulations. With the exception of one 15 minute period for driver 2 during the 30 day sample period, both drivers were in conformity with the hours of service regulations *according to data from their logbooks.*

PART IV - Countermeasures for alertness and performance

The ability of long haul drivers and train engineers to maintain an adequate level of vigilance is critical to highway and railroad safety. Because of the many similarities between motor carrier and rail operations as evidenced by this exploratory study, it is imperative that motor carriers consider effective countermeasures to reduce the probability of major vehicle crashes. These include scientifically based strategies to change circadian rhythms, monitoring and warning systems, and others.

Strategies have evolved to shift natural circadian rhythms to accommodate changing work patterns and extended work hours. Scheduled exposure to light of various intensities can be used to manipulate human circadian rhythms and promote adaptation to changing shifts (Van Cauter et al, 1990; Dawson and Campbell, 1991; and Czeisler, 1990). While this approach appears to have promise in laboratory tests, the realities of long haul trucking make it difficult to expose a driver to bright light therapy on an ongoing basis.

Other strategies include manipulation of the sleep-wake cycle with the use of short-lasting hypnotic drugs such as Benzodiazeprine, Corticotrophin, and Triazolan (Mitter, 1990; Hrwshesky, 1988). The hormone Melatonin facilitates sleep because of its sedative properties (Office of Technology Assessment; 1988). While these countermeasures have been shown to synchronize circadian rhythms and promote sleep, serious side effects such as memory problems, anxiety, dependency and drowsiness are not acceptable in the trucking industry where vigilance and alertness are paramount.

Other countermeasures include monitoring systems to detect when individuals pose a risk because of impaired performance. Specific on the job tests are impractical to administer to long distance drivers enroute but could be administered at the home terminal. Systems that provide real-time, on the job feedback (Office of Technology Assessment; 1988) show some promise; however, drivers may push themselves beyond acceptable limits by relying on mechanical warning devices. Experienced drivers may have a built-in warning system in that they appear to recognize the inherent dangers of sleep deprivation. They alter their behavior accordingly by increasing the following distance for any given speed thereby effectively reducing task demands (Fuller, 1984).

Napping for long haul drivers has been proposed as an effective countermeasure (Dinges, 1988; Haslam et al, 1987). Four to five hours of uninterrupted sleep prevents impaired performance (Krueger; 1989) while napping before, rather than after, extended periods of work reduces the effects of sleep loss (Office of Technology Assessment; 1991). Some studies suggest, however, the effects of napping are limited and that predicted differences in performance fall far short of the ideal (Dinges; 1988). Czeisler (1990) indicates *smaller segments of sleep do not have the same restorative effects and that there is a failure on the part of regulatory authorities to recognize the interrelationship between circadian rhythms and the necessity for longer uninterrupted periods of sleep.* This finding has a direct impact on the regulations concerning sleeper berths. Hertz (1988) indicates that the practice of accumulating eight hours of rest in two consecutive periods in a sleeper berth increases the risk of fatality to tractor trailer drivers and thus is dysfunctional.

Recommendation 1

The regulation which allows two shorter rest periods in a sleeper berth should be discontinued.

Other countermeasures include innovative carrier routing practices. Fixed schedules, and relay and team drivers improve operational efficiency and reduce the impact of extended and irregular duty hours on drivers.

Few countermeasures appear to be the panacea for vigilance and alertness in long haul trucking, however. This leads to a final area of discussion, hours of service regulations.

Part V - Hours of service regulations

If hours of service regulations enhance the life and work of drivers and improve road safety (McDonald; 1981), there should be a high level of compliance. Numerous studies (Wyckoff,1979; Beilock and Capelle, 1987; Hertz; 1991; Braver et al, 1992) show this is not the case with a substantial proportion of truck drivers in violation of hours of service rules.

Hours of service regulations have little chance of being enforced unless they correspond to operational realities and are designed with the body's circadian rhythms in mind. In an ideal world, for sleep patterns to be consistent with the body's natural circadian rhythms, work periods would not exceed 40 hours in a seven day period. In such a situation, an ideal schedule for long haul drivers would be work periods between 6 AM and midnight with limits on driving after 40 hours. Such an ideal is impractical, however, in the trucking environment where flexibility is the key to prompt deliveries and customer service. Elimination of periods of night driving is simply not acceptable. Similarly, the GAO study (1992) of railroad train crews clearly demonstrates that shortening maximum work hours often increases the variability of start times and work periods which increases fatigue. Hence, it is realistic to believe that all schedules will be sub optimal in terms of driver's needs.

Recommendation 2

The interrelationship between circadian rhythms, work/rest patterns and performance must be considered in development of hours of service regulations.

McDonald (1985) suggests hours of service regulations should consider a) safety which is based on an objective assessment of the relationship between hours of service and actual accident risk rather than miles driven; b) personal factors such as sleep, rest, hygiene; and nourishment; and c) degree of congruence between work norms, and social and domestic norms. Current hours of service regulations permit drivers to work 60 hours in 7 days or 240 in a 28 day period. Smiley (1987) suggests total hours should not exceed 170 in a 30 day period to prevent performance deterioration. *Hence, current hours of service regulations exceed the guideline by 41%.*

What options exist then to reduce the impact of current hours of service regulations on drivers. Several innovations have been proposed. One is the "24 hour rest and recovery rule" which permits drivers to begin a new 60 or 70 hour period following an off duty period of 24 consecutive hours. The FHWA envisioned an enhanced level of compliance with both the 10 and 15 hour rules because the limitations more closely characterize actual operations of motor carriers. While this proposal more closely approximates operational realities, it is inconsistent with the guideline whereby productivity decreases and absenteeism increases at approximately 170 hours per month for workers on long variable shifts without scheduled days. This proposal was withdrawn in January of 1993 (Transport Topic; Jan. 25, 1993). Ontario is currently considering a 36 hour rule which would reset the clock to zero after 36 hours of continuous rest (Transport Topics; March 15, 1993). Thus, a driver could be on duty 100 hours in an 8 day period. A third option is one in which a person drove 10 hours with 8 to 10 hours off in between and a 24 hour off duty period every sixth day; the driver could accrue 96 hours driving in an 8 day period with work cycled repeated indefinitely. These proposals also suffer from the same shortcomings as the first.

Other options include expanding 60 hours in 7 days to 70 hours in the same period; similarly, expand 70 hours in 8 days to 80 hours. (Gough and Gray; 1992). Still others are the 12 on/12 off rule whereby drivers either remain on duty for 12 hours are then required to take 12 hours off duty before they can drive again. Finally, Gough and Gray (1992) describe a 13 driving/15 hour on duty/ 8 hour off duty rule if the caps and cycles are removed. *Most alternatives, however, focus primarily on productivity and fail to take into account the relationship between circadian rhythms and human performance.* Thus, they do little to reduce fatigue and the probability of highway crashes.

Recommendation 3

Proposed changes to hours of service regulations which increase the driving limits by 41% should be carefully considered in view of the guidelines established as a result of the Hinton rail disaster.

Part VI - Discussion

This exploratory study compares the work/rest patterns of workers from the rail and motor carrier sectors as a means to predict the likelihood of accidents. This is a replication of work previously undertaken in the investigation of a major rail disaster.

Some observations about methodology are useful. With very limited sample sizes, study conclusions are tentative and ought to be confirmed with larger sample sizes. Secondly, the credibility of data from highway drivers' log books is open to question. Drivers' hours are likely underreported to meet hours of service regulations and dispatcher demands for on time delivery. Thus, "creativity" in logbook completion suggests the placement of work/rest periods in any 24 hour period may not reflect what actually takes place. Further research to establish the work/rest patterns of long haul drivers should be carried out using recording devices such as on-board tachograph or computer equipment. Hence, it is realistic to believe that with underreporting, *the situation for highway drivers is worse than recorded.* Based on the limited evidence from this exploratory study and subject to the limitations of logbook data, it can be concluded tentatively that *the work/rest patterns of the two long haul drivers may in fact be similar in many respects but not all to that of the train engineer. The obvious difference can be seen in the graph (Figure 1) which shows the erratic nature of the engineer's schedule.*

In spite of the study limitations, the following observations can be made. The graphs and tables show that the percentage of time and actual hours for off duty/rest periods for the engineer and the two long haul drivers are similar. The extended periods are cause for concern in that the research findings indicate the probability of vehicle crashes increases with the number of consecutive days on duty. What is obviously different is the erratic nature of the engineer's schedule. The train engineer had fewer consecutive days of continuous sleep between midnight and 6 AM than did the long haul drivers. The extended work periods and irregular start and stop times of the train engineer prevented a minimum number of hours of sleep each day nor was there sufficient cumulative sleep over a 30 day period to reduce or eliminate a sleep deficit. These results are in sharp contrast to the patterns for the two long haul drivers where sleep is reported to occur for a greater number of consecutive nights between midnight and 6 AM. However, if one considers the limitations of data from drivers' log books, this result is questionable. It is reasonable to assume that with accurate data, sleep periods for long haul drivers also may be so short as to prevent REM sleep, the most restorative sleep phase or so erratic in placement within the 24 hour period as to cause desynchronization with normal circadian rhythms. *Thus, it might be argued that there are marginal differences in a driver's ability to rest when compared to a train engineer.*

With long haul driving, the problem of adequate rest is exacerbated by hours of service regulations which permit the practice of accumulating eight hours of rest in a sleeper berth in two consecutive periods not less than two hours. This practice encourages disjointed sleep patterns and reduced periods of sleep. This situation is similar to that of train engineers because it prevents restorative sleep and promotes a sleep deficit.

Long haul drivers have some latitude in scheduling their work. While time schedules are demanding, the unsupervised nature of the work currently allows long haul drivers to change from "driving" and "on-duty" to "off-duty", or "sleeper berth" status within reasonable limits. This option is not available to train engineers who are closely monitored. Again, the reality of long haul trucking (as opposed to what is reported in logbooks) is such that drivers may not be empowered to change duty status in a competitive, technology-driven environment.

Part VII Conclusion

This paper has described the effects of work/rest patterns and circadian rhythms on driver fatigue and highway safety. This research compared the work/rest patterns of two long-haul drivers with that of a train engineer in a simple but logical case study extrapolation of a rail situation to the trucking environment. While this exploratory study should be replicated with larger and more accurate data bases, parallels in work/rest patterns between the train engineer and two long haul drivers indicate the same potential for accidents in long haul trucking as in the rail industry.

A number of countermeasures are discussed. Unfortunately, few have application to the trucking industry because of its unique operating characteristics. This report concludes that in the interim, greatest strides to trucking safety with respect to human factors will be in the proper design and enforcement of hours of safety regulations which take into account circadian rhythm research.

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Balancing Sufficiency, Efficiency, Simplicity, and Equity: Theory and Practice of Road User Charges

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Introduction

A number of conceptual issues and quantitative problems embedded in the conventional models for the allocation of road costs to users must be approached with caution. These include the theoretical assumptions behind cost attribution and allocation, and issues of revenue raising, tax reform and equity, cost shares among heavy and light vehicles, and intermodal balance. Data deficiencies and uncertainties in the allocation process can jeopardize confidence that charge rates are fair and non-distortionary. The overlay of other fiscal and income distribution objectives upon the tax structure further obscures the objectives of efficiency and equity upon road users.

Road user tax policies and revenue strategies have significant impact on modal choice and vehicle fleet composition, utilization and renewal. Road financing policies and pricing strategies become even more complicated when the issues of congestion pricing, road tolls and infrastructure finance are overlaid upon the user tax regime. As cost-effective refinements in electronic road pricing and automatic vehicle identification and classification become more prevalent, the potential of road pricing not only responding to- but in turn affecting intensity of demand has broad policy implications for financing and implementing road maintenance and improvement programs.

With demand-sensitive pricing, full cost recovery, and charging policies extending beyond congestion and into other traffic externalities including social costs of pollution and accidents, heavily-trafficked sections and urban arterials can potentially generate "profits." Paradoxically, this creates a dilemma for developed countries with sophisticated direct charging instruments available, a

dilemma which parallels that confronting less developed countries with more rudimentary institutions and tax structures.

As financial budgetary doctrine pushes toward full cost recovery and perhaps even generation of surpluses with the addition of congestion and externality-correcting tolls, the three groups of road users, "the tolled, the un-tolled, and the tolled-off,"[1] can all find themselves worse off. Setting the congestion toll to capture an average valuation of time savings means losses for those users with lower values of time and those less willing or able to pay. Those who are priced off the road are also worse off as are those they in turn affect, that is the "untolled" who remain on alternate routes and itineraries but which are affected by diversion of traffic of the "tolled-off". Only in the case of hyper-congestion and gridlock do users most likely perceive the benefit of congestion tolls.[2]

Limits of the Policy Envelope

Below are discussed findings from a number of less-developed country case studies. These serve as examples of what can happen at the extreme edges of the taxation incidence universe, the road user charge policy envelope. These are examples of some of the effects on revenues and user behavior when road user charges are driven by fiscal necessity and financial policy to be an important component of the over-all tax harvest.

Less-developed countries most often suffer from great disparities of income and even wider gulfs in the valuation of time. Narrow tax bases, less efficient collection and administration systems result in funding deficits which are set against many competing demands, among them back-logged road maintenance and rehabilitation needs. Characteristics include pushing to the limit the price elasticity of light vehicles with additional excises, but then a paralleling by high rates of tax avoidance and evasion. Open and hidden subsidies and concessional arrangements to favoured users or operators often further distort modal choice and utilization.

For many countries tax collections from customs duties and sales taxes on vehicles, parts and fuel represent a significant share of public revenue. For example in early 1980's Indonesia, import and domestic sales tax yields on vehicles constituted 17 and 22 percent respectively of total receipts from these two categories of taxes. Road taxes also contributed in the order of 40 percent of provincial tax revenue.[3]

On the expenditure side, as senior and junior levels of government cope with deficits, often the budget-cutting exercise is addressed by reducing budgets for road maintenance. While for a time deteriorating roads may perversely increase tax yields as vehicle operating costs and resource consumption increases with road roughness, eventually travel and commerce suffer and user dissatisfaction turns into open revolt.

To secure steady funding for rehabilitation and maintenance programs, dedication of a share of road user revenues to road upkeep is often recommended. This also has the intuitive appeal that users are more willing to cooperate and pay if a connection between tax and benefit can be perceived. However, tieing or earmarking user revenues is not a panacea either. Finance ministers prefer not to cede control over any portion of revenue. Public officials outside the Roads Authority or Highways Ministry also often question the ability of roads administrators to efficiently carry out their direct engineering responsibilities, let alone administer such a tempting pool of money. There are however, cases where public sector mismanagement is so rampant elsewhere in government, that the Roads Authority may demonstrate a relatively higher administrative competence and capacity to carry out condition-responsive maintenance. Earmarking or dedication of road maintenance funds is then attractive, if only to better ensure program continuity and timely payment. Confidence in husbanding of earmarked funds increases when funds are devoted solely to a maintenance program with perceptible results, a program of finite duration with carefully planned priorities and controls against diversion of funds.

One of the basic problems however remains that while theoretical cost assignments, methodologies, and approximations exist, no country or international lending institution has solved satisfactorily the question of the appropriate level and structure of user charge and the connection with the composition of expenditures. All governments have general revenue and income distribution objectives. In the ideal world this should force them to extract the revenue requirement with a mix of taxes which imposes the least deadweight cost- in other words, choose departures from marginal cost pricing for private and public goods which distort production least and hit income-elastic expenditures most.

General Concepts

Two general approaches have characterized the financing and charging for road use. The first is the treatment of roads as public goods or a natural monopoly

where in principle, excess capacity should not be charged for, and unrestrained pricing above marginal cost is acknowledged to restrict usage. In this theoretical framework, pricing will be optimal and net economic benefits will be maximized when road pricing is set equal to short-run marginal costs, that is, variable road maintenance costs plus externalities- usually limited to congestion costs although pollution charges are being introduced in several EEC countries. In this approach, marginal cost recovery is treated as a separate policy goal from revenue raising or redistribution of income.[4] Road users pay taxes into general revenues and annual budget allocations are made for maintenance and improvements, but there is no direct connection between road taxation, costs of road use, and budgetary expenditures.

The second approach, elaborated further below, subordinates the public goods characteristics of roads to the user-pay principle. Vehicles are charged for use of the roadway and all road costs are allocated to users based on approximations of causality between use and cost. Allocation and assignment of cost responsibility to various vehicle types using the network is based on a mixture of objective and subjective relationships for variable and fixed costs. User charge policy is targeted to recover total allocated costs. Many countries employing the user-pay system also treat road user taxation in two components, a general tax component which applies to other commodities and a specific road user charge component. A few countries recognize explicitly the road user charge component of the tax; many more do not distinguish between general tax and user charge components but set the rate high enough to cover annual road expenditures. Although several country policies are attempting to deal with external costs of road use, including congestion, accidents and environmental impacts, neither of these approaches provides an entirely satisfactory method of cost assessment for these elements.

The cost recovery/cost allocation process assumes constant returns to scale in road construction and road use. This may by chance average out over the entire network, but in rural areas, excess capacity and increasing returns to scale mean that this portion of the network is subsidized by urban users. Additionally there is the problem of scope, that is the delivery of road service to both light and heavy vehicles. This problem is akin to that of allocating freight and passenger rail costs; pavement strengthening and axle damage repair costs should be charged to heavy vehicles, and capacity costs somehow allocated between light and heavy vehicles. These allocations often invite the charge on the part of heavy vehicles that they are being double-charged for use of the road. To further complicate the estimation of marginal costs, there is the problem of fairly allocating fixed costs of routine and periodic maintenance. Depending upon climate and work practice, between 20 and 65 percent of

periodic maintenance costs are fixed and unrelated to traffic. Routine maintenance can account for up to half of maintenance costs and perhaps 70 per cent of this item may be fixed costs.

Generally accepting that user charges should not fall below variable or short-run marginal costs-those that can be attributed to vehicle classes by road wear and use, how best then should the remaining costs be covered? The application and share of the residual to be borne by the users or spread across the general tax base is a function of the costs of general taxation- administration, burden (deadweight) upon the economy and leakage. The less the elasticities of transport demand with respect to the marginal cost of public funds or general taxation, the greater the case for collecting the funding gap from road users. Contemporary public utility cost recovery philosophy also reinforces the capture of this remainder from users rather than through general taxation. Local access and feeder networks may still be financed through beneficiaries with mixtures of property tax, local levies and general revenue, but intercity and urban highways with their higher volumes make attractive candidates for full cost recovery with perhaps even hopes for surpluses.

Methodologies

Estimating short-run marginal costs is the initial step. These costs are immediately avoidable and directly linked to passage of vehicles over the road. These consist of variable administrative and routine maintenance costs and are usually allocated in terms of vehicle-km's, this plus passage of heavy axles-consisting of variable strengthening and resurfacing cost and allocated by equivalent standard axles (ESA's).

Assigning the remaining unallocated costs again usually entails an approach analogous to rail costing concepts of avoidable cost, that is the remainder being divided into those costs which are avoidable over the short-term and are incurred as common costs by identifiable groups of users. These include a remaining share of routine maintenance which can be attributed to heavy vehicles in terms of ESA-km's and the apportionment of improvement and expansion costs to heavy vehicles (by ESA-km's), and to urban and rural road users by passenger car equivalent units(PCU-km's.) Finer grained, more detailed analyses will further breakdown the network by function among urban, intercity and rural and by traffic level and terrain type. The remainder of unapportioned costs, common to all users and fixed regardless of usage (short of complete road closure) are commonly allocated either on the basis of use in

terms of vehicle-km's or through a mark-up on the sum of the first two allocations, variable and avoidable common costs.
The mark-up approach seeks to generate enough revenue to cover collective common costs but minimize the loss of consumer surplus to individual classes of users- in other words not to price off classes of cost-sensitive users. As with other modes, this is also known as "PWTMWB" or pricing what the market will bear. In traditional economic terms, the more inelastic the demand, the more potential for marking up the price over marginal cost, or in other words, the percentage markup should be inversely proportional to the price elasticity of demand. When the economic costs of general taxation are high, perhaps 20 per cent or more, public welfare costs of pricing users at their average cost are generally less than combined financing with marginal cost pricing and general revenue taxes, the latter making-up the shortfall. [5]

Caveats

The adverse impact upon those users least able to pay average or marginal cost allocations, for instance public transit, may be offset through subsidy or transfer payments, but such ameliorative policies are often clumsy or misdirected, not accruing to lower income and mobility groups but to the middle and upper income classes. Among other considerations, uneconomic diversion of traffic, the "tolled-off," should generally not exceed 10 to 15 per cent of vehicle trips.[6] The impact of queues and diversions should also be considered in the feasibility analysis of direct charging and toll facilities.

The case for collecting from heavy vehicles by general taxation the difference between their marginal costs and total highway costs is based on the argument that freight transport as an intermediate good should not be subject to pure taxation. However, where the tax base is narrow and administration weak, many final goods and services may escape tax; hence taxes on intermediate goods and services such as trucking may be the only available alternative for raising revenue.

The arguments for optimum pricing and comparison of efficiency of general taxation vs specific user charges also hinge upon the relative efficiency of the delivery of service. When highway investment and maintenance are not delivered efficiently, backlogs of work accumulate, and user operating costs increase as a result of deteriorating road conditions. Instituting a system of "optimum taxes or user charges" based on allocated costs may in itself be a further cause of distortion and welfare loss.

In the ideal, taxation levels should not create or exacerbate distortions in provision of road facilities or choice of mode or type of vehicle. In sum, for the user-pay approach and looking beyond at the level of revenue generated by taxes and tolls, it is important to assess impacts upon users and the general public in terms of four general criteria:

- Sufficiency of revenues to cover firstly, road maintenance costs attributable to traffic loading, and secondly, use of road space, including congestion.
- Efficiency in allocation of traffic within and between modes;
- Simplicity of collection and administration
- Equity and fairness of cost assessment among users and non-users

Cost Assignment Model

To carry out a general cost assignment involves the following steps:

a. Determination of the incidence of the existing tax system upon the vehicle fleet, including the tax component of economic vehicle operating cost and separating the general commodity portion of tax from that increment specific to vehicles and their road use;
b. Evaluation of the costs of road use and allocation of these costs to the fleet by type of vehicle;
c. Comparison of the road user charge(RUC) contribution to the allocated cost share for each vehicle type.

As may be noted from Table 1, drawn from the 1990 road user charges study in Sri Lanka,[7] a not untypical example of a developing economy's structure of taxation, three issues emerge. These include:

- large contribution by light vehicles in terms of both general tax revenues and the road user charge;
- under contribution by heavy vehicles with respect to cost share in terms of both total tax burden and road user charge, in this case mainly because of the subsidy on diesel fuel, as measured in terms of the disparity between domestic sales price and the border price of fuel.
- an even greater disparity when cost allocations are based upon an idealized, closer to optimum highway rehabilitation and maintenance program, one which if satisfactorily implemented would produce vehicle operating cost savings far in excess of the additional maintenance expenditures.

Table 1: Sri Lanka: Relative Contributions to Revenue and Road Cost Responsibility, 1990

	Tax share of Vehicle Operating Cost		RUCS Tax Yield vs Road Cost Share	
Vehicle Type	Tax/VOC	RUCS/VOC	1990/91 Budget	'Ideal' Budget
Motor cycle	0.50	0.39	6.507	3.865
Car	0.54	0.47	30.217	17.836
four-wd	0.40	0.24	23.719	14.000
Pickup-petrol	0.38	0.28	15.764	9.254
Pickup-diesel	0.35	0.21	11.019	6.468
Minibus-petrol	0.39	0.31	20.859	12.100
Minibus-diesel	0.33	0.19	10.570	6.132
Med bus	0.29	0.14	0.242	0.037
Lg bus	0.25	0.13	0.015	0.002
Truck 4.4T	0.33	0.15	0.017	0.003
Truck 7.0T	0.33	0.16	0.026	0.004
Truck 12.5 T	0.32	0.16	0.005	0.001
Truck 16 T	0.31	0.11	0.010	0.001
Truck 21T	0.34	0.17	0.038	0.006
Truck 30.5 T	0.34	0.12	0.085	0.013

Source: Ministry of Finance and Roads Authority, Government of Sri Lanka

For many countries, the policy to charge heavy vehicles less than their road cost share has been driven by two concerns. The first has been the view that freight and public passenger transport is an intermediate good and a lower tax burden would keep transport rates down. A second concern has been the desire to keep diesel prices low to assist other sectors such as fisheries, agriculture, and power generation. Oftentimes, raising the price of diesel to reflect allocated cost responsibility has led to smuggling from lower-priced sources or mixing kerosene, subsidized for household use, into the motor fuel.

Equity and Evasion

The question of cost allocation among users is further complicated by the fiscal administration of a country and the breadth of tax incidence upon the transport

sector. For both Indonesia in the early 1980's and Laos in the early 90's, significant portions of the motor fleet avoided elements of the tax structure, particularly entry fees, the taxes on ownership.

Indonesia in 1980 collected 75 per cent of the potential taxes on vehicle purchase, including customs duties, import and domestic sales taxes. With parts, tires, and lubricants, however, only 46 per cent of the potential taxes were collected. Again, light vehicles bore the major burden in terms of collection efficiency as shown in Table 2.

Table 2: Indonesia: Comparison of Potential vs Actual Tax Contribution,1980

Type of Vehicle	Revenue Contribution (%)	
	Potential	Actual
Motorcycles	13.4	10.4
Sedans	44.4	58.4
Bus & lt. pass.	16.6	14.5
Trucks	25.6	16.7
Total	100	100

Source: Direktorat Jenderal Perhubungan Darat, Government of Indonesia

As with many countries, weak enforcement at provincial level constituted a major leakage of registration, licensing and transfer fees, in many instances achieving less than half the potential yield, even when government and international agency vehicles were excluded from the fleet. In the case of 1980 Indonesia, provincial receipts amounted to only about 40 percent of potential collections.

In Laos, a number of leakages effect the tax structure. [8] Except for motorcycles, all vehicles have been imported. Of these, a significant share were officially exempt under diplomatic, project or government agency affiliation. For example, more than 30 per cent of cars, 25 per cent of pickups and jeeps, and 12 per cent of trucks avoided import duties and sales taxes. For those vehicles subject to tax, extensive undervaluation and "negotiated assessments" has led to effective tax rates significantly less than statutory rates. In the case of cars, statutory rates ranged between 60 and 80 per cent of value, but effective duty rates of collection were in the order of 20 percent of declared

cif value. With respect to the business turnover/sales tax, cars should have paid a rate of 10 percent; the effective collection has been in the order of 1.6 percent. For the total entry or purchase tax collections, yield has been less than 60 percent of potential. In considering the road user increment of tax revenue, effective collections were estimated at slightly over half of potential.

The estimated tax contribution from road users for 1992 amounted to about US$9 million . The road user increment amounted to $5.8 million, close to the 1993 road maintenance budget of $5.4 million (foreign and local funds combined). Since then, it is anticipated that IMF-advised reforms on assessments would improve revenue collection. As in many countries, however, the large share of tax-exempt imports and high rate of tax evasion cuts into one of the major sources of tax revenue for the country.

Another aspect is perhaps more telling through the results of sensitivity analysis on assumptions for estimating charging units and allocating costs between light and heavy vehicles. As shown below in table 3, equally plausible sets of assumptions produce interesting differences of result. Comparing against cost allocations a proposed roads budget which could catch-up on war and neglect-incurred rehabilitation needs, produces an interesting range of short-fall estimates between light and heavy vehicles.

Table 3: Lao Peoples Democratic Republic: Comparison of Road User Taxes And Cost Assignments

Part A: Steady-State Budget Allocation On Major National/Provincial Network

	Cost Allocation Basis			
Base Assumption "A"	Total	veh-km	ESA	PCU
Maintenance (% Share)	45%	45%	10%	
($US Mill)	5.4	2.4	2.4	0.5
Rehabilitation (% Share)	10%	70%	20%	
($US Mill)	21.1	2.1	14.8	4.2
Total (% Share)	100%	17%	65%	18%
($US Mill)	26.5	4.5	17.2	4.8

Part B: Sensitivity Analysis

	Road Use Cost Shares $US Mill.	Revenue/Cost Ratio
Base Assumptions "A" (Rehab shares: 70% ESA's; 10% Veh-km's; remainder by PCU's Ministry Estimate of Vehicle Fleet and PCU-Effect)		
Light veh.	3.7	0.82
Heavy veh.	22.8	0.12
Alternative Assumption "B" (25% more light veh-km's)		
Light veh.	4.1	0.73
Heavy veh.	22.3	0.13
Alternative Assumption "C" (Heavy veh. PCU factor 25% higher)		
Light veh.	3.5	0.87
Heavy veh.	23.0	0.12
Alternative Assumption "D" (Rehab shares: 50% ESA's; 30% Veh-km's; remainder by PCU's)		
Light veh.	5.8	0.51
Heavy Veh.	20.6	0.14

Source: Ministry of Economic Planning & Finance and Ministry of Construction, Transportation, Posts, and Communications, Lao PDR

Influencing User Behavior Through Tax Carrots And Sticks

Energy, environmental, and broader objectives figure prominently in many transportation policies. Government policies to influence vehicle choice, use, fuel efficiency and axle load damage take various forms of road user charges. As mentioned previously, road user charges can be viewed as two-part tariffs with "entry" prices, the front-end taxes on vehicle purchase and ownership, and those which vary with use such as fuel taxes and kilometer charges. Kilometer taxes have been in effect in the Scandinavian countries and some U.S. states for some years. France is considering varying charges on toll roads by location and time of day. High registration and licensing fees have had dramatic effects on curbing growth of auto fleets in many countries, Singapore being a notable example. Many jurisdictions also penalize older cars with the objective of discouraging less safe or more polluting vehicles from the road.

Given the costs of pavement repairs or additional pavement strengthening which heavily loaded vehicles impose, institutions financing road rehabilitation projects have pushed for additional charges based on ESA's, with the impetus

to encourage more road-friendly trucks with weight distribution over more axles. Systematic enforcement programs on overloading are complementary. Public Works authorities in Malaysia report that implementation of such policies has hastened fleet evolution to multi-axle tractor-trailers. Part of this evolution however can be attributed towards carrier consolidation and the demise of smaller trucking firms which depended on single or double-axle straight trucks. Most effective have been the "flying squads" of portable weigh scale enforcement teams patrolling the country's primary system.

Congestion Pricing

As increasing urbanization and motorization causes more traffic congestion, so now electronic means of direct road charging by time and place are becoming more feasible. Transaction costs for electronic road pricing are decreasing relative to manual, cordon, and toll-booth systems while their reliability and user convenience is increasing. Although electronic road pricing system costs are significant, these schemes are becoming more attractive on congested links, justified in deterring road over-use and potentially yielding user time and operating cost savings in excess of agency and user cost. Congestion pricing will also produce by-products of reduced air and noise pollution.

From the user's point of view, direct road pricing with peak-off differentials and discrimination by time, distance, and location must be simple to understand in terms of when, where and how much. Agency goals should include the efficiency and flexibility of direct charging for the internal and external costs of road use by time and space occupancy as well as performance reliability and consistency with mixed traffic in varied and sometimes hostile environments. Security from fraud by users and operators is another consideration. Finally, economic and financial viability depends upon passing the benefit-cost and revenue-cost tests.

Because of the negative impacts on the "tolled and the tolled-off," the system must be perceived as fair and the benefits returned to society in some combination of forms. Earmarking revenues may help in the political sale of road pricing schemes; other inducements can include reductions in front-end or entry taxes on first registration and licensing, improved public transport, and better driving conditions.

In summary, the message is one of caution in attempting full-cost recovery and congestion/social cost penalty pricing. The third-world examples cited above illustrate what happens in approaching the limits of information analysis, policy

implementation, and administrative capability. Fine-grained marginal cost pricing depends upon daunting data requirements which discriminate between types of vehicles and reflect the difference between existing and "optimal" road use by time and place. Improvements in pavement deterioration models will allow better approximations of incremental cost by vehicle type, but measurement flaws and calibration problems should humble assertions that "optimality" has yet been achieved. Cost allocation is still relatively crude and insensitive to vehicle differences; this results in overly aggregated marginal cost curves covering a mixed bag of users. Enthusiasm for user-pay and external social cost recovery must be tempered with some compassion for the potentially "tolled-off" who still have to make work trips by some means.

Furthermore, there is a message from the citizens of Hong Kong who with their eye on 1997, warn that surveillance and billing by time and location can be interpreted as an unacceptable invasion of privacy. Further advice can be taken from Singapore, a pioneer in central area licensing, vehicle fleet control, and soon, electronic road pricing with smart cards and automatic vehicle identification. Their philosophy of user acceptance and successful implementation has been to offer with each new system of charging, anonymity of charge unit coupled with an increase in the level of service- better park and ride opportunities and enhanced transit, while inducing reduced congestion in core areas.

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Lions Gate Bridge - Vancouver
Toll Revenue and Traffic Impact Study

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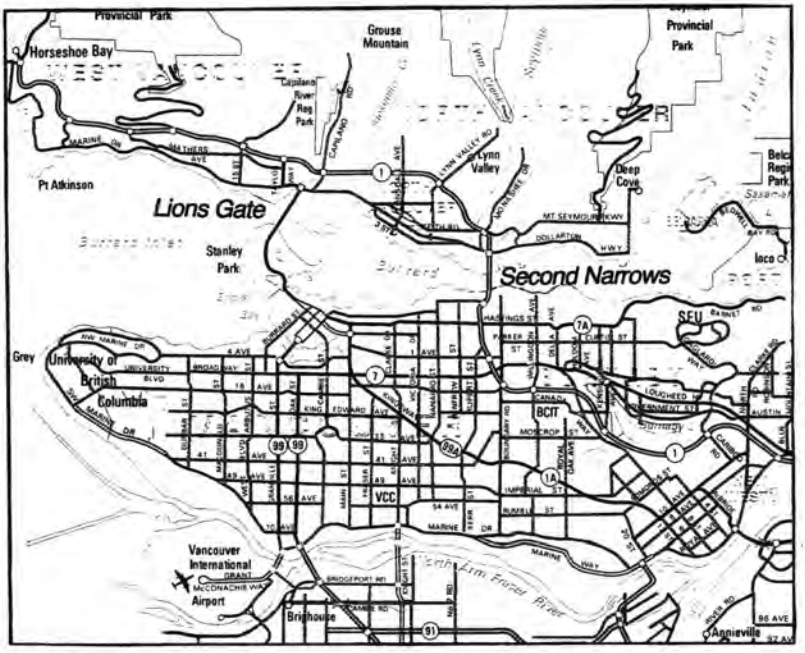
Introduction

The Lions Gate Bridge and the Second Narrows Bridge are the two major links carrying 70,000 and 100,000 vehicles/day respectively across the Burrard Inlet between North Vancouver and Vancouver (exhibit 1). The Lions Gate Bridge is now 56 years old and is approaching the end of its physical and functional life. Several improvement alternatives are being studied and tolls are being considered as a means to finance future capital works. The objectives of this study are to analyze the impact on traffic patterns of introducing tolls on the Lions Gate and Second Narrows Bridges and to assess the potential toll revenues.

The analysis assumes the Lions Gate Bridge is replaced or improved to provide four full standard lane widths replacing the existing three substandard width lanes.

Traffic demands and traffic forecasts on the improved system were developed under different toll rates and schemes using the Transportation Model developed by the Greater Vancouver Regional District (GVRD). The GVRD Transportation Model is implemented using the EMME/2 transportation modelling package.

Exhibit 1
The Study Area



GVRD Transportation Model

The GVRD Transportation Planning Model is a strategic planning tool that can be used to estimate morning peak hour travel demand for current and future years. The model is comprised of three main components:

- **traffic zone system** - The region is divided up into 445 traffic zones. Each zone contains detailed demographic information for current and future years.
- **road and transit network** - a digital road and transit network provides coverage for the entire region. The road network consists of 1,900 nodes (intersections) and 7,000 links (roadway segments). Each roadway link

contains information on the number of lanes, posted speed limit, capacity and turning restrictions. The transit network which utilizes the road network (with the exception of Skytrain and SeaBus), contains information on 180 transit lines totalling 8,000 transit line segments.

- **modelling procedure** - predicts the number of auto and transit trips made in the morning peak hour (7:30-8:30 am)

The modelling procedure is based on the classic four step transportation forecasting methodology:

- **Trip generation** - estimates the number of person trips produced and attracted by each traffic zone based on zonal demographics (e.g. population, labour force, employment). This stage produces a set of production and attraction vectors for four trip purposes: work, post-secondary school, grade school and other.

- **Trip distribution** - a gravity model that allocates trips between origin and destination based on the impedances (auto and transit travel costs - including perceived time costs, operating costs, parking costs etc.) between zones. This stage produces origin/destination tables for the four trip purposes.

- **Mode split** - a logit model that determines how many trips go by auto or transit, based on the impedances between zones. This stage produces origin destination tables by mode and trip purpose. These tables are aggregated by purpose to produce an auto driver and transit passenger trip table.

- **Trip Assignment** - utilizes the EMME/2 equilibrium assignment algorithm to load the auto trips onto the digital network, and through an iterative process, estimates the routes taken by each trip. The transit table is assigned to the network using a multipath assignment algorithm to determine transit routing. A multitude of statistics are available from the assignments that include: link volumes (auto and transit), link speeds, origin destination travel times, transit loading factors etc.

The current model was calibrated using survey data collected from 1985 (Greater Vancouver Travel Survey). It has since been validated for 1992 travel conditions using demographic estimates and vehicle and transit screenline data.

Modelling Road Tolls

The application of road tolls could potentially affect travel demand and patterns for each step of the modelling process - trip generation, trip distribution, mode split and trip assignment. The current GVRD Transportation Model together with the EMME/2 transportation modelling package are capable of simulating changes in trip distribution, mode split and trip assignment as a result of road tolls. The effects of road tolls on the four step modelling process are discussed in the following sections.

Most of the trips made during the morning peak hour are obligatory trips (work and school trips)and tend to be inelastic with respect to the cost of travel. In another word, many of these trips have to be made for work or school purposes, therefore, the impact of road tolls on morning peak hour trip generation would be minor or negligible. However the impact of road tolls on discretionary trips (e.g. leisure family, recreation and shopping trips) might be greater due to the elastic nature of these trips. Most discretionary trips usually occur during afternoon and off-peak periods.

The added cost of road tolls would also result in changes in trip distribution similar to traffic congestion. In general the impacts of road tolls on trip distribution would be more gradual and longer term because the majority of trip makers could not change their residential or employment locations immediately after the imposition of road tolls. The study only considered a ten year time frame and their impacts on trip distribution was considered to be negligible.

Road tolls would have immediate impacts on mode choices. The additional costs would shift some of the auto users to higher occupancy vehicles and public transit. The simulation of mode shifts was performed using the GVRD Logit Mode Choice Model by including road tolls in the generalized travel time impedances measured in units of time. Different road toll schemes were tested by increasing the time impedances on a link by the time equivalent of the proposed tolls. The time equivalent of a toll is the amount of the toll divided by the value of travel time.

$$\text{Travel Impedance (minutes)} = \frac{\text{Toll Rate (\$)} \times 60}{\text{Time Value (\$/hr)}}$$

The time equivalent of a given toll would also vary by aggregated income level and by vehicle occupancy.

A road toll would also have an immediate impact on route choice in the transportation network. The trip assignment was performed using the EMME/2 equilibrium assignment algorithm. The auto assignment program considers travel time, vehicle operating cost based on distance travelled, and road tolls in the computing network paths for each iteration of the assignment. Typically 15 to 30 iterations are required to achieve network equilibrium depending on the level of traffic congestion and the value of the toll. Exhibit 2 depicts the shift in network traffic as the toll on the Lions Gate Bridge increases.

Study Assumptions

A base case and two proposed scenarios were tested. The base case assumes no tolls are in place and the Lions Gate link is a 4 lane link. The proposed cases simulate:

1. Tolls on Lions Gate Bridge only
2. Tolls on both Lions Gate and Second Narrows Bridges

The two scenarios simulate traffic diversions which would occur between the two bridges over a range of equivalent toll impedances from 10 to 40 minutes.The analysis assumes:

- No change in trip generation or distribution from the base case
- Constant number of person trips across Burrard Inlet

The values of time used were:

Commuter Trips	$6 to $9/hr
Business/work trips	$18/hr
Other Trips	$2 to $3/hr

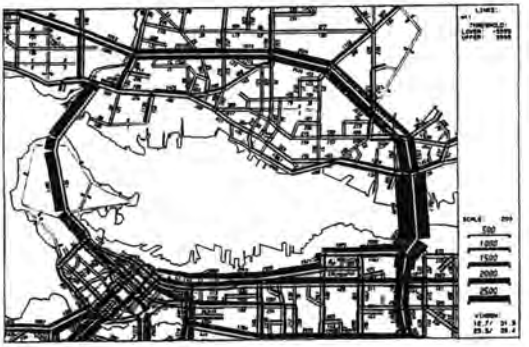
Analysis

In scenario 1, a range of tolls from $1 to $7 are applied to the Lions Gate bridge only, to establish the pattern of traffic diversion away from the bridge. Exhibit 3 shows the percentage of daily traffic which diverts as the toll level is increased. The diverted traffic includes traffic shifting to the Second Narrows Bridge (a toll free alternative) and from private auto to transit. The initial effect of a $1 toll in each direction results in about 23% of Lions Gate traffic diverting to Second Narrows or to transit. As the Lions Gate toll is increased further the rate of diversion declines due to the increasing congestion on the Second Narrows Bridge.

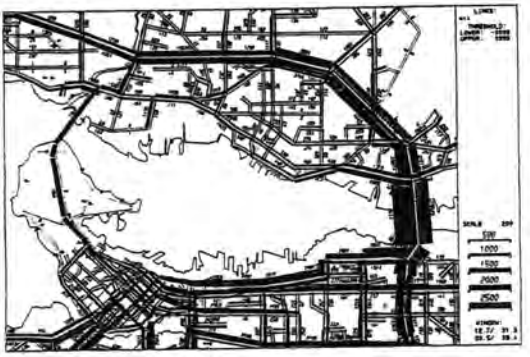
Exhibit 2
Traffic Shift to Second Narrows with Tolls on Lions Gate Bridge



No Toll

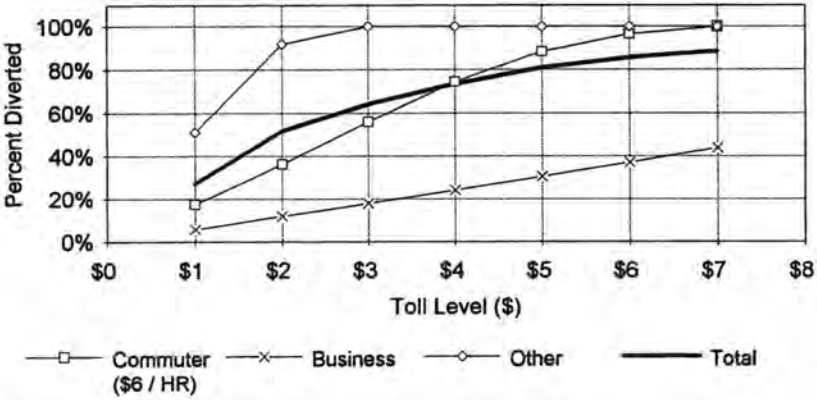


$2 Toll



$7 Toll

Exhibit 3
Two Way Tolls on the Lions Gate Bridge Only
Diversion to Second Narrows Bridge and Transit



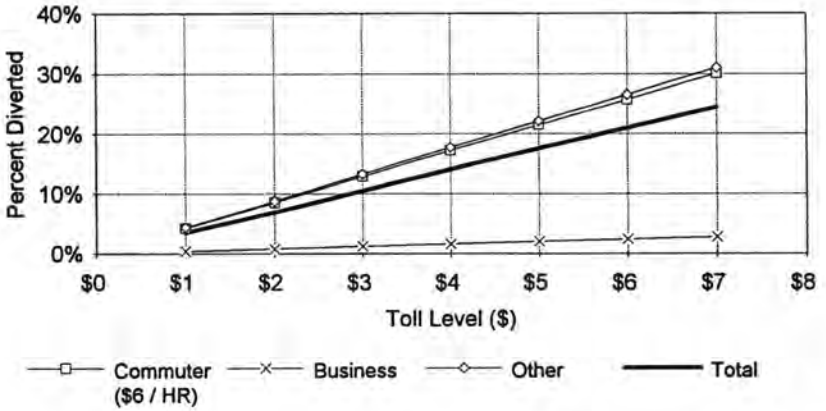
In scenario 2, the tolls are increased on both bridges simultaneously. The increasing toll level results in a shift to transit but very little diversion between the two bridges. Exhibit 4 plots the results for this scenario and shows that the diversion to transit is a linear function of toll with about %3.5 diversion for each $1 increase in the toll.

Calculating the daily toll revenues cannot be done directly from the link volumes provided by the GVRD Regional Transportation Model since the model is designed to predict volumes for the a.m. peak period only. The a.m. peak hour volumes were factored up to daily volumes based on the weekday hourly traffic profile from permanent count stations (PCS) on the approaches to each bridge.

Annual toll revenues were similarly factored up using PCS data for the entire year. The day which was modelled was a typical October weekday. Annual traffic is then calculated, knowing the ratio between the typical October weekday volume and the annual weekday volume.

In addition to toll level, the rate of traffic diversion is also influenced by other travel factors which vary over the course of the day. Ideally these factors would be incorporated in further runs of the regional model representing the p.m. peak and off-peak periods. At present, the regional model does not have these capabilities and, for the purpose of this study, a series of extrapolations were made outside the modelled a.m. peak period.

Exhibit 4
One-Way Toll (SB) on Both the Lions Gate and Second Narrows Bridges - Diversion to Transit



Trip purpose data during peak and off peak periods was taken from 1985 GVRD travel surveys to provide approximate proportions of commuter, business and other trip purpose for different periods of the day. As the trip purpose varies, the aggregate value of time will also vary. If the average value of time increases during off-peak periods, due to a higher component of business travel, then there will be increased acceptance of a specific toll as compared with the specific modelled a.m. peak period. This results in a lower proportion of diversion to other routes and modes.

For a given trip purpose and toll at Lions Gate, the proportion of traffic diverted to Second Narrows will also vary depending upon general volume and travel time conditions throughout the network. During off-peak periods for example, travel times throughout the network joining North Vancouver and Vancouver are substantially less than those experienced in the morning peak period. During these periods the reduced travel times mean that the catchment area of trips which divert to the Second Narrows Bridge will be much larger for a given toll.

In using the regional model a.m. peak projections with mode split changes incorporated, consideration had to be given to estimating transfers to transit during the rest of the day. For different periods of the day, estimates of the existing percentages of trips by transit to and from North Vancouver (excluding internal

North Vancouver trips) were taken from the 1985 GVRD travel Survey. Overall transit ridership levels have been fairly constant over recent years.

The rate of transit ridership in the a.m. peak period and direction is about three times greater than off-peak rates. To account for this variation over the day, a series of factors were established for other time periods to reflect the changes in transit ridership rate (by direction) relative to the modelled a.m. period. An allowance was also made for trip purpose, since commuter travel is more likely to use transit when compared to business and personal travel.

Based on the travel factors outlined above, a spreadsheet analysis was developed to maintain separated journey purposes by direction and time of day for diversion analysis. An example of this worksheet is illustrated in exhibit 5.

The left hand column in exhibit 5 (6-9 a.m.) presents the traffic diversions based on the model runs, and the remaining column show the extrapolations for the rest of the day. At the bottom of the spreadsheet the summary includes the estimate of diverted traffic and distribution of toll revenue.

These worksheets were completed for each combination of toll charge, bridge and direction and used to determine the diversion rates in exhibits 3 and 4 and toll revenues in exhibits 6 and 7.

Summary of Results

Exhibit 6 shows the impact of increasing toll level on total toll revenues in scenario 1 where the toll is applied only to the Lions Gate Bridge. The graph shows total revenue increasing up to a toll level of $3. As the toll increases beyond $3, total revenues begin to decline again as the revenue lost to diverting traffic begins to exceed the revenue gained from the higher toll level. At a toll level of $3, there is an estimated 60% diversion including diversion from private auto to transit or to the Second Narrows Bridge.

The estimated diversion is about 20% for each $1 of toll implemented on the Lions Gate Bridge.

Exhibit 7 shows the impact of toll levels on total revenue for scenario 2 where tolls are applied equally to both bridges. Total revenues increase almost linearly with toll level since traffic cannot divert to a non-tolled route. The estimated diversion from private auto to transit is about 3% for each $1 of toll implemented on the two bridges.

Exhibit 5 TOLL REVENUE WORKSHEET – WEEKDAY AUTOMOBILE TRAVEL

BRIDGE: LIONS GATE (NO TOLL ON SECOND NARROWS)
DIRECTION: SOUTH BOUND
TOLL: $2.00

TIME PERIOD	1 6–9 A.M.	2 9–12	3 12–3 P.M.	4 3–6	5 6–9	6 9–12	7 12–3 A.M.	8 3–6	9 24 HR
TRAFFIC DATA (1992 VOLUMES)									
A. TRAFFIC VOLUMES	9300	6900	5100	4600	3800	2200	400	400	32699.5
B. VOLUME FACTOR	1.00	0.74	0.55	0.49	0.41	0.24	0.04	0.04	3.52
C. VOLUME FOR DIVERSION	9300	6900	5100	4600	3800	2200	2000	2000	–
C1. OVERALL USAGE FACTOR	1.00	0.40	0.30	0.39	0.30	0.20	0.10	0.00	
C2. COMMUTER TRANSIT FACTOR	1.10	0.55	0.45	0.54	0.42	0.28	0.14	0.00	
C3. BUSINESS TRANSIT FACTOR	0.40	0.20	0.16	0.20	0.15	0.10	0.05	0.00	
C4. OTHER TRANSIT FACTOR	0.80	0.40	0.32	0.39	0.31	0.20	0.10	0.00	
C5. COMMUTER TRANSIT DIVERSION	10.4%	10.4%	10.4%	10.4%	10.4%	10.4%	10.4%	10.4%	
C6. BUSINESS TRANSIT DIVERSION	4.8%	4.8%	4.8%	4.8%	4.8%	4.8%	4.8%	4.8%	
C7. OTHER TRANSIT DIVERSION	43.8%	43.8%	43.8%	43.8%	43.8%	43.8%	43.8%	43.8%	
TRIP INFORMATION									
D. COMMUTER %	80%	40%	20%	40%	20%	10%	10%	10%	43%
E. COMMUTER VOLUME	7440	2760	1020	1840	760	220	40	40	14120
F. COMMUTER AUTO OCC.	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	
G. BUSINESS %	10%	30%	30%	30%	20%	10%	10%	10%	21%
H. BUSINESS VOLUME	930	2070	1530	1380	760	220	40	40	6970
I. BUSINESS AUTO OCC.	1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10	
J. OTHER %	10%	30%	50%	30%	60%	80%	80%	80%	36%
K. OTHER VOLUME	930	2070	2550	1380	2280	1760	320	320	11610
L. OTHER AUTO OCC.	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50	
TIME VALUE INFORMATION									
M. COMMUTER TIME VALUE ($/HR)	$9	$9	$9	$9	$9	$9	$9	$9	$9
N. BUSINESS TIME VALUE ($/HR)	$18	$18	$18	$18	$18	$18	$18	$18	$18
O. OTHER TIME VALUE ($/HR)	$3	$3	$3	$3	$3	$3	$3	$3	$3
P. TOLL ($)	$2.00	$2.00	$2.00	$2.00	$2.00	$2.00	$2.00	$2.00	$2.00
DIVERSION CALCULATION									
Q. COMMUTER IMPEDANCE (MIN)	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	
R1. COMMUTER % DIVERTED TO TRANSIT	11.4%	5.7%	4.7%	5.6%	4.4%	2.9%	1.5%	0.0%	8%
R2. COMMUTER % DIVERTED TO 2ND NARROWS	1.6%	14.1%	23.5%	25.9%	30.4%	39.3%	40.9%	41.5%	11%
R. COMMUTER % DIVERTED	13.1%	19.8%	28.2%	31.5%	34.7%	42.2%	42.4%	41.5%	20%
S. COMMUTER VOLUME DIVERTED	973	545	288	579	264	93	17	17	2775
T. BUSINESS IMPEDANCE (MIN)	6.1	6.1	6.1	6.1	6.1	6.1	6.1	6.1	
U1. BUSINESS% DIVERTED TO TRANSIT	2.0%	1.0%	0.7%	0.9%	0.8%	0.5%	0.2%	−0.0%	1%
U2. BUSINESS% DIVERTED TO 2ND NARROWS	0.4%	7.7%	13.2%	14.7%	17.1%	22.0%	22.7%	22.8%	11%
U. BUSINESS % DIVERTED	2.4%	8.7%	13.9%	15.6%	17.9%	22.5%	22.9%	22.8%	12%
V. BUSINESS VOLUME DIVERTED	22	179	213	216	136	50	9	9	834
W. OTHER% IMPEDANCE (MIN)	26.7	26.7	26.7	26.7	26.7	26.7	26.7	26.7	
X1. OTHER% DIVERTED TO TRANSIT	35.1%	17.5%	14.0%	17.1%	13.6%	8.8%	4.4%	0.0%	15%
X2. OTHER% DIVERTED TO 2ND NARROWS	10.2%	35.2%	54.1%	56.8%	66.9%	87.1%	93.4%	97.7%	57%
X. OTHER % DIVERTED	45.3%	52.7%	68.1%	73.9%	80.5%	95.8%	97.8%	97.7%	72%
Y. OTHER VOLUME DIVERTED	421	1092	1736	1020	1836	1687	313	313	8417
SUMMARY									
Z. TOTAL DIVERTED	1416	1816	2237	1814	2236	1829	339	338	12026
AA. TOTAL % DIVERTED	15.2%	26.3%	43.9%	39.4%	58.8%	83.1%	84.8%	84.6%	36.8%
BB. TRAFFIC REMAINING	7884	5084	2863	2786	1564	371	61	62	20674
DD. % 24 HOUR TOLL REVENUE	38.1%	24.6%	13.8%	13.5%	7.6%	1.8%	0.3%	0.3%	100.0%

Exhibit 6
Two Way Toll on the Lions Gate Bridge Only -
Daily Toll Revenues

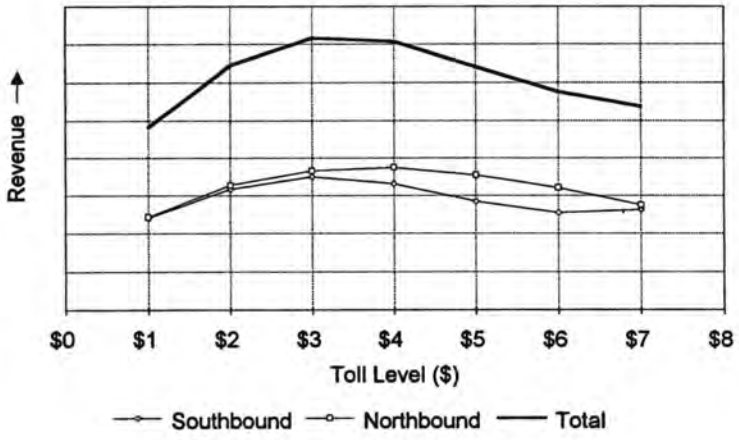
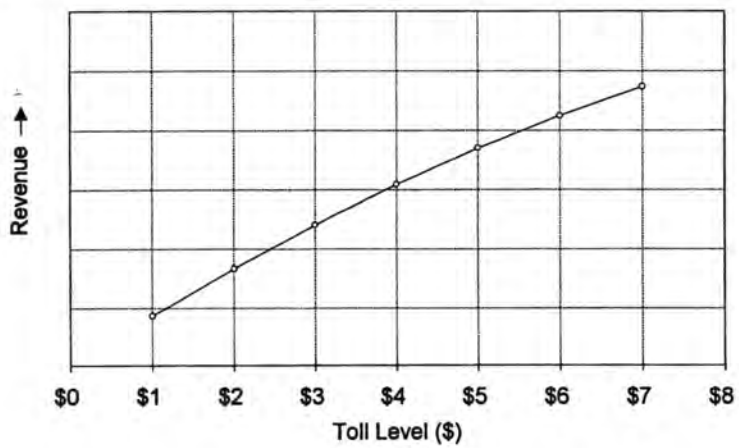


Exhibit 7
One-Way Toll (SB) on Both the Lions Gate and Second Narrows
Daily Toll Revenues



Conclusions

- The study procedures were successful in meeting the Ministry of Transportation and Highways objective to produce a comprehensive set of traffic diversion and revenue projections for a range of possible toll levels on Lions Gate only or both Lions Gate and Second Narrows Bridges.

- The Regional Transportation Model using time impedances to represent tolls, provided outputs for the a.m. peak period that were rational and reasonable in terms of changes in traffic patterns. Valuable information was also provided regarding ranges in peak period traffic congestion levels resulting from traffic diversions.

- Considerable judgement and some ingenuity were required to extrapolate a.m. peak period results to daily totals. The extrapolation calculations, based on limited data, were quite different for the two directions of travel but produced very similar results for overall daily traffic diversions and toll revenues in each direction. These results supported our confidence in the process used.

- For further work in this area, use of the Regional Transportation Model would be enhanced by extension of the model into the off-peak and p.m. peak hour of the day. Model development and calibration for these other periods of the day is a substantive project, which is under consideration by the GVRD.

- More research is required into behavioral travel forecasts that can be shown to be directly applicable to areas such as Greater Vancouver, dealing with perceived values of time relative to the toll charges and covering the variability of trip purpose and travel conditions throughout the day. These factors are crucial to the actual decisions made by the travelling public in changing their mode of travel or route choice in response to tolls or other road system user charges.

Disclaimer

The findings, interpretations and conclusions expressed in this study are the results of research supported by the British Columbia Ministry of Transportation and Highways, but they are entirely those of the authors and should not be attributed in any manner to the Ministry.

Airport Improvement Fees/Passenger Facility Charges and Canadian Airports

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Introduction

There is a new cost/revenue item which further complicates any analysis of passenger traffic demand or airport financing in Canada. This is the Airport Improvement Fee [AIF], which is known as the Passenger Facility Charge [PFC] in the United States. While more common in the United States than in Canada, this is yet one more charge being added onto the cost of passenger air travel. This paper examines the Airport Improvement Fee or Passenger Facility Charge which is increasingly being used to fund capital projects at airports in North America. The paper examines some of the major implications of the fees for the air carriers, consumers, airports and the government.

The Air Transport Association of America reported that as of December 1993, 161 airports in the United States had approval and a further 32 airports were proposing to collect passenger facility charges.[1] This is an increase from no airports in May 1992. In Canada, Vancouver International has its Airport Improvement Fee while Edmonton Municipal also has a charge. It has an "airport user fee" of $5.20 "for each enplaning or deplaning passenger using the Airport, to be collected and remitted by the airline".[2] In the case of the AIF and the PFC, the charges or fees are assessed on passengers *enplaning* at the airport. The funds are used as revenue for the airport authority, generally for capital improvements.

Will the use of AIFs grow in Canada? The issue is linked to the issue of airport privatization. The fees are an obvious source of revenue to finance capital improvements for airports that have been privatized. They are being used at Vancouver, and it was reported to have been provided for in the cancelled Pearson Development Corporation lease.[3] The Royal Commission on National Passenger Transportation suggested that passenger facility charges would be one means for local airport authorities to finance their operations.[4] The analysis in this paper examines the possible ramifications of the adoption of the AIF/PFC at major Canadian airports.

Air Carrier/Consumer Issues

The issue for both consumers and air carriers is the cost of PFCs and AIFs. While in the United States, PFCs are restricted to US$1, US$2 or US$3 per enplaned passenger, Vancouver International adopted an AIF of $5 for a departure to a point within British Columbia, $10 for a departure to other North American destinations and $15 for passengers travelling on flights to points outside of North America.

Table 1 shows the potential airport revenue generation/consumer cost for AIFs based on the US PFC model and a modified Vancouver AIF model at major Canadian airports. Table 1 assumes a $3 PFC since the $3 maximum is in use or awaiting approval at 190 of the 193 United States PFC airports. The modified Vancouver model assumes a $5 fee for domestic passenger enplanements, $10 for Canada-United States (transborder) passenger enplanements and $15 for Other International passenger enplanements.

Table 1: Potential Airport Revenue Generation/Consumer Cost of Airport Improvement Fees, 1992 Passenger Volumes

Airports	U.S. Model	Modified Vancouver Model
	$ '000	$'000
Victoria	1,031	1,959
Vancouver	14,125	36,689
Edmonton	3,309	6,442
Calgary	7,002	14,916
Lester Pearson	29,178	83,524
Ottawa	3,743	7,249
Montréal-Dorval	8,322	19,246
Montréal-Mirabel	3,577	16,928
Halifax	3,464	6,511
St. John's	937	1,656
TOTAL	74,688	195,120

Source: Passenger volumes are from Statistics Canada catalogue 51-005, Air Carrier Traffic at Canadian Airports

If the United States PFC model were used at only the 10 major airports, consumers would have had to pay an extra $74.7 million dollars to travel in 1992. The modified Vancouver AIF model would have required $195.1 million dollars extra from consumers.

Analysis of consumer resistance to the added cost of an airport fee is complicated since the area of charges and fees is one of the few in the aviation sector which has shown great growth. The AIF/PFC is but one more charge being added onto the cost of a trip. This is in addition to the Canadian Air Transportation Tax, the Goods and Services Tax, and provincial sales taxes (in the case of Quebec) for domestic travel. For Canada-United States travel there are also U.S. Immigration and Naturalization Fees and U.S. Customs User fees.

Table 2 shows the impact of various fees and taxes on two trips. For the full economy return trip Vancouver-Los Angeles, 15% of the trip cost is made up of fees and taxes. For a short-haul trip such as Vancouver-Seattle, the cost of the direct fees and taxes is 26%. [There also are fees levied on the airlines for each flight for terminal, landing and security fees which are built into the ticket price by the carrier.]

Since AIFs and PFCs to date have been applied as head taxes rather than proportional to the fare paid or the distance travelled, any negative impact on consumer demand should be greater on the discount fare travellers.

Table 2: Taxes and Fees as a Percentage of the Total Trip Cost

Cost of Return Trip Vancouver-Los Angeles, January 1994

	$	Percentage of Trip Cost
Return Economy Fare	720.00	85.31
Air Transportation Tax	40.00	
Goods & Services Tax	53.20	
Immigration & Naturalization Fee	[US$6] 8.05	
Customs User Fee	[US$6.50] 8.72	
AIF at Vancouver	10.00	
PFC at Los Angeles	[US$3] 4.03	
Sub-Total	124.00	14.69
Total	844.00	100.00

Cost of Return Trip Vancouver-Seattle, January 1994

	$	Percentage of Trip Cost
Return Economy Fare	206.00	74.27
Air Transportation Tax	24.42	
Goods & Services Tax	16.13	
Immigration & Naturalization Fee	[US$6] 8.05	
Customs User Fee	[US$6.50] 8.72	
AIF at Vancouver	10.00	
PFC at Seattle	[US$3] 4.03	
Sub-Total	71.35	25.73
Total	277.35	100.00

Source: Official Airline Guide

While Table 1 gives some idea of the total amount of dollars that must be paid by consumers if the AIF/PFC becomes widespread in Canada, like the large number of additional charges and fees, it is the cumulative effect of the fee at several airports during one trip which may be the more harmful than the actual cost of the fee. With the hub and spoke system, many Canadians must transfer at airports rather than fly directly to their destination. Table 3 gives an indication of the number of passengers that must transfer at one, two, three or more of the other major Canadian airports on their journeys. For example, if the AIF/PFC had existed in 1992 at the ten Canadian airports listed in Table 3, then 693,000 passengers who had paid a fee when enplaning at Vancouver would have also paid a fee at one of the other nine airports. Almost 81,000 passengers would have paid at two more Canadian airports in addition to Vancouver. A further 16,000 travellers would have reached for their wallets at three or more additional airports in Canada after Vancouver during their trip. Not surprisingly, the numbers are highest for the travellers out of Toronto's Lester B. Pearson airport where over 1.3 million passengers would have paid fees more than once at Canadian airports during their journey.[5]

The cost implications for an individual passenger can almost be doubled since most passengers flying to a destination also return. In the United States, there are restrictions on the number of PFC charges that can be imposed on one passenger. They can be charged a maximum of two PFCs on a one way ticket and four on a round trip.[6] No such restrictions exist, at present, in Canada. If AIFs are adopted, a passenger flying from Victoria to Vancouver to Toronto to Cuba could end up paying AIFs at all three Canadian airports on the outbound leg and at Toronto and Vancouver on the return leg. If all of the Canadian airports involved had adopted an AIF policy similar to Vancouver, this would add an additional $45 to the cost of the trip.

For consumers, the problem of AIF/PFCs is the added cost. Could the existence of an AIF/PFC result in the diversion of passenger traffic to other modes in short-haul markets? Since the average scheduled service air fare for domestic travel in 1992 was $178 (based on the coupon origin-destination[7]), the AIF charge of $5 represents an increase of 2.8% in the cost of the flight. The Air Transport Association of America estimated that a 1% increase in price of air travel results in a 0.7% decline in traffic.[8] If this is true, what are the implications of the imposition of AIFs in Canada? If the Air Transport Association estimates of the effect of price increases on demand are correct, this would have translated into a 2.0% decline in domestic passenger traffic.

Table 3: Number of Transfers by Scheduled Service Passengers at Major Canadian Airports, 1992

Airport of Passenger Enplanement	Number of Connections at the Other Major Canadian Airports: No Connections at the Other Major Canadian Airports	One Connection	Two Connections	Three or More Connections
Victoria	124,550	167,570	25,990	7,970
Vancouver	2,593,990	692,500	80,640	16,420
Edmonton	510,330	202,530	31,780	5,620
Calgary	1,444,180	427,040	53,590	8,340
Lester B. Pearson	5,452,100	1,158,570	124,890	19,400
Ottawa	701,480	324,470	27,220	6,190
Montreal-Dorval	1,858,210	382,630	47,230	8,870
Montreal-Mirabel	140,830	29,300	5,710	700
Halifax	634,400	351,900	51,340	8,540
St. John's	160,100	106,330	18,980	4,500

Source: Revenue Passenger Origin-Destination Survey, Aviation Statistics Centre, Statistics Canada

For air carriers, the amount of the AIF/PFC poses two problems. One is the impact on consumer demand; the other is the limit on their own ability to raise air fares that the AIF/PFCs might impose. The latter may be more of an issue in the United States where the PFC cost is included in the calculation of the ticket cost. These problems could at least in part be offset by the capital spending. Presumably there would be some advantages to air carriers from projects such as runway expansion and terminal renewal. If the capital spending improves service to the travelling public at the airport, this could possibly offset any declines in passenger traffic due to price.

Another issue for the carriers is the collection of the AIF. In the United States, the PFC is recorded on the ticket, the fee is collected by the air carrier. For this they receive 12¢ per PFC and use of the collected funds for 45 days.[9] This is to help reimburse the carriers for the workload imposed by the changes to their ticketing and accounting systems. Vancouver's preference was for their AIF to be collected at the point of sale of the ticket or at the airline check-in counter but agreement was not reached with the carriers on this issue.[10]

Airport Issues

The advantage for airports is the AIF/PFC as a source of capital funding. Vancouver is hoping to raise 40.8% of the funding ($161.7 million) for the new runway and the international terminal building from the AIF.[11]

Could an AIF result in traffic diversion to another airport? The Vancouver International Airport Authority estimated Vancouver's loss in diverted traffic to U.S. airports as a result of the 7% GST at 4%. They felt that the imposition of their AIF could have lead to a further 1% diversion.[12] While it seems unlikely that the AIF/PFC charge alone would convince a passenger to use a different airport there may be some danger that the *cumulative* effect of the various fees and charges could make American border airports more attractive to Canadian consumers travelling to the United States. By commencing their voyage in the United States they could avoid paying the AIF, the GST, the U.S. Customs User Fee and the U.S. Immigration and Naturalization Fee.

The reaction of consumers to an airport imposing an AIF/PFC may also be affected by the fees use. If the consumers can see how they will benefit from the charge, there could be less opposition. This is one advantage of the situation, at present, in Vancouver. It is possible to show the physical evidence of the new runway and terminal and indicate the future benefit as a result of the AIF charges. More resistance would be likely if the AIF revenues were to be used only to cover operating costs rather than capital improvements. On the assumption that those using the airport should pay for the improvements that they will then benefit from, the AIF/PFC could be considered as an equitable and valid way of using "user fees to replenish and restore the system".[13]

The Royal Commission on National Passenger Transportation concluded that " in general, airlines have few opportunities to switch airports if LAAs [Local Airport Authorities] abuse their market power".[14] It is doubtful that an AIF could alter a carrier's choice of an airport to serve but the level of their service at an airport is determined by the consumer demand which might be affected.

Government Issues

As mentioned previously, in the United States there are several restrictions on the PFCs. There are a maximum two PFCs on a one way ticket and four on a return ticket. The maximum that may be charged per PFC is US$3. The PFCs require Federal Aviation Administration approval and involve consultation with air carriers as to how the funds will be spent and the length of time that the PFC will be imposed. These restrictions do not exist in Canada. The federal, provincial and territorial governments are still the major operators of airports in Canada. They could greatly influence what occurs in Canada by the terms set in the lease/rental agreements with local airport authorities.

Restrictions similar to those imposed federally in the United States, however, may now be difficult to impose in Canada. Firstly, with the Vancouver style AIF collected directly from the passenger at the airport departure rather than on the airline ticket at the point of sale, it would be operationally very difficult to limit the number of times a passenger would pay AIF/PFCs on one journey. Secondly, Vancouver has implemented their AIF. Vancouver's financing of the new runway and terminal is based on their forecast levels of revenue generation. This would mean that the imposition of a $3 maximum for AIFs may have to exclude Vancouver and possibly the other LAAs that have already signed agreements with Transport Canada. There may be a possibility of the existing LAAs requesting some kind of compensation for any AIF restrictions. Prospective LAAs may demand a 'level playing field' with a latitude in AIF levels similar to that granted Vancouver. Anything else would force them to use other means to raise capital. Ron Gilbertson, President of the Edmonton Regional Airports Authority was quoted as saying that airports which claim "we don't charge an AIF...charge more for user fees or concession rentals".[15] Any restrictions on AIFs to levels below those charged in Vancouver are yet one more complexity in the privatization of more airports.

Conclusion

The airport revenue generation device of the Airport Improvement Fee/Passenger Facility Charge is fast growing in North America. While a good revenue source for capital construction at privatized airports, it is also another cost item for air passengers to absorb. They have been introduced into Canada without any regulatory control. Imposing restrictions now would be one more issue in the already complicated process of airport privatization. While individually their effect on consumer or carrier decisions is expected to be small, their cumulative effect and their addition to the myriad of other charges and fees could constrain future demand for passenger air travel.

Note

The views and options expressed in this paper are those of the author and do not necessarily reflect those of Statistics Canada

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Competition and Cooperation Between Air and Rail Transport: An Analysis of the European Experience

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Introduction

The possible implementation of a high-speed train in the Windsor-Québec corridor arises many questions. One is related to its impact on the Québec-Ontario air transportation system. Having this in mind, we conducted a survey of interconnections between air and rail modes in Europe, as part of a study supported by the ministère des Transports du Québec.

Conventional trains traveling at 100 to 120 km/hour were not a threat to air transport. But the introduction of high-speed train traveling from one city centre to another in three hours or less when the distance is 700 km or more, has completely changed the situation. The experience on the Paris-Lyon business travel market shows a modal split of 90 % in favor of the TGV over the air, where the modal split was 50 %-50 % before the introduction of the TGV in 1981.

But this situation of severe competition is evolving as the opening, in 1994, of a TGV station under Terminal 2 at Charles-de-Gaulle airport in Paris seems to indicate. In fact, Switzerland and Germany have the most advanced developments in terms of cooperation between airlines and railway. Air and rail transport are complementing each other, with rail services offered as an alternative to short haul flights. Other examples of cooperation between airline and railway companies can be found in the Netherlands, Belgium and Italy. Meanwhile,

airlines are currently reviewing their involvement in rail operations. For example, Lufthansa has recently stepped back from operating itself the "Lufthansa Airport Express" and is now using first class compartments in regular Deutsche Bundesbahn trains.

The future of air and rail transport seems then to wave between competition and cooperation. What is the future of this cooperation? What are the advantages for business and other travellers? What are the opportunities or threats for airlines and for railways? We conclude with lessons to be learned from the European experience with regard to the possible implementation of high-speed train technology in Canada.

Competition and Complementarity

There are three different situations that prevail when examining the kind of interaction between rail and air passengers transport. First, for some distance each mode has its own natural market where the other is not really a competitor. Second, they can compete on some markets. Finally, they can also complement each other where certain conditions are fulfilled.

Natural Markets for Rail and Air Transport

As the train is usually cheaper than the air mode, and if we consider speed as the only decision factor left to the traveller, then rail will be the dominant mode whenever it is faster than air which occurs for relatively short trips. Of course, the duration of travel has to be measured between city centres. On the other hand, when the distance is long enough, then the length of the journey by train can become unacceptable and therefore the air mode will capture the market. It is then possible to determine the intermediate distance range within which competition between the two modes prevails. This has been done by Pavaux (1991) for 154 European O-D pairs, for conventional trains, high-speed trains and air.

These simulations show how the high-speed train (HST) extends the natural market of the railways. For international links, the rail natural market is increased from 150 km to 250 km (orthodromic or air distance). This distance is equivalent to roughly 350 km on the roads or railways network. For French domestic links, the natural market of the rail mode expands from 140 km to 240 km. For German domestic links, the introduction of the ICE (Inter-City-Express) trains,

which are slower than the French TGV, brings the limit to 150 km. These figures do not mean however that the construction of a HST is economically viable for all those situations. In Europe, eight to ten millions passengers a year are considered to be the minimum traffic required to ensure the viability of a HST link.

On the other hand, air transport maintains its competitive advantage over HST on long hauls. Air transport is twice faster than the HST on a 200 km (air distance) trip, and three times faster on a 1 500 km trip. The limit from which air transport is said to dominate the rail mode can then be established at 1 000 km. For trips longer than that, the rail mode might be used in some cases, but it's not really a competitor to air transport. Those trips are taking five hours and more so there is no air traffic diversion to the HST.

We then see the coexistence of two markets, one exclusively served by rail transport for short distance trips up to 250 km, and one nearly exclusively served by air transport for trips longer than 1 000 km. The HST has extended the natural market of the rail by nearly 50 %, by cutting the travel time by 40 to 50 %. But, it is not the only impact HST will have on air travel, as it provides railways the opportunity to challenge air transport for trips longer than 250 km, as we will see in next section.

Competitive Markets for Rail and Air Transport

Rail and air modes will compete for passenger travels between 250 and 1 000 km. In that range, the traveller has the choice between rail which is cheaper but slower, and air which is more expensive but faster. Fares are important, of course, but we also have to consider the monetary value passengers are assigning to their savings in travel time.

A mode will be chosen when its total cost, fare and time spent for the trip, is lower with this alternative. HST is then important here too, because it lowers the total cost of rail transport. In addition to what we called the natural market for rail, we then have a competitive market where the rail is still dominant but less and less so as the distance of the trip increases.

The drop in air traffic between Paris and Lyon, after the opening of the TGV line in September 1981, is quite illustrative of the impact of HST in that distance range (391 km in this case). When the whole HST line between Paris and Lyon became fully operational, in 1983, the travel time on this link was brought back to two hours, from an original 3 h 45. The rail traffic increased from 12,2 millions in 1980 to 20 millions in 1991. The air traffic experienced a 54 % drop

between 1980 and 1984, when it was growing at a 8,7 % rate a year before the advent of the TGV (Bjarnadottir, 1990). A study conducted by Plassard (1989) shows where the six millions new passengers in 1985 came from: two millions from air transport, one million from the road and the last three millions were new travellers or new trips by people that were already travelling.

Table 1 shows the impact of the opening of the TGV on air traffic for some cities in the South-Eastern part of France:

	Distance (km)	Time Conventional Rail	Time HST	Decrease in Air Traffic
Lyon	391	3h45	2h00	70-75 %
Grenoble	435	5h11	3h10	35-40 %
Saint-Étienne	384	4h42	2h40	25-30 %
Montpellier	585	6h49	4h40	20-25 %
Marseille	630	6h33	4h40	20-25 %

Source: Aéroports de Paris (1993)

The HST technology surely had an important impact on air traffic evolution. This impact is readily seen on air traffic diversion experienced following the introduction of new HST services. But after this initial impact, there is another phenomenon that can be observed: a stabilization of air traffic compared to a continuous increase in HST traffic. It means HST is also generating new traffic by inducing more trips by the same travellers or more people travelling. According to Plassard, the explanation is mostly related to the increase in mobility by people who were already travelling. These changes in mobility are, of course, occurring on a longer period, and even after ten years this induction of new trips is still having an effect. The French TGV has also provided railways with the opportunity to take a significant part in the fastest growing market of travellers, the business trips. A situation very similar to the one experienced in part of South-Eastern France is also developing with the expansion of the French TGV network: the West link in operation since 1989, and the Atlantic link in operation since 1990.

Simulations conducted by Pavaux (1991) on 72 European routes show similar results as those that were observed in the French context. These results are also pointing out to the fact that travel time, not distance, is the decisive factor explaining traffic shifts between rail and air transport. The impact of HST is therefore very important for trips that take three hours and less. For instance, simulation results indicate that a two-hour long trip in HST will provoke a 79 % shift of air traffic to the rail. But for a trip of four hours, the shift is evaluated between 14 % and 30 %. Competition between air and rail transport is then particulary strong for trips of a duration between two and four hours by HST. The market for rail transport, which was limited to 250 km when only travel time was considered, could then be extended to 600 km for business passengers and to 540 km for tourists and other passengers, when we add prices and value of time in the analysis. The shorter extension of the touristic passengers market is caused by the cheaper air fares they can get.

These results show an important extension of the market of rail transport with the introduction of HST technology. Yet, we must not forget that these results are very sensitive to variations in airline fares or passengers value of time. How the airline companies are going to respond to this new competition is an important part of the answer. The situation might also be quite different on various O-D pairs. We can predict that the longer the distance will be, more effective will be the reductions in airline fares, because the position of air transport is getting stronger as distance grows. For instance, for HST trips of two hours, a 30 % reduction in airline fares will add from three to five percent in air traffic market share while in the case of four-hour trips, the market share will increase by some 14 % (Pavaux, 1991).

We must also point out that the modal choice is not only dependent on the travel time and out-of-pocket money spent for a trip. Schedules, frequencies, availability of other modes, and different service aspects (comfort, reliability, security) can all have a direct impact on the modal shares. It is interesting to note also that the situation for international routes appears to be slightly different as the HST is not having as great of an impact on air traffic as for domestic routes.

The French experience with the TGV is the most instructive. It has generated completely new travellers' behaviours. Between Paris and Lyon, we saw an explosion of faster but more frequent trips. Between those two cities, the TGV is nearly providing the same kind of service as subway does in a city. The two-hour duration of this trip seems to represent a critical time limit because it allows a passenger to make a round-trip in half a day. Of course, airlines suffer a lot from the competition of HST on those very short trips. But they can compete more easily when the distance and the length of the trips are growing. There are

also other situations where the two modes can work together in order to provide passengers with a better service.

Rail and Air Complementarity

Rail and air transport are not only substitute modes to each other. In some cases they can be complementary. It will be the case when the advantages of each mode can be put together to offer passengers a better overall service by combining a long haul by air and a shorter one by rail. HST opens the door to more opportunities for using the rail on the short part of the trip in combination with the air mode which remains the best alternative on the longer portion of it.

For many O-D pairs between a large city with good air connections and a medium-size city with no or bad connections to air transport networks, the HST/air combination can become the best alternative. The ITA study (Pavaux, 1991) examines some of these situations where there are air links between two European cities against instances where no such links exist. For example, between Berlin and Le Mans (France), two cities not linked with a regular air service, passengers can use the TGV between Le Mans and Roissy-CDG airport in order to air connect to Berlin. This combination is faster than previous arrangements and will raise the flows of people between those cities by 30 %. Another simulation between Nantes and Milan, which are presently connected by air, also predicts an increase in movements by 15 to 30 percent following the use of air/rail combination.

We can see that using a combination of those two modes can be more efficient for passengers travelling between several city pairs in Europe. The total cost can be reduced because of the savings in travel time on the HST portion of the trip. The use of rail services to feed an airport hub gives travellers access to more frequent flights for an increased number of destinations and at the same time strengthens the hub. It also allows the airport to use those slots saved by the elimination of short distance flights for more long distance flights.

The interconnection of the TGV lines in Paris Rossy-CDG airport will also allow for good intermodal facilities for passengers coming from different regions of France. The connection with the TGVs "Sud-Est" and "Nord" will be made this year, while the TGVs "Ouest" and "Atlantique" will be connected in 1996. The Roissy-CDG interconnection will then make it possible for travellers to use the TGV for the shorter part of a trip and the airplane for the longer haul.

We can thus conclude that the complementarity between rail and air services in Europe will most likely occur when trips can be divided into two segments: one of 250-300 km by HST, and the other one of 800 km or more by air. It will provide passengers with good transportation services between cities that otherwise cannot afford effective air services because of insufficient demand.

Air/Rail Cooperation in Europe

The Swiss Experience

Switzerland possesses one of the most effective transportation system in the world. In response to forecasts predicting an increase in people mobility in general and continuous degradation of the environment, Switzerland has put forward a transportation policy aiming at shifting part of individual traffic towards public transit.

One of the major components of this policy is project "Rail 2000" which is based on the principle that every node and junction station in the rail network is serviced regularly at the same minute on the hour. These nodes are spread out on the overall network and provide for appropriate connections between trains on one hand, and rail and bus services on the other hand. This project is obviously easier to implement in the Swiss context where 94.7 % of the population lives within one kilometer of one of the 20 000 points (bus stop or rail station) served by public transit (Varlet, 1992).

The Swiss system rests on the following three principles:

i) to provide optimal transportation services to all potential travellers.

ii) to provide transportation services on the overall network and not only on some lanes.

iii) to ensure adequate interconnections between different transportation networks: rail, air and road.

This project aims at providing the population with a completely interconnected transportation system from a person's place of origin to his or her final destination. To accomplish this goal, the following actions have been undertaken:

i) increasing train frequencies to

- hourly services on most corridors

- twice hourly services on major corridors;

ii) ensuring adequate train connections at each of the 9 junction stations;

iii) interconnecting regional buses and city tramways;

iv) connecting the overall ground public transit at one point every 30 minutes;

v) interconnecting air and rail transportation services at two points:

- the Zurich-Kloten airport (in 1981)
- the Geneva-Cointrin airport (in 1987);

vi) applying attractive fares.

In order to achieve those results, both airline and railroad companies had to come to an agreement. Let us examine how this was accomplished using the case of two major national links, namely Geneva-Berne and Berne-Zurich, as an example.

First, some of the trains operated by the Swiss railways between Berne on the one hand and Geneva and Zurich on the other hand, are given a Swissair flight number and consequently appear in the ABC World Airways Guide. Indeed, the relatively short distances involved, roughly 150 km by rail, do not call for the establishment of more expensive air links between those cities. Travellers with either a train or an airline ticket are therefore admitted on those trains.

With this arrangement, Swissair can restrict its international services at two airports (Zurich and Geneva) while providing an effective service to Berne through its rail connection. Passengers travelling to or from Berne can be processed through the airlines computerized reservation system and are issued with only one ticket. However, Swissair encounters competition from foreign airlines that provide services to Berne via London, Brussels, Paris and Düsseldorf.

For long distance flights, the train connection fares to and from Berne are included in the price of the airline ticket which is equal to that of flights to or from either Zurich or Geneva. For shorter flights, Swissair will charge a slightly higher fare than the Swiss railways to and from Berne in order to account for baggage handling and reservation costs.

Furthermore, direct train services run between Geneva and Zurich airports in both directions, on an hourly basis via Berne, between 6:50 and 19:40, and a non stop service is also offered every two hours from 7:45 to 17:45.

The air/rail cooperation in Switzerland also extends to other services such as the "Fly-Rail" system which allows Swissair passengers to register, select their seats and receive their boarding pass 24 hours in advance. At least 24 train stations are equipped with Swissair's computerized reservation system.

Since 1989, passengers wishing to use a rail/air combination may register their baggages at the point of departure (foreign airport or Swiss train station) and recover them at their destination, regardless of which airlines they are flying with (regular or charter).

It was lately observed that 27 % of airline passengers departing from Zurich airport and originating from outside the Zurich metropolitan area, actually took the train to get to the airport. Swiss authorities would like to see this percentage increase to 60 % (Pavaux, 1991).

The German Experience

In Germany, the national airline, Lufthansa, and the national railways, Deutsche Bundesbahn (DB), have a long history of cooperation which starts at the highest level where some top executives are members of both companies' Board of directors. For example, the rail mode will be preferred over air as feeder service to airports whenever it is economically justifiable. Perhaps the best example of rail/air cooperation is the case of the "Lufthansa Airport Express" (LAE).

The Lufthansa Airport Express

At the end of the 1970's, Lufthansa was loosing money in the operation of air feeder services from Cologne and Düsseldorf to Frankfurt international airport. The airline has decided to make good use of its cooperation with the Deutsche Bundesbahn by setting up a new rail feeder service between those cities. The new train service was completely managed by the airline and began operating in 1982 under the name "Lufthansa Airport Express". The train service frequencies were increased in replacement of air feeder services which were reduced considerably. Lufthansa still maintained limited air feeder services but with smaller, more economical, airplanes. This resulted in spare slot capacity at Frankfurt airport which was put to better use for international flights.

The LAE trains were especially equipped to satisfy the needs of the airline with exclusive Lufthansa design. Two trains were providing shuttle service between Düsseldorf, Frankfurt and Stuttgart. The train schedule was planned in order to facilitate flight connections at Frankfurt and Düsseldorf airports. The service on

board the LAE trains was provided by actual Lufthansa flight attendants and was comparable to that offered on board the regular planes.

Complete baggage check-in and transfer services were provided to LAE passengers from origin to destination (airport or train station). The LAE service was also offered to passengers from any airline, worldwide, through Lufthansa's computerized reservation system. For example, Air France was selling tickets from Paris to Stuttgart via Frankfurt which included an Air France flight between Paris and Frankfurt and the LAE service between Frankfurt and Stuttgart.

The LAE fare was exactly the same as the equivalent air fare on a domestic leg. But when used in combination with a long haul international flight, the LAE segment was included in the air fare, which means that passengers were basically offered the choice between a domestic air feeder service and the LAE, the later being offered more frequently and serving city centers as well as suburban areas in Germany.

However, the LAE service was abandoned in the spring of 1993 after two successive years of heavy losses (20 millions DM in 1992 alone) and a significant drop in traffic. The monetary loss in itself may not have been sufficient to withdraw the LAE service because it has to be compared to the monetary losses associated with the operation of air feeder services. But the drop in traffic is much more serious. It can be explained in part by the relative lack of attractiveness of an air-rail connection in the computerized reservation systems (CRS) when compared to other air-air connections.

For example, when looking for the best routing between Montreal and Cologne, the CRS will show a Montreal-Paris-Cologne itinerary using Air France flights as the most effective routing while the Montreal-Frankfurt-Cologne itinerary using Lufthansa and the LAE service will appear in second place because of the untimely connection with LAE upon arrival in Frankfurt. Furthermore, the CRS does not take into account the relative advantage of the LAE service which takes the passenger right into the city center of Cologne, thereby reducing total travel time.

Lufthansa has therefore replaced its LAE service with a similar system by reserving a block of seats in the first class compartments of regular Deutsche Bundesbahn (DB) trains. These trains have a much higher service frequency than the LAE service but the on board service is somewhat downgraded when compared to what it used to be. Lufthansa is also in the process of assigning flight numbers to those trains in order to improve the ranking of such air-rail combinations in airlines' CRS.

Other examples of Cooperation in Germany

Cooperation between air and rail in Germany is not restricted to the LAE experience. Indeed the DB provides airline passengers with the following services:

i) The Rail & Fly for Airlines

This is an arrangement between the DB and an airline which allows the airline to offer its passengers a combination of flight and rail services between an airport and the city of origin or destination of the passenger. Those rail services are made available to the airlines at a very reasonable wholesale price. The airlines are then free to charge whatever tariff (if any) they deem necessary to their passengers. Some airlines will offer this train service free of charge to their customers.

ii) The Rail & Fly for everyone

This program was put forward by the DB and allows airline passengers to access 10 German airports by train at a reduced rate. This special "Rail & Fly" rate includes the trip by train to the departure airport city, the shuttle service between the train station and the airport as well as urban public transit.

iii) The Rail & Fly baggages

Users of the "Rail & Fly" system may also decide to send their baggages the day before departure, from 58 train stations to Frankfurt, and from 49 stations to Düsseldorf. The DB takes care of baggage handling and transfer to the airport where it is held by Lufthansa until check-in.

Air/Rail Cooperation: A Synthesis

After studying the various arrangements between rail and air services in Europe, we can identify the following three levels of cooperation:

i) Rail is used to link a city center to the airport;

ii) Rail provides feeder services to the airport, thereby linking that airport to its hinterland;

iii) Rail complements air services on relatively long haul trips.

The third level of "cooperation" is illustrated by the French TGV which can be used to extend the range of Roissy - CDG airport. The first two levels of cooperation can be found in the above Swiss and German experiences and are in a way, much more desirable from an airline's view point since they provide airports with economical feeder services.

However, from our review of the European experience we believe that in order to be successful, those air/rail cooperative efforts must satisfy the following critical conditions:

i) Both the national airline and railways companies must demonstrate their willingness to cooperate. If this is the case in Germany and Switzerland, we may have some doubt about the French SNCF which has always perceived the domestic airline (Air Inter) as a fierce competitor.

ii) The combination trip (rail-air) should be trouble free for the passengers and as seamless as possible which means:

- the use of one ticket for both services
- baggage check-in and handling services
- security zones available when connecting between air and rail on international trips

iii) The train segment of the trip should be included in the air fare for international flights.

iv) The train service should appear in airlines' CRS under a flight number.

v) Adequate facilities must be made available at airports in order to facilitate passenger/baggage handling and transfer, including security.

vi) Special care must be taken to satisfy the specific needs of various passenger categories (business/tourists) on both air and rail services.

Concluding Remarks

Let us now conclude with some lessons that can be learned from the European experience with regard to the possible implementation of high-speed train (HST) technology in Canada. The most important city pair in the Quebec-Windsor

corridor, Montreal-Toronto, falls into roughly the same distance range as the Paris-Bordeaux link which is slightly longer than the Paris-Lyon link. Now, depending or how much time a HST would take to cover the distance between the two city centers, we could witness a loss of air traffic of between 25 % to 50 % to the advantage of HST based on the European experience. It seems that traffic diversion is mostly dependent upon travel time as illustrated in Table 1. Obviously, other factors must also be taken into account before we can predict the impact of HST on air traffic in Canada. For instance, Canadians are not used to take the train and our suburban public transit systems are not as developed as those in Europe.

However, could there also be room for cooperation between rail and air transport in Canada? We think so because the advent of HST could raise several questions about how these rail links could be connected to airport and city centers. One such positive impact could be the connection of Montreal's Mirabel Airport to Ottawa and Quebec city. Using HST as feeder services to Mirabel would allow this airport to be linked to its catchment market. We could also envision a rail link (possibly conventional) between Mirabel and Montreal's city center. These connections would finally allow that airport to play a much more important role and make good use of its existing capacity.

But, as we have seen before, in order to reap the benefits of air/rail cooperation, there are several critical conditions that must be satisfied. This has been done elsewhere and it can also be done in Canada. But such cooperative work requires advanced planning and a lot of good will. This is the challenge that could lie ahead if HST technology is to be implemented in Canada.

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Demand Model Developments to Assess High Speed Passenger Train Markets on Windsor to Quebec City Corridor

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1. INTRODUCTION

This paper is about the effects on passenger travel demand pattern that would result following the introduction of a high speed train (HST) in the Windsor-Quebec City corridor. How might consumers perceive HST, and how would they use it? What level of ridership would this new mode attract? What level of revenue could it sustain? How could technological change influence HST service? Which existing transportation modes will be the most influenced by traffic diversion? Those are typical questions dealt within this paper. It summarizes the demand models developed for the High Speed Train Market Assessment Project commissioned by Air Canada and CP Rail System. A more detailed discussion on these issues and others can be found in the 1993 report prepared by SC Stormont Corporation.

This research builds on the Ontario Quebec Rapid Train Task Force (OQRTTF) study (1991). The intent is to maintain consistency with the major assumptions used to prepare the OQRTTF forecasts, while taking into account new information regarding traveller attitudes and behaviour developed as part of the current project. The goal is not to repeat the work of the Joint Task Force but to seek a finer calibration of demand, based on consumer preference.

Even though this study used widely accepted methodologies, it nevertheless regroups a diversity of state-of-the-art techniques and innovative ones. The most noteworthy techniques are:

i) The Interactive Video Intercept Station (IVIS) was designed to gather "stated preference data" on consumer mode choice intentions, as well as "revealed preference" data from actual travel patterns. The IVIS is a microcomputer-based system that provides a graphically-based, adaptive, self-administered survey medium. This study was a first time application of this technique.

ii) In the transportation demand literature, there exist two broad data categories: stated preference data sets and revealed preference data sets. By design, stated preference data sets yield more precise estimates of travellers' sensitivity to attributes than do revealed preference data sets. But the latter have the advantage that they arise from market place decisions. The forecasting process of this study integrates the advantages of both data categories.

iii) Previous studies of travel in the Windsor-Québec City corridor have made diverse assumptions about how travellers choose among current and possible future transportation modes. Some have assumed that all modes compete more or less equally, so that a new transportation mode would draw from existing modes in direct proportion to their current market shares. This is the implicit assumption with the Multinomial Logit model. In this study, a special set of statistical procedures was used to empirically determine how travellers compare and choose among intercity travel alternatives. The model structure adopted is known as a "Linear Nested Logit" model.

iv) The linear formulation, however, does have one property that could pose a shortcoming: it assumed, for example, that a 30 minute change in travel time is presumed to have twice as great an impact on demand as a 15 minute change in travel time. The modelling technique that addresses the non-linearity issue is called the Box-Cox transformation. In order to overcome linearity assumption Box-Cox transformations were added to the Nested Logit models. It is worth noting that the application of this technique to the Nested Logit model has not been done before.

2. THE ONTARIO QUEBEC RAPID TRAIN TASK FORCE DATA BASE

In 1989, the Ontario and Quebec Rapid Train Task Force (OQRTTF) revised a Via Rail's data base resulting from a travel market survey conducted in the Quebec-Windsor corridor. The OQRTTF data base recognizes three major types of data: travel market data, travel impedance data, and socio-economic data.

Most of the travel impedances from the OQRTTF data base are retained in the Air Canada/CP Rail System (AC/CPRS) data base to be described in the next section. However, the following changes were made: revisions of the travel impedances were circumscribed to non-business auto costs and airfares; auto costs were estimated at 12 cents/km instead of 6 cents/km as assumed in the OQRTTF's data base; airfares were revised to include the airport taxes; 2010 trip tables were slightly different. Furthermore, the recalibration of alternative-specific constants and trip forecasts also rely on this database.

The OQRTTF data base is referred as a "revealed" preference data set. It is based upon choices and decisions that have actually been made in the marketplace. This is certainly an advantage. However, revealed preference data sets share one deficiency: there are, very often, build-in strong correlations between explanatory variables of interest, like fare and travel time, which renders difficult the estimation of parameters reflecting proper trade-off ratios. For instance, the OQRTTF demand study could not estimate the separate effects of travel time and fare on the mode choices made by non-business travellers.

For this reason, it was felt that more accurate sensitivity measurements could be achieved with a data base that combines both stated preference and revealed preference data. Such a data base is described in the next section. The OQRTTF data set is intended primarily to be used to assist in forecasting the full corridor-level origin/destination trip table.

3. THE INTERACTIVE VIDEO INTERCEPT STATION SURVEY

The interactive video interview system (IVIS) is a microcomputer-based system that provides a graphically-based, adaptive, self-administered survey medium. It gathers "stated preference data" on consumer mode choice intentions, as well as "revealed preference" data from actual travel patterns. This study is a first time application of the technique. The IVIS survey plays a major role in the Air Canada/CP Rail research since the demand models are estimated with it.

In the stated preference part, the survey consists of a set of "experiments" in which respondents are asked to react to a set of hypothetical scenarios. Respondents choose between their current mode of travel and high speed train and other modes under different scenarios. These scenarios, defined by total travel cost, major mode time, access plus egress time, and major mode frequency, vary until respondents indicate that they would switch from their current travel mode. This survey method is known as Direct Utility Assessment (DUA) and is particularly well suited to travel demand modelling applications involving travel alternatives not currently available.

Corresponding to each respondent, the IVIS regression data set regroups one "revealed preference" record and thirteen "stated preference" records. Note that the inclusion of the two types of data, revealed and stated, into the estimation data set is of particular interest. As stated by Miller and Fan (1992), this may represent a practical method for using the strengths of both revealed preference and stated preference data while minimizing the weaknesses of both approaches.

4. LINEAR AND NON-LINEAR NESTED LOGIT MODELS

In order to explain the number of trips by mode, it is common practice to express it as the product of the total number of trips by all modes and the share of each mode in total trips. This decomposition suggests the development of two kinds of models, namely: total demand model and modal choice models. Much of the effort of the analysis focused on the latter.

A modal choice model estimates the probability that travellers will choose particular alternatives that are available for making a trip. The alternatives that were considered separately in this project were auto, air, bus, conventional train and HST.

The recognition of two behavioral segments, namely business and non-business, yielded the development of separate sets of equation coefficients. Indeed, compilations from the IVIS surveys indicated the dissimilarities in mode choice behaviour between business and non-business trip purposes.

Instead of using the popular Multinomial Logit model, this study investigated the most appropriate "nested" structure that reflects the traveller's decision-making process. The Multinomial Logit model implies that, following the introduction of a new mode, market shares of existing modes would decrease in the same percentage. Furthermore, this percentage reduction would be exactly equal to the market share of the new mode (see Ortúzar and Willumsen, 1990). It was felt that this built-in property of the Multinomial Logit model is incompatible with the need to have analytically defensible forecasts.

The Linear Nested Logit does not have the aforementioned property. From a statistical point of view, it generalizes the Multinomial Logit model with the addition of one parameter (referred later as θ). For business trips, it was statistically estimated that travellers would choose among air, HST and a composite of "slow" modes including auto, bus, and conventional train. The slow modes have sufficient similarities with each other so that they are not perceived as distinctly different choices. The choice structure for non-business trips is similar, except that auto competes directly with air and HST, with bus and conventional rail being treated as a composite alternative. The relocation of the auto mode in the structure could reflect the flexibility and lower per-person costs for the larger parties typical of non-business trips. In a completely independent research effort, Forinash (1992) recommended the same structures for business and non-business trips based on the OQRTTF data set.

A linear model, however, does have one property that could pose a shortcoming: a 30 minute change in travel time is presumed to have twice as great an impact on demand as a 15 minute change in travel time. It does not recognize the possibility that a 10 minute improvement in travel time on a long journey may not stimulate a consumer to switch modes, while the same 10 minute improvement for a short journey could generate a distinctly different response. The modelling technique that addresses the non-linearity issue is called the Box-Cox transformation[1]. In order to overcome the shortcoming of the linearity assumption, Box-Cox transformations, referred as λ parameters, were estimated with the Nested Logit models. Exhibit 1 contains a formal description of both Linear and Non-Linear Nested models.

The independent variables used in the business and non-business models are: travel time, travel cost inclusive of the access and egress cost, access and egress travel time divided by the distance. In addition, the variable frequency is included in the business model.

Exhibit 2 contains the calibrated coefficients of both the linear and non-linear models. The first group of parameters pertain to the attributes of travel time, travel costs and frequency. The coefficients of travel time and travel costs variables are negative since, all else being equal, travellers prefer lower time and cost alternatives. At this point, it is important to warn the reader of not interpreting the attribute parameters as direct indicators of sensitivity of modal share to attribute variables. This is mainly because the parameters are directly affected by the scale of measurement of the explanatory variables.

The second group of variables is termed alternative-specific constants. These parameters reflect the differences in the utility of alternative air, rail auto and bus from that of HST when "all else is equal". If θ is equal to one then the Nested Logit becomes identical to the Multinomial Logit. The values of θ in Exhibit 2 are all statistically significantly smaller than 1. Similarly, a variable has a linear effect if the corresponding λ parameter is estimated to be equal to one. The values of λ in Exhibit 2 are all statistically significantly different from 1.

5. DESIGN CHOICES

The year 2010 was selected as the base year for forecasting, based on the assumption that the HST system would have matured by that point in time.

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[1] For a full discussion concerning the application of Box-Cox transformations to modal choice models see Gaudry (1994).

The observed mode choice behaviour suggested that the corridor should be segmented into geographic areas, to better address suspected cultural and other factors that affect the mode choice decision. Thus, trip forecasts were performed recognizing three geographic segments: origin and destination zones west of or including Toronto, origin and destination zones east of or including Ottawa and all other origin-destination combinations.

After reviewing and testing the assumptions of future transportation demand growth that had been used by the OQRTTF, it was decided to adopt their forecasts of the total travel demand through to 2010 without substantial modification. The major determinants of demand growth are forecasts of population, employment and income for the major centres of population on the corridor. These variables predicted a cumulative 29% increase in overall trip making from the current time to 2010.

The HST impedance data was derived for a single HST network encompassing the following 19 stations: Windsor, Chatham, London, Kitchener, Burlington, Pearson, Toronto, Guildwood, Oshawa, Trenton, Kingston, Ottawa, Hull, Dorval, Laval, Montreal, Trois-Rivières, Ste. Foy and Quebec City. Note that the existing rail system serves 50 stations.

The study considered four different technologies defining the HST concept - 200 kph, 250 kph, 300 kph, and 400 kph - for each of business and non-business trip purposes. HST travel times corresponding to each speed include acceleration and deceleration times as well.

HST access times and costs were estimated from the transport networks with the following minimum value constraints. Minimum access costs were set to 10 and 5 dollars for business and non-business, respectively. Minimum access time was set to 10 minutes (at each end of the trip). HST terminal time was set at 30 minutes. At least hourly departures are provided or 16 trains per day. In those markets where competing air frequency exceed 16 flights per day the HST frequency was set equal to the air frequency.

6. REVMAX MODEL

The REVMAX demand forecasting model optimizes revenue on individual routes to derive estimates of ridership and revenue. The model maximizes HST revenue on each origin-destination by finding the price level that generates the highest-revenue-producing combination of ridership and fare. This process is repeated for each of the four speed levels defined- 200 kph, 250 kph, 300 kph, and 400 kph - for each of business and non-business trips.

The calibrated demand models described in Section 4 were not applied directly into the REVMAX model, instead two adjustments had to be done before.

Alternative-specific constants needed to be reestimated because the sample used for the regression analysis (IVIS data set) is different from the one used for the forecasting (OQRTTF data set). Indeed, as mentioned by Bates (1992), the alternative-specific parameters are not transferable from one situation to another. The alternative-specific constants for the existing modes (air, rail, auto and plane) were changed such that computed market shares match the observed market shares described by the OQRTTF data. An innovative approach was developed for the estimation of the HST alternative-specific constant. It is estimated such that: observed market shares can be replicated by the demand models; and, the relative preference of the HST mode, as revealed by the IVIS data set, is respected.

Predicted market shares, as computed by any econometric model, may differ very substantially from observed market shares. Clearly, an econometric model cannot predict perfectly each single origin-destination pair: there exists residual errors. This is a fact of modelling. This problem was mitigated with the use of the Pivot Point Model.[2]

7. FORECASTS

The composition of HST users is forecast to be significantly different from the existing train service. This result comes from the fact that business travellers are expected to travel by HST more than non-business travellers. Under base conditions about 20 percent of the rail users would be travelling for business purposes. This is estimated to increase to about 55-60% of HST users (see Exhibit 3).

In terms of market share, HST is estimated to capture about 7-9% of the total HST potential market. This may be compared to a base rail market share of about 4%. Auto diversion is not significant: a reduction of auto travel in the order of 1% for all HST speed levels.

Diversion of travellers from air to HST is very significant. Air travel in the corridor is forecast to decline by about 50% if HST service is provided in the corridor. Moreover, about 85% of the reduction of air traffic comes from the business traveller market.

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[2] Econometric issues arising with the application of the Pivot Point technique are discussed in Laferrière (1993).

In Exhibit 4, the forecasts resulting from the Linear and Non-Linear models are compared with those obtained by the OQRTTF. Interestingly enough, the two Linear models, REVMAX and OQRTTF, yield opposite pattern of trip and revenue estimates: the Linear REVMAX model predicts less ridership but more revenues than the OQRTTF model. It appears that the introduction of non-linearity produces intermediate forecasts.

Exhibit 5 presents the effect of reducing the HST travel time on HST revenues. To do so, the HST network configuration (number of stations, access time, number of departures, terminal time, etc.) as discussed in Section 5 is held constant and the HST speed is increased successively from 120 kph (the base case) to 200 kph, to 300 kph, and to 400 kph. For each speed level, the HST fares are set at revenue-maximizing level.

The passage of the base case to 200 kph decreases the average travel time in the Quebec-Windsor corridor by 41% and augments total revenue by 85%. In other words, a 1% reduction of travel time increases total revenue by 2.09%. There are increasing returns to HST speed. Higher speeds produce much more moderate outcomes. For instance, a further increment of speed from 200 kph to 300 kph means that a 1% reduction of travel time augments revenue by 0.89%. There are decreasing returns to HST speed.

9. CONCLUSIONS

There are many factors that affect travellers' choices among available intercity travel modes. This study has explored the effects of key service variables on those choices. It found that travellers make mode choices very differently depending on whether the trip is for a business or non-business purpose. Non-business travellers are highly sensitive to price and less responsive to travel time reductions, while business travellers place a high value on their time, and are, therefore, more responsive to travel time as a factor in mode choice. As a result, the HST service combination of higher fares than conventional rail in return for less travel time is much more appealing to business travellers than non-business travellers.

Considering the high price sensitivity of non-business travellers, many of whom currently travel by automobile, HST is unlikely to succeed in capturing a major share of non-business travel, unless the consumer perception of HST travel can be shifted fundamentally in a positive direction.

Diversions of travellers from air to HST would be significant, making the cross-modal policy implications of HST more serious than previously reported.

The passage of the base case to 200 kph implies increasing returns to HST speed: a 1% reduction of travel time increases total revenue by 2.09%. Higher speeds produce much more moderate outcomes. For instance, a further increment of speed from 200 kph to 300 kph means that a 1% reduction of travel time augments revenue by 0.89%. There are decreasing returns to HST speed.

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EXHIBIT 1
Computation of Mode Choice Probabilities
with the Linear and Non-Linear Nested Logit Models

The level-of-service of mode m (U_m) computed with the linear and non-linear models is a weighted sum of impedances.

Linear model

$$U_m = \beta_{0,m} + \beta_1 TravelTime_m + \beta_2 Cost_m + ..$$

Non-Linear model

$$U_m = \beta_{0,m} + \beta_1 TravelTime_m^{(\lambda_1)} + \beta_2 Cost_m^{(\lambda_1)} + ..$$

The Box-Cox transformation is defined as follows

$$TravelTime_m^{(\lambda_1)} = \begin{cases} \ln(TravelTime_m) & , \text{if } \lambda_1 = 0 \\ \dfrac{TravelTime_m^{\lambda_1} - 1}{\lambda_1} & , \text{else} \end{cases}$$

The following equations describes the mode choice probabilities of a business traveller. The parameter δ is equal to one if the mode is available and is equal to zero otherwise.

$$P_{AIR} = \frac{\delta_{AIR} \cdot \exp(U_{AIR})}{\delta_{AIR} \cdot \exp(U_{AIR}) + \delta_{HST} \cdot \exp(U_{HST}) + \exp(\theta U_{MM})}$$

$$P_{HST} = \frac{\delta_{HST} \cdot \exp(U_{HST})}{\delta_{AIR} \cdot \exp(U_{AIR}) + \delta_{HST} \cdot \exp(U_{HST}) + \exp(\theta U_{MM})}$$

$$P_{BUS} = \frac{\delta_{BUS} \cdot \exp(U_{BUS}) \cdot \exp((\theta - 1) U_{MM})}{\delta_{AIR} \cdot \exp(U_{AIR}) + \delta_{HST} \cdot \exp(U_{HST}) + \exp(\theta U_{MM})}$$

$$P_{CAR} = \frac{\delta_{CAR} \cdot \exp(U_{CAR}) \cdot \exp((\theta - 1) U_{MM})}{\delta_{AIR} \cdot \exp(U_{AIR}) + \delta_{HST} \cdot \exp(U_{HST}) + \exp(\theta U_{MM})}$$

$$P_{RAIL} = \frac{\delta_{RAIL} \cdot \exp(U_{RAIL}) \cdot \exp((\theta - 1) U_{MM})}{\delta_{AIR} \cdot \exp(U_{AIR}) + \delta_{HST} \cdot \exp(U_{HST}) + \exp(\theta U_{MM})}$$

$$U_{MM} = \ln(\delta_{BUS} \cdot \exp(U_{BUS}) + \delta_{CAR} \cdot \exp(U_{CAR}) + \delta_{RAIL} \cdot \exp(U_{RAIL}))$$

EXHIBIT 2
Regression Results with Business
and Non-Business Models

	BUSINESS TRIPS		NON-BUSINESS TRIPS	
	LINEAR	NON-LINEAR	LINEAR	NON-LINEAR
MODE ATTRIBUTE PARAMETERS				
travel cost	-0.009	-0.512	-0.201	-0.456
travel time	-0.012	-0.112	-0.002	-1.778
access time	-2.960	-1.651	-4.430	-1.936
frequency	0.044	0.036	.....	.....
MODAL CONSTANT PARAMETERS				
air	-0.487	0.269	0.578	-0.118
rail	0.309	0.509	-3.360	-4.149
auto	0.599	1.990	-0.183	2.302
bus	-2.704	-3.462	-7.110	-7.045
θ PARAMETERS				
	0.843	0.891	0.518	0.691
λ PARAMETERS				
λ_{COST}		0.256		0.312
$\lambda_{TRAVEL\ TIME}$		0.562		-0.102
λ_{ACCESS}		0.194		0.513

EXHIBIT 3
HST Demand Forecast, 2010
REVMAX Linear Model
(million of trips)

	Business Trips	Non-Business Trips	Total
120 kph	0.74	3.26	4.00
200 kph	2.47	2.85	5.32
300 kph	2.87	2.96	5.83
400 kph	3.21	3.05	6.26

EXHIBIT 4
HST Forecasts, 300 kph Scenario
REVMAX Linear and Non-Linear Results
vs OQRTTF Results

	Linear model	Non-Linear model	OQRTTF
Trip Forecasts (million)	5.83	7.70	7.78
Revenue Forecasts ($million)	$576	$446	$350

EXHIBIT 5
HST Revenue Forecasts
with the REVMAX Linear Model

	Average Travel Time (minute)	Revenue ($million)	Elasticity
120 kph	201	262	
200 kph	119	485	
From: 120 kph to : 200 kph	-41%	+85%	-2.09
300 kph	94	576	
From: 200 kph to: 300 kph	-21%	+19%	-0.89
400 kph	68	690	
From: 300 kph to: 400 kph	-28%	+20%	-0.72

ELECTRONICS AND THE RECOVERY OF LOST RAIL TRAFFIC[1]

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The proposed merger of the principal Canadian railways' eastern operations advances to the forefront ideas for conserving railway plant and railway technology which until recently would have been considered untimely. This paper, based entirely on technology already known and applied, if not always on railways, outlines one concept that seems worthy of consideration, The text must be evaluated as a framework, within which details remain to be investigated. We present it here because its potential benefits seem to exceed its potential costs.

Why have trucks "become Canada's dominant freight transportation mode over the past thirty years.."? According to the President of the Ontario Trucking Association, the reason is "the more flexible...and timely service that motor carriers provide" (Toronto Globe & Mail, 19 January 1994) Such remarks could have been uttered as well by that President's US counterparts.

It would perhaps have been more precise to claim that trucks have become Canada's dominant medium-haul high-value quick-despatch freight transportation mode. Despite higher fuel and labour costs per ton-mile, trucks have wrested this presumably profitable source of revenue away from the rail mode, especially as private sidings have become fewer and fewer.

1 The authors acknowledge the generous contribution of Mr George B Dutton, Transportation Consultant,Bethesda, Md, upon whose technical advice on matters of electronics and train control they relied heavily.

It has not yet been calculated, let alone decided beyond argument, exactly how much trucks do or should pay for their share of joint-use roads. They are deemed, sometimes at CTRF conferences, not to be paying fully for their infrastructure, contrary to railroads. Nevertheless, while this cannot be debated here, the development of superhighways and expressways has guaranteed ever more efficient and so more severe truck competition.

Railroads have responded by way of their already- or newly-owned trucking subsidiaries, sometimes operated at arms' length, but more importantly, by their introduction of intermodal technology, most often TOFC. This had two versions: one offered to their trucking competitors as Plan 1 (truck-billed) piggyback, the other used by themselves as Plan 2 (rail-billed) replacing boxcars.

Plan 1 has, alas, not been accepted enthusiastically by most of the trucking fraternity. The operation of small-crew fast and short TOFC trains, known by some as "Sprint" is said to be a success, but they move only at long intervals between two selected medium-distance cities, and don't duplicate the frequency and flexibility demanded by truck's clients, especially those at intermediate points. A T Kearney conceived the "Mini=Piggi" some years ago, but it is not in operation, and the New York Air Brake Iron Highway may have a part to play. But the industry has yet to find a way to recapture this mass of business back to the rails. Can a new strategy be devised to restore those lost revenues, since the competition can't be eliminated? That question is addressed here.

The Concept

The ability to control a locomotive from a distance has been demonstrated, but never exploited as it should have been.[2] In 1958, at the urging of the Iron Ore Company, General Motors, working with General Railway Signal, built a locomotive that oulled a train 120 miles with no hand at the controls. This was followed by a radio-controlled electric locomotive for that company (Fig 1). Its radio range is not much more than a mile, nor is the Vertran system's.[3] Long distance transmission of control must be put to use in a new rail strategy.[4]

2 Robert L Banks, unpublished paper, ICHCA/CIT joint meeting Ottawa, 28 June, 1993
3 Running trains by remote control TRAINS, March 1994
4 Operational Functions of ATCS, W J Moore Ede, presentation to US Federal Government Agencies, 29 January 1987

The subject of this paper is the feasibility of automatically-operated small trains with no crews at all, in large numbers at short intervals, designed to penetrate truck-dominant territory. The saving over crewed operation in cents per ton-mile would be significant, but more importantly, the frequency of service would duplicate that of the trucks swarming over the highways, often within sight of the railways themselves. To attract current truck traffic onto these very railways is at the heart of this proposal, not directed therefore at making rails as they are today competitive with trucks, but rather at seducing them onto the tracks, at a price below their avoidable costs (consisting 20% of fuel and 35¢ a mile for labour, as recently stated) In other words, a redesigned dynamic Plan 1, and not necessarily closed to Plan 2.

We suggest that only speed and frequency to match the trucks, combined with rail costs to attract them, can accomplish the seduction. High speed is of course itself the way to optimize equipment turnover.

Picture 300-400 miles of railway, with capacity much in excess of present traffic levels - an underutilized investment. And picture a modest terminal at every point within that territory that produces or terminates respectable truck traffic. Picture the conventional trains being either transferred to another somewhat parallel line, if there is one, or being integrated into the truck-competitive system. Picture a central authority in charge of all this.

Each terminal facility would be paved, with simple loading arrangements. It would store a few cars ready for loading, incoming cars being made empty, and some motive power to pull them, as well as to hostle them as needed. Sometimes deadheading power, crewless of course, may have to be called upon, on notice to headquarters.

Tractors and trailers, both common carrier and private, including rail-owned intermodal services would be admitted through a gate into the loading area. Circus-loading of trailers is the easiest at the start; containers are not yet favoured by any but the very largest carriers, but their day will come, and side-loading with it, even double-stacking. As time goes by, car design will no doubt inspire even simpler methods; perhaps side-loading right off the ground is in the stars; we have yet to hear the final word on the TrailerRail car demonstrated at Atlanta a couple of years ago. RoadRailers too, of course would be welcome candidates.

No more than two should suffice for a terminal ground crew, one working with the truck driver to secure his trailer, the other handling ticketing and customer contact.

With the large fleets of the major carriers, the team of driver and tractor may stay behind at the terminal, perhaps awaiting the arrival of an incoming trailer. The team can, of course, come in or go out light at no charge. In some cases, another team would drive away the arriving trailer; arrangements would vary with highway carriers' convenience.

A standard TOFC/COFC car can accomodate two 40' trailers; an articulated 5-platform spine car with aprons up to four of any length. But many more times, what do we do with the driver and the tractor, especially if he owns the combination? There is room on a 89' car for the longest rig on the road to be carried complete, probably at an extra fare. The owner-operator must accompany his equipment somehow, but he cannot stay with it in person, as the carriage of passengers is so burdened with institutional impedimenta as to be quite out of the question. But several drivers could be carried by van to their pick-up points, to coincide with their rigs' arrival on the rails. This may turn out to be a multi-stop jitney service up and down the route, all included in the base price for the rig. Occasionally, fatigue, defective equipment or the prospect of rain might attract the casual driver off the road.

Loaded cars must be despatched promptly so as to provide the immediacy characteristic of truck freight. Perhaps three or four cars would be ready to leave together, but there must be no waiting for tonnage, Since no crews need be called, there can be no restrictions on departure times. No schedules, no extra movements, no white flags, no conventional railroading. The rails won't change, but now they belong to the trucks.

So at some particular volume there might be several of these mini-trains and their low-power locomotives at various points on the line. When single track remains the standard, there might have to be additional passing sidings, and at some time in the future, doubling the track not only will provide capacity, but will prove more economical. Higher speeds may demand that slow-order curves be modified.

Minor snowfalls will be cleared by simply running the trains through them. More snow will be cleared by despatching a manned flanger ahead of an unmanned locomotive, but major snow falls will likely block the highway and the railway both.

At some point in the process, the attendant himself might have to start the engine, but usually it would remain at idle. He would hostle the locomotive over onto the little group of cars and test the brakes, preparatory to setting the controls and having it enter the main line.

At the outset, existing lower-powered diesel-electric locomotives, probably older, would suffice, after gearing to truck speed, and equipping with special controls[5]. They need never to be turned, they are bi-directional anyway. In due course they will become worn-out, beyond economical repair and wasteful of fuel, etc. They will need replacing, by units of a tractive effort to lift, say, 400-500 tons, and horsepower to move it at truck speed. There may be no diesel electric of that specification available, although there are several diesel mechanical types under development; two big Detroit Diesel truck engines and an Allison transmission can be happily married.

Controls

How would it be modified to operate without a crew?

Automatic operation requires apparatus to respond to the receipt of control information, a system to provide the information needed to route the train, and to supply that information to the locomotive,

A train must be able to be started, accelerated, run at speed, braked and stopped. Throttle setting and generator excitation can be regulated to accelerate smoothly, limiting tractive effort to avoid or immediately arrest wheel-slip. Such automatic acceleration is now used in electric multiple unit suburban trains, and its adaptation to locomotives will not be difficult.

Many locomotives now have speed-limiting governors, usually sounding a warning and then applying the brakes if it is ignored. Where there is a system of speed control, as in the Northeast Corridor, there are governor settings for various events, such as through crossovers and approaching stop signals. In this proposal, instead of a warning - there is nobody to warn - the governor could be set to cut off the power and apply brakes, then releasing them when the speed has been brought down. While speed control of long freight trains requires delicate handling, very short trains would present no difficulty. When a stop is demanded, power is reduced to idle and the brakes applied.

The skeptic may ask "how is control information going to move the throttle and brake levers, and vary generator excitation?" The reply is that electronically-controlled contactors and magnet valves do it now, as in the case of slave units in long freight trains, and so, to a degree, in any consist of more than one unit.

5 The Case for Remote-Control Locomotive Technology
Martin A Schlenker, Proceedings of the Transportation Research Forum, 1993

One reliable way of transmitting control information to a locomotive is by using coded cab signals, as in the Northeast Corridor, the Union Pacific, and elsewhere. As part of the automatic block or the Centralized Traffic Control (CTC) coded, ie pulsed, AC is sent through the rails (from a signal location or where one could be) along one, through the front wheels and axle and back along the other. The pulse rate per minute indicates the speed limit imposed by the signal, eg 75 for 30 mph, 150 for 60 mph, etc, while none at all means "prepare to stop short of obstruction", 15 mph at most. The AC induces a corresponding alternating voltage in coils just ahead of the wheels, which is amplified, and via tuned circuits, selects the proper speed governor. This can be modified to respond to 270 pulses per minute for a new speed.[6] As part of CTC, the coded signal system is failsafe, and a loss of power or broken wire will result in the most protective order. It likewise provides broken rail protection.

But for the automatic train operation discussed here, the absence of coded must stop the train, not just slow it to 15 mph. Because the short trains could accelerate so quickly, the three or four speeds of a conventional cab signal system would likely be enough.

This system spaces trains so the distance from the first warning to the obstruction is no less than the stopping distance for the most poorly-braked train (the fastest or longest). Very short trains, as envisioned here, will have very short stopping distances, si it follows that the system can be changed to space them closer as volume rises.

CTC combines a block system with central, or remote, control of switches and their protective signals, subject to safety control; a switch can be changed only with a stop signal and a clear track. A control signal can be set at stop by an operator, but can show proceed only if the switches are lined and the automatic block circuits permit it, just as for a block signal. Such controls from a central point are sent over copper wire, microwave, or fiber optic. That communication system informs the central point as to the positions of switches and their signals, as well as the location of trains

6 High Capacity Signalling for the Northeast Corridor
Harvey M Glickenstein PE, Thomas A Dyer Inc and
Gregory A Kelly PE, New Jersey Transit
Proceedings !EEE/ASME 8 February, 1994

CTC is of course in wide use, but is not as common on double track as on single. As foreseen above, traffic may someday require doubling, but the expensive part of CTC is operation of sidings and two-way signalling, none of which is needed with double track, only provision for turnouts to the terminals, hence the economy mentioned.

Computer-Assisted Dispatching, a way of operating large areas of CTC partially automatically - although under human supervision - is in use on several railroads. To take care of a great many trains, enhanced memory and programming would be required. Once a train was introduced into the system, with its destination specified, a central computer would line up its route and keep track of its whereabouts from section to section. Locomotives can now be tagged with radio-responsive identifiers, and devices to read them are set up at suitable places, linked to the central computers. The groundman would do this.

Various safety devices, such as dragging equipment and hot box detectors etc, can be tied into the block system so as to stop a train. A carman or signalman would have to be sent to the site to attend to trouble and then reset all the controls so that the train can proceed. The central office would then be notified by phone.

Electrification

If and when traffic builds up to a critical mass, management will contemplate electrification, with its superior fuel and maintenance advantages, and the possibility of acceleration through short time motor ratings. Dynamic braking will be of no great advantage with mini-trains. The locomotive will have the same attributes as the diesel, and once again there seems to be no suitable one available, and Europe might have to be canvassed. Fig 2 shows an electric locomotive of 800 HP and 30,000 lb tractive effort on the old CP Electric Lines. Its tonnage rating was about 1000.

The handicap is the cost of the wire. 600-volt wire has been installed in Canadian LRT situations, at about $300,000 per mile, including sub-stations for conversion from public-utility AC to DC. Third rail might be less expensive, but that introduces complexities, while AC doesn't belong in this picture at all.

600-volt unfenced overhead is no menace to anybody on the ground, as demonstrated with ordinary street railways.

Marketing and Pricing

How would this new service be marketed, and paid for? The usual marketing department would approach a completely different group of customers: truck lines, common-carrier and privately-owned, and the mass of owner-operators who would have to be solicited one by one, maybe even at truck stops. Prices would be as high as possible and lower than truck costs, varying by mileage, perhaps by day of the week, maybe discounted for volume or for round trips, enought to generate loyalty. In short, all the common pricing strategy in a new market. To avoid reliance on cumbersome accounting a system of entrance-exit tickets, as used on the New York State Throughway, is simple, where the "in" is printed at the top and a menu of "outs" underneath, each with its price to be collected on the way out the gate, or by credit card. A more advanced and labour-saving arrangement is used by BART, for one, where a "bank" of miles is bought and used up trip by trip. There may be others, but the driver and the railway each need only a simple audit trail.

Other considerations

There will be public apprehension of the unknown: crewless operation of strange little trains on familiar tracks. This will call for sophisticated public relations, careful contacts with political and other thought leaders, and will certainly be followed by government curiousity, followed by scrutiny and then regulation.

For example, grade crossings. Unorotected crossings will be no less safe than they are now, while protected ones will be track-circuit activated as they are now, possibly with longer gate arms to discourage endarounds. But automobiles will stall now and then, acts of others' negligence, but not to be dismissed as such. A manned locomotive is hardly ever able to be stopped short of a collision, so an unmanned one presents no greater hazard. Still, it will be wise to fix a crash-sensitive device on the front of the locomotive, maybe a length of brittle pipe on the end of the train line, to be split on contact and apply the air brake in emergency. But if there is even the merest contact, it will call for a railway policeman to be sent. As for the obligatory crossing warning, a radio-frequency sensitive sender should be placed at the approach, and a frequency interrogator on the locomotive will respond with the usual code signal. There will be demands for grade crossing eliminations, nonetheless, Rotating headlight beams and strobe ditch lights could become mandatory. Maybe the bell should ring continuously

There will certainly have to be an appreciation of rail Labour's views. Those principally affected will fall into three groups. There will be no reduction in straight Maintenance of Way, ie track and bridge expense. Locomotive and Car maintenance will stay in tune with the mileages run up, likely no reduction, maybe the opposite. Running trades have already been affected by traffic loss to the trucks, but that group can and ought to be trained and redirected into automatic electronic control maintenance,

In any event, the greatest effort must be made to expose the idea early and to try to enlist the understanding and support of labour leadership in the introduction of what will be job preservation and eventually job growth.

The community will observe several side-effects from a truck-dominant railroad. One is a reduction in fuel taxes with trucks coming off the road in intercity haulage. That effect will be offset by a reduction in maintenance costs and in highway congestion, as well as demands for more lanes in critical corridors. The shift from high to low fuel consumption per ton-mile will reduce exhaust gas pollution, not quantifiable but beneficial to the public. It would seem that the whole idea is a no-lose situation.

Here will be the end to gross ton-miles per train-hour as the index of freight train efficiency. There will be more ton-miles, and in the absence of crews a train-hour will count for less. The index of gross ton-miles per operating dollar will be of the greatest interest.

Since all revenue will come from truckers and all movements dictated by them, this becomes the truckers' railroad, their Rapid Transit!

The Canadian Scene

For Canadians, an example of the scheme could, we suggest be the present Canadian Pacific 300+ mile single-track main line from Montreal to Toronto, soon to be, it appears, part of a merged set of tracks. It parallels, in function and just about in form, Throughway 401 of the Province of Ontario. It likewise parallels the present Canadian National Double track main line. This would allow the CP line to be converted to the electronic truckers' railroad.

The route is seen as beginning at Dorion, just west of the Montreal commuting area, and on the main highway to from that city. It would end at Agincourt, just east of Toronto, and also on a main highway. There are seven cities in between, generating or absorbing observable truck traffic: three, Oshawa, Port Hope/Coburg and Belleville are on this CP line, the others, Kingston, Brockville Ottawa and Cornwall are reached by a highway trip, 45 minutes at most.

Extending this through Toronto to the west would involve at least one major interlocking, at West Toronto Junction. One can foresee an obstacle here, but nothing that advanced engineering cannot solve, as the flood of eastbound auto parts to Oshawa must not be turned away, nor the empty movements going home. Another flood, to an Oakville automobile plant, is to the west of Toronto in any case, and so is a third, at Bramalea, short drays all from the converted line. This traffic is JIT-driven, and the service offered will have to comply.

Duplicate lines go all the way to Windsor/Detroit, especially west of London, where the two are literally parallel to each other and to Highway 401. Important points in this area are Waterloo/Cambridge, Woodstock/Ingersoll, London, Brantford, Hamilton, Chatham and St Thomas.

The former Canada Southern, at one time known as the Michigan Central (and double track all the way) across southern Ontario between the two border points, is clearly a candidate for conversion to electronics, especially as there is a parallel CN track practically all the way, under lease to the Norfolk Southern.

Final thoughts

One reason for the Government of Ontario developing the GO train for Toronto commuters was to forestall widening Highway 401, already 14 lanes in places. Is it too fanciful to spectulate that this government might encourage, even actively support, this particular form of highway "improvement"? After all, it does support Park 'N Ride for passengers. And not much can be built or widened either, for the relatively modest sums required for an electronic truckers' railroad.

And our new Federal government has dedicated itself to the advancement of "high tech", that is the way the country can advance and prosper, especially the young. Can this be a starter in that contest?

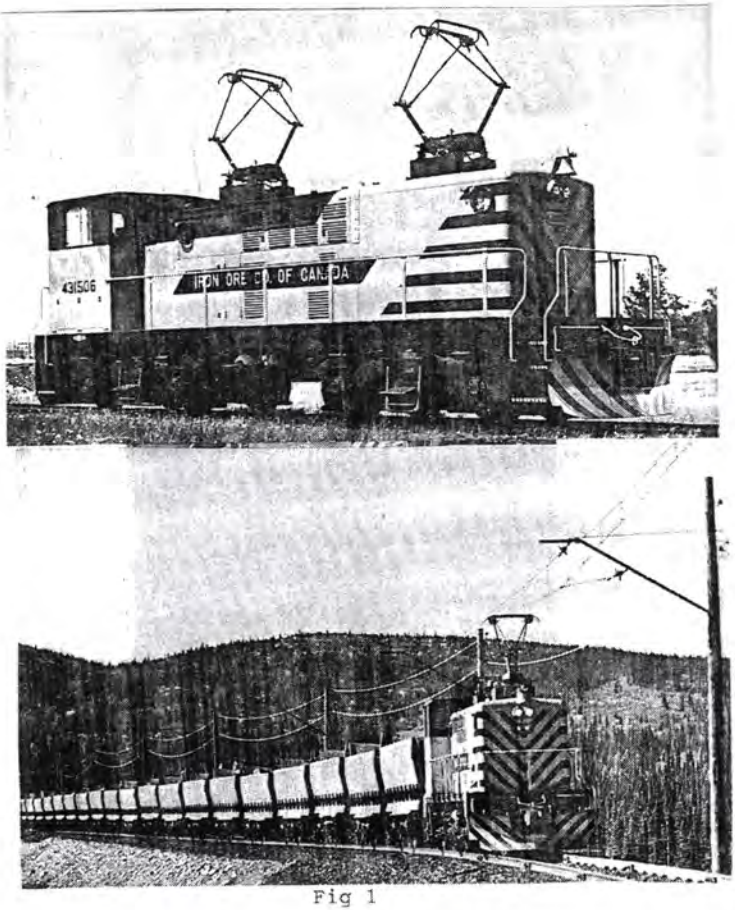


Fig 1



George Roth

Fig 2

A RISK ASSESSMENT OF INTELLIGENT VEHICLE-HIGHWAY SYSTEMS

by

Darcy B. Toms

KPMG Canada

A. Introduction

Intelligent Vehicle-Highway Systems (IVHS) have great potential to improve transportation efficiency and safety. However, there are many challenges that must be overcome before this potential can be realized. This paper assesses the relative risks of specific IVHS applications based on a survey of industry stakeholders. It also discusses implications for project selection under a capital rationing environment.

The term IVHS means different things to different people. This in itself is a serious roadblock to constructive debate. According to a recent Transportation Association of Canada report, IVHS are systems which use advanced computer, communications, and sensor technologies to improve the performance of passenger and freight transportation systems [1]. The same publication provides definitions and acronyms for specific IVHS applications, which have been adopted for this paper as outlined in Exhibit 1.

B. Project risk defined

There are three broad classes of project risk that should be considered by a risk assessment methodology:

- Development risk – the risk that a project can not be designed and implemented successfully. For example, the design may not be technically feasible, or implementation costs may be higher than expected.

- Performance risk – the risk that the system will not operate as planned on a day to day basis. For example, if the system is not durable enough to withstand field operating conditions its annual maintenance costs will be higher than projected.

- Acceptance risk – the risk that the system will not be fully accepted by its various users. This implies that anticipated benefits will not materialize fully.

Exhibit 1
Definitions and acronyms for IVHS applications

Application (acronym)	Description
Advanced Trip Planning System (ATPS)	Provides information on preferred routing, optimum travel times, modal choices, and roadside service sites.
Advanced Travel Conditions System (ATCS)	Provides information on road, traffic, and weather conditions, as well as traffic rules.
Advanced Travel Orientation System (ATOS)	Identifies current user location, and provides information required for navigation and route guidance.
Advanced Business Information System (ABIS)	Provides information on the facilities, products, and services that are available in the local community.
Advanced Mobile Communication System (AMCS)	Allows in-vehicle, vehicle to vehicle, vehicle to roadside, and vehicle to control centre communication.
Automatic Vehicle Identification (AVI)	Identifies passing vehicles based on some form of electronic license plate. Can be used for automated toll collection and other IVHS systems.
Weigh-in-Motion (WIM)	Measures axle and gross vehicle weights for commercial trucks. Vehicles that appear to be within legal weight limits are allowed to bypass roadside scales.
Advanced Corridor Control System (ACCS)	May include traffic incident detection and management, control of access and traffic flow, and demand management features for a specific corridor.
Advanced Area-Wide System (AAWS)	Extends control system to a wider operating area. May include traffic flow optimization, control of street parking, and other features.
Advanced Assist/Control System (AACS)	May include monitoring of driver behavior, driver assist (gap control), vehicle control (governed speed, automatic braking), and automatic chauffeuring.

Together, these elements determine the overall **business risk** of a project. In this sense, business risk refers to the probability that actual project cash flows will differ materially from expectations [2]. For example, if development risk is excessive, the initial investment may far exceed the present value of benefits generated by the project over its useful life. Similarly, if performance or acceptance risk is excessive, annual net benefits may be too low to provide an acceptable return.

B. Theoretical basis for the analysis

The risk assessment methodology presented in this paper is based on the notion that project risk is related to several generic risk factors:

- **Level of investment** required to design and implement the project. Other things being equal, large projects are more complex than small projects. Therefore large projects tend to have higher levels of development and performance risk.
- **Number of players** actively involved in design and implementation (e.g., government agencies, suppliers, contractors, users). The presence of many players with competing interests can result in project paralysis.
- **Time required** for design and implementation. A project that takes a long time to implement can be expected to have a high degree of development risk. For example, user needs may change during the interim, equipment suppliers may go out of business, or the basic design may become obsolete.
- **Level of technology required**. Technologically complex systems often have high levels of development and performance risk. They may also have high levels of acceptance risk if the technology is visible to end users.
- **Type of technology required**. Projects based on proven technology should have less development and performance risk than projects based on new technology (although new technology may provide greater benefits if successful).
- **Degree of end user involvement** in design and implementation. End users are more likely to accept a system if they are actively involved in its design and implementation.
- **Level of end user experience with similar systems**. End users are more likely to accept systems with a similar look and feel to other systems they have used. For example, automated bank machines have given a large segment of the population some exposure to menu-based systems.

If we accept the basic premise outlined above, we can gain insight on overall business risk by assessing the extent of these seven risk factors. In this case, risk factors were evaluated through an industry survey.

C. Stakeholder survey

A risk assessment questionnaire was mailed to one hundred and fifty-two members of the Transportation Association of Canada IVHS Round Table. Recipients were asked to return the survey by fax. Fifty-four usable responses were received, resulting in a response rate of thirty-six percent. Exhibit 2 shows responses by industry segment. Roughly one half of survey respondents work for one of the three levels of government.

Stakeholders were asked to indicate their opinions on IVHS risk factors using a six point interval scale. For example, the scale for the level of investment question ranged from *relatively small investment* (one) to *relatively large investment* (six). Definitions of IVHS applications were included with the questionnaire to encourage consistency.

Exhibit 3 summarizes the survey results (acronyms are defined in Exhibit 1). It shows the average rating and standard deviation by risk factor for each of the IVHS applications considered. Rating scales have been inverted for the user involvement and user experience factors, since higher levels of user involvement and experience are associated with less project risk.

Exhibit 2
Survey responses by industry segment

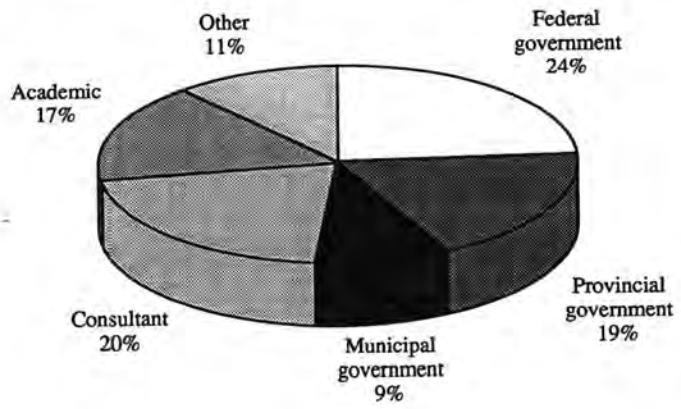


Exhibit 3
Project risk factor ratings from industry survey

IVHS Application	Project risk factor						
	Required Investment	Number of Players	Time to Implement	Technology Level	Technology Type	User Involvement	User Experience
ATPS							
Mean rating	3.25	3.50	3.23	2.96	2.40	3.74	2.69
Standard dev.	1.25	1.36	1.34	1.32	1.10	1.53	1.35
ATCS							
Mean rating	3.06	3.44	3.00	2.81	2.26	3.30	3.22
Standard dev.	1.19	1.33	1.30	1.18	1.11	1.48	1.27
ATOS							
Mean rating	3.48	3.22	3.30	3.45	2.83	3.60	2.40
Standard dev.	1.45	1.29	1.28	1.26	1.20	1.57	1.39
ABIS							
Mean rating	2.50	3.29	2.58	2.19	1.91	3.58	3.20
Standard dev.	0.92	1.38	0.95	0.88	0.86	1.61	1.58
AMCS							
Mean rating	3.69	3.51	3.19	3.37	2.79	3.46	3.37
Standard dev.	1.27	1.29	1.19	1.14	1.32	1.30	1.41
AVI							
Mean rating	2.81	3.06	2.43	2.74	2.28	2.52	2.51
Standard dev.	1.10	1.24	1.09	1.12	1.27	1.45	1.37
WIM							
Mean rating	2.75	2.62	2.15	2.50	2.11	2.65	3.25
Standard dev.	1.08	1.22	1.04	1.08	1.25	1.52	1.59
ACCS							
Mean rating	4.44	4.04	4.08	4.23	3.53	3.26	2.76
Standard dev.	1.06	1.31	1.25	1.09	1.31	1.39	1.27
AAWS							
Mean rating	4.85	4.60	4.68	4.51	4.08	3.42	2.08
Standard dev.	1.06	1.26	1.11	1.03	1.11	1.31	1.10
AACS							
Mean rating	5.31	4.60	5.36	5.66	5.36	4.45	1.57
Standard dev.	1.04	1.40	0.90	0.71	1.00	1.61	1.10

D. Assessment methodology and results

Survey data were analyzed using a weighted risk assessment model. The model determines an overall risk index by combining survey ratings for the seven risk factors with factor weights selected by the author. The mechanics of this calculation are outlined in Exhibit 4. In this example, the weighted average risk factor is 4.25. The maximum possible result is 6.00. Therefore, the overall risk index is equivalent to 0.71 on a scale of zero to one.

Exhibit 4
Illustration of risk index calculation

Risk Factor	Weight	Rating	Weighted Rating
Required investment	20%	5	1.00
Number of players	15%	2	0.30
Time to implement	10%	4	0.40
Technology level	15%	6	0.90
Technology type	15%	5	0.75
User involvement	15%	2	0.30
User experience	10%	6	0.60
Total	100%		4.25 ÷ 6.00 = **0.71**

The same process was repeated for each completed survey to obtain a range of risk indices by IVHS application. Results are summarized in Exhibit 5, which shows median indices and inter quartile ranges (i.e., 25th to 75th percentiles). From Exhibit 5 it is apparent that:

- There are substantial differences in perceived levels of risk between the various applications.
- Applications such as Advanced Business Information Systems (ABIS), Advanced Travel Conditions Systems (ATCS), Automatic Vehicle Identification (AVI) and Weigh-in-Motion (WIM) are perceived to have relatively low levels of business risk.
- Applications such as Advanced Corridor Control Systems (ACCS), Advanced Area-Wide Systems (AAWS), and Advanced Assist/Control Systems (AACS) are perceived to have relatively high levels of business risk.

Exhibit 6 compares risk indices for several high risk and low risk applications, and evaluates whether the differences are significant. Significance (p value) is based on paired two-tailed t-tests. The null hypothesis is no difference between applications. Most of the examples shown are statistically significant at the 99% confidence level.

Exhibit 5
Risk indices calculated from survey results

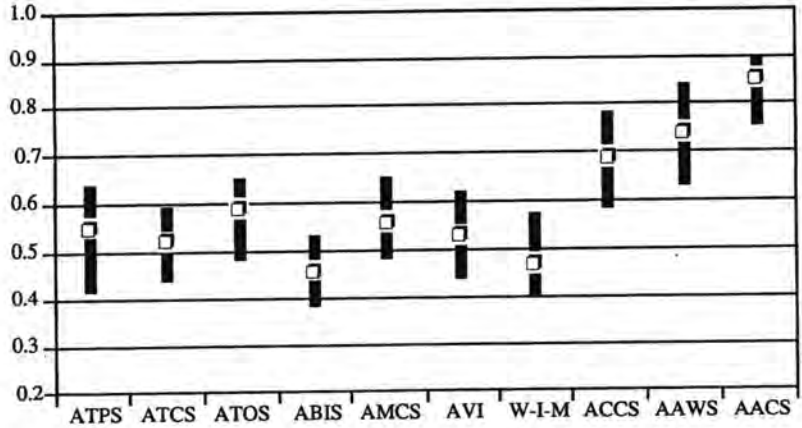


Exhibit 6
Statistical comparison of risk indices (based on matched t-test)

Application A	Application B	Mean Difference	p
Trip Planning (ATPS)	Weigh-in-Motion (W-I-M)	0.05	4%
Travel Conditions (ATCS)	Corridor Control (ACCS)	-0.16	<1%
Travel Conditions (ATCS)	Assist/Control (AACS)	-0.29	<1%
Business Information (ABIS)	Corridor Control (ACCS)	-0.22	<1%
Business Information (ABIS)	Area-Wide (AAWS)	-0.28	<1%
Business Information (ABIS)	Assist/Control (AACS)	-0.35	<1%
Mobile Com. (AMCS)	Weigh-in-Motion (W-I-M)	0.09	<1%
Mobile Com. (AMCS)	Assist/Control (AACS)	-0.24	<1%
Weigh-in-Motion (W-I-M)	Corridor Control (ACCS)	-0.20	<1%
Weigh-in-Motion (W-I-M)	Assist/Control (AACS)	-0.33	<1%
Corridor Control (ACCS)	Area-Wide (AAWS)	-0.06	<1%
Corridor Control (ACCS)	Assist/Control (AACS)	-0.13	<1%

E. Implications

Potential investors in IVHS have many other investment opportunities to consider in addition to IVHS projects. In the case of governments, funds could be used in competing areas such health and education, or they could be retained to reduce the deficit and national debt. Private sector investors face a similar decision.

In theory, project selection in an environment of capital rationing should proceed as a three step process:

1. Forecast cash flows for all projects that are being considered. In the case of public sector projects, cash flows should include the value of benefits such as fewer accidents, less pollution, and lower vehicle operating costs.

2. Determine project net present values using an appropriate discount rate.

3. Select the portfolio of projects which maximizes total net present value while respecting the limits on available capital.

The appropriate discount rate to use for net present value calculations (Step 2) depends on the level of business risk associated with a project. If the project has the same risk level as existing investments, the discount rate would be equal to the investor's average cost of capital . However, if the project has a higher or lower level of risk, the discount rate should be adjusted accordingly [2].

The Capital Asset Pricing Model (CAPM) is a useful tool for evaluating risk-return issues. Its basic premise is that investors should be rewarded with higher than average returns for accepting projects with higher than average risk. This relationship, which is illustrated in Exhibit 7, is represented by the following formula [2]:

$$R_j = R_f + (R_m - R_f) \times \beta_j$$

Where: R_j = Expected return on asset j.

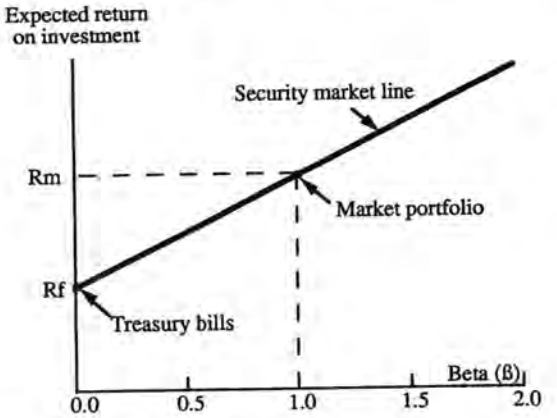
R_f = Return on a risk-free asset. In practical terms, this is usually assumed to be the yield on ninety day treasury bills.

R_m = Expected return on a market portfolio of assets. In practical terms, this is usually assumed to be the return on a broad-based market index such as the TSE 300 Composite Index.

β_j = Index of systematic risk associated with the asset. Beta is calculated by regressing asset returns against market returns. By definition, beta is one for a market portfolio.

When considered in the context of the Capital Asset Pricing Model, Exhibit 5 demonstrates that it is not appropriate to use the same discount rate to analyze all IVHS projects. Using a common discount rate would penalize relatively low risk IVHS projects, and favour relatively high risk IVHS projects.

Exhibit 7
Illustration of capital asset pricing model



Before we can apply the Capital Asset Pricing Model we must determine an appropriate asset beta. However, IVHS betas cannot be estimated by the traditional method – that is regressing past asset returns against returns on the market portfolio. Since most IVHS projects only exist on paper there are no records of past returns to consider. A practical alternative is to use measured asset betas for industries considered to have similar risk characteristics. Estimated asset betas for several industries are presented in Exhibit 8.

Exhibit 8
Estimated asset betas for selected industries

Industry	Asset Beta (ß)
Electronic components	1.49
Crude petroleum and natural gas	1.07
Petroleum refining	0.95
Retail department stores	0.95
Motor vehicle parts	0.89
Chemicals	0.88
Retail grocery stores	0.76
Steel	0.66
Natural gas transmission	0.52
Telephone companies	0.50
Electric utilities	0.46

Source: [2]

Selecting a surrogate industry beta is by nature a subjective process. However, there are some basic principles that should be considered. Other things being equal, high asset betas tend to be associated with industries that are highly cyclical and industries that have high levels of operating leverage (i.e., high fixed costs) [2].

One can argue that benefits from IVHS projects would be relatively non-cyclical – traffic levels vary with economic activity but differences should be less than profit swings in high-risk industries. This suggests an asset beta on the low end of the range represented by Exhibit 8. On the other hand, many IVHS projects would have high fixed costs, which suggests using a somewhat higher asset beta. Ultimately, the surrogate industry selected depends on the judgment of the analyst.

F. Conclusions

The following conclusions can be drawn from this paper:

- Weighted average risk assessment models provide a practical method to evaluate relative levels of business risk for IVHS projects.
- Perceived business risk is much higher for some IVHS applications than for others. Applications such as Advanced Business Information Systems, Advanced Travel Conditions Systems, Automatic Vehicle Identification and Weigh-in-Motion are perceived to have relatively low levels of risk. On the other hand, applications such as Advanced Corridor Control Systems, Advanced Area-Wide Systems, and Advanced Assist/Control Systems are perceived to have relatively high levels of risk.
- It is inappropriate to use the same discount rate for all IVHS applications. Discount rates should be adjusted to reflect different degrees of business risk.
- The Capital Asset Pricing Model is a useful tool for evaluating risk-return relationships. Project analysts can use asset betas for surrogate industries to provide insight on appropriate discount rates for IVHS projects.

Potential investors in IVHS projects operate in a capital rationing environment. Therefore, the discount rates used for financial analyses will affect which projects are selected for implementation. Accounting for different levels of business risk could shift funds from one IVHS project to another, or even affect overall levels of IVHS funding from public and private sources.

This paper has focused on applying a risk assessment methodology to potential IVHS projects. However, the methodology could also be applied to other transportation projects, or other industries.

Acknowledgments

I would like to thank survey participants for sharing their opinions on IVHS risk factors. I would also like to thank Francine Perrigo of KPMG Canada for assisting with the analysis of completed questionnaires.

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GOING THE DISTANCE WITH INTELLIGENT VEHICLE HIGHWAY SYSTEMS (IVHS)

PAYOFFS FROM PARTNERSHIPS

Greg Little and Bill Raney
Ministry of Transportation, Ontario *

1. Introduction

The Ontario government and the Ontario trucking industry are poised to enter the world of Intelligent Vehicle Highway Systems (IVHS). IVHS is broadly defined as a system using advanced computer, communications, and sensor technologies to improve the performance of passenger and freight transportation systems.[1]

This paper will focus on Intelligent Vehicle Highway Systems that road agencies are developing to manage roads and/or vehicles using the roads. In this paper we will be using the term Road Agency IVHS to refer to this application. In particular, we are concerned with applications which will allow commercial vehicles to bypass truck inspection stations by utilizing a combination of technologies including communications, a main frame computer, weigh-in-motion scales, electronic licence plates, and automated data bases.

The Ministry of Transportation, Ontario, through its AVION project, is participating in the Advantage I-75 project which is testing IVHS technology on the I-75 Interstate Highway in the United States, and Highway 401 in Ontario. This involves state and provincial governments as well as trucking companies in both the United States and Canada.

IVHS is being promoted as having significant potential benefits for both the trucking industry and government. The benefits include increased productivity through inspection station by-pass, fleet management capabilities, and administrative savings. An additional benefit, which has not been as widely recognized, is the potential for IVHS to collect data on the trucking industry.

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* The views expressed are those of the authors and not necessarily those of the ministry.

2. Purpose

The purposes of this paper are:

1. To briefly review the potential benefits to government and industry stemming from Road Agency IVHS, and
2. To explore in more detail the value to the trucking industry of market and operational data that can potentially be generated from Road Agency IVHS.

3. Road Agency IVHS Benefits

Table 1 shows various potential benefits for government and industry, which include productivity and efficiency benefits, as well as the potential strategic information that can be generated from a Road Agency IVHS. It should be pointed out that many of these potential benefits probably cannot be realized for some time. Moreover, to achieve the full benefits, it will be necessary to achieve a very high participation rate by the trucking industry.

TABLE 1

POTENTIAL ROAD AGENCY IVHS BENEFITS

PRODUCTIVITY & EFFICIENCY	STRATEGIC INFORMATION

Government
- effective allocation of resources
- more effective collection of taxes and fees
- reduced administrative duplication
- promotion of new technologies
- enhanced safety
	Government
	- Legislation & Regulation
	  - monitor changes and trends
	  - early warning system
	  - determining impacts
	  - determining system performance
	- Government expenditures
	  - impact of investment on infrastructure
	- Government revenue collection
	  - level of revenue
	  - impact on economy

Industry
- bypassing inspection stations
- fleet management
- streamlined administrative compliance
	Industry
	- Comparative data
	  - marketing
	  - operations
	- Market intelligence
	  - marketing
	  - operations

Although the potential benefits are great and should be pursued, it is also important to recognize that new technologies being developed may ultimately provide superior solutions to government and industry needs than the Road Agency IVHS option.

3.1 Productivity & Efficiency Benefits

One benefit of IVHS cited for the trucking industry and government is increased productivity. This benefit will arise for both parties by allowing trucks to by-pass inspection stations. Simply put, once a truck passes the initial clearance on a trip, it will be authorized to by-pass subsequent inspection stations if certain criteria are met. *

3.1.1 Government Efficiency Benefits

Road agencies in North America currently have significant resources dedicated to on-highway enforcement of trucking regulations. The Ontario Ministry of Transportation conducted over 40,000 truck inspections (excluding pure weight enforcement) in 1993, at the strategically important locations of Sarnia and Windsor. The average staff time expended per inspection was 29 minutes. With a Road Agency IVHS such as AVION in place, those resources could be redirected to other commercial vehicles, and thereby increase the effectiveness of the inspection program. The redirection of resources along with pre-authorization of carriers and other efficiencies will have direct benefits for enhanced safety.

North American governments have numerous programs which collect fees and taxes from the trucking industry on the basis of highway operations, e.g. fuel tax, registration proration, and highway tolls. IVHS technology could be used for automated collection of these revenues through electronic vehicle identification and distance calculation.

The automated revenue collection process can also be used for verification of the revenue collected. This will reduce the resources required to administer the programs and audit carriers.

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* The Advantage I-75 concept is to have the truck stop at the first inspection station and by-pass the rest. Ontario is participating in Advantage I-75 through its AVION project. The Ontario AVION project seeks to go further by having "no-stop-shopping" and "paperless processing", with pre-authorization for qualified carriers.

Finally, IVHS is one of the opportunities for government to promote new technologies which would have difficulty getting established without government support.

3.1.2 Industry Productivity Benefits

Estimates of carrier benefits from by-passing inspection stations were made as part of the Advantage I-75 project. A survey conducted for the project found that vehicles had an average trip length of 235 miles (378 km) and passed 2.4 inspection stations. It has been estimated by the Ministry of Transportation that, in Ontario, loss of productivity from inspections amount to $10.8 million annually.[2]

As this demonstrates, potentially there are significant savings from a Road Agency IVHS. However, the benefit of time savings through inspection station by-pass does not have the same significance to all carriers. Carriers with just-in-time operations will likely have more interest than carriers with loads that are less time-sensitive. Care must be taken to ensure that the time savings are real. According to Heald and Nix, "the few minutes saved here and there can rapidly disappear in other activities".[3]

AVION, the Ontario IVHS initiative, will have the capability of providing fleet management functions for carriers. As noted in Smart Trucking in Ontario:

> AVION will permit minimal cost two-way communication between driver and trucking company offices, providing dispatchers and shippers with truck location and cargo tracking capability; and allow dispatchers to contact drivers when they pass truck inspection stations or AVI reader sites. The participating truckers will improve their customer service and meet shipper and market demand.[4]

This application of Road Agency IVHS has been questioned. To some extent, other IVHS developments such as satellite tracking, have by-passed Road Agency IVHS. Fleet management systems are now on the market which may be better suited to this function than Road Agency IVHS.[5] However, there may still be benefits from Road Agency IVHS in this area for small carriers who cannot afford a commercial fleet management system.

Finally, Road Agency IVHS has been promoted as a mechanism to reduce administrative burden for carriers complying with government regulation. Carriers devote a significant amount of resources to comply with government programs such as fuel tax reporting, vehicle registration, and permit requirements of various types.

Government administrative burden is particularly significant for long haul carriers as they must comply with different requirements for every state and province in which they operate. One estimate calculates the cost of this burden at $23,000 per typical power unit. [6]

It has been proposed that Road Agency IVHS would allow savings by providing a mechanism to automate many of these compliance functions. Provided that administrative barriers could be overcome by the jurisdictions involved, vehicles could be qualified for travel in all jurisdictions at the beginning of the trip. In addition, vehicle distance calculation could be automated for such things as fuel tax, registration proration reporting, and verification for audit purposes.

However, administrative issues among North American jurisdictions have historically proven highly resistant to attempts at resolution. In addition, mechanisms for distance reporting are not included in the initial design of Advantage I-75, or the HELP Crescent Project operating on the west coast of the United States and in British Columbia. These administrative issues can, of course, be addressed independently of Road Agency IVHS. However, a Road Agency IVHS is a golden opportunity for making advances in this difficult area. It would be unfortunate if the governments involved did not use the opportunity to make changes which have potential for significantly improved efficiency in the trucking industry.

3.2 Strategic Information

A Road Agency IVHS involves the collection and processing of data on commercial vehicle operations. Data which can be collected includes such things as vehicle description, gross vehicle weight, carrier identification, commodity type, and trip origin-destination. With proper systems to manage the data, significant information on the activity of the trucking industry could be available. This information could be used for what we are calling strategic purposes. This would provide a picture of current activity and eventually provide trend information.

3.2.1 Strategic Information for Government

There is the potential for utilizing strategic data for government policy development. For government to fully utilize IVHS for policy analysis, the system must collect characteristics of trucking operations in four areas:

1. carrier (base, type, size)
2. vehicle (type, weight, age)
3. load (commodity, weight)
4. trip (speed, origin-destination, driver type)

A Road Agency IVHS will access these data through various means which will require a combination of active and passive participation on the part of carriers. Upon enroling in the system, a carrier will provide basic information on the company and the vehicles being operated. The system will obtain information on the operation of all vehicles on-highway through the weigh-in-motion scales and initial inspections. This will include vehicle location, speed, weight, and configuration. In addition, the carrier would have to update some trip and load information i.e., O-D, commodity type, and driver characteristics for each trip. Trip and load information will not automatically be included in an Advantage I-75 or AVION type systems. The technology to permit carriers to input this data into the system prior to a trip would have to be available.

The data has a high level of utility and could be used for a broad range of government programs.[7] Road Agency IVHS data can be used by government for the following activities:

1. Legislation and Regulation
   - monitor changes and trends
   - determine impacts of decisions
   - provide an early warning system for arising issues
   - determine performance of users of the highway network
   - determine the performance of the highway network
   - evaluate proposals for change

2. Government Expenditures
   - measure the impact of infrastructure investment
   - plan future investment
   - measure the impact of direct support to users of the highway network

3. Government Revenue Collection
   - measure the impact of revenue levels on users
   - measure the impact of the means of collection on users

Issues which are addressed within these activities include such things as:
- economic growth
- competitiveness of transborder trucking
- safety of trucking
- changes to weights & dimension regulations
- use of energy
- level and cost of congestion
- pavement design

3.2.2 Strategic Information for the Trucking Industry

In the absence of mandatory data requirements, it is unlikely that carriers would participate in providing the trip and load information unless they perceived some benefit from doing so. In effect, would carriers have access to the data generated by the system; and, if so, would they have a use for it?

The answer to the first question is apparent from the system design; IVHS technology will be able to provide carriers with information on what their vehicles are doing in the system. In addition, aggregate information on the activity of vehicles in the system could be provided to carriers. Information on an individual carrier basis would have to be protected to ensure confidentiality.

The answer to the second question is not as readily apparent; we need to explore the use by carriers of what we are calling strategic data. We are defining strategic data as information that can be used by carriers to measure operational and marketing performance in order to assess current activities and develop future plans.

The need for Ontario carriers to have access to better strategic data was identified in a study undertaken in 1991 to examine the competitiveness of the Ontario trucking industry in the transborder market. The report of the study recommended that:

> The government, in conjunction with industry, should develop the capability to use available data to monitor transborder flows and advise carriers of important market developments.[8]

The remainder of this paper will focus on the potential for the trucking industry to use strategic information that can be generated from a Road Agency IVHS.

4. Trucking Industry Strategic Information Needs Survey

In order to determine the potential value of strategic information to the trucking industry, an informal survey of 12 carriers was conducted. An on-site visit was made to one carrier, and 11 carriers were contacted by telephone. Representatives of carriers were asked questions regarding:

- company characteristics
- specific carrier marketing and operating data collected
- industry marketing and operational data collected for comparative purposes
- the value of industry marketing and operational data for comparative purposes
- the importance of timing of data availability

- the value of other strategic data, such as financial information, that cannot be generated from IVHS

No attempt was made to obtain a purely random sample of carriers to be interviewed. Obviously, a sample of this size is not intended to represent the industry. It does, however, provide an indication of the current use of strategic data and the value of such data in general.

4.1 Company Characteristics

The companies contacted were diverse in size. The number of power units operated by the carriers ranged from 16 to 1200. The carriers included those operating only within Ontario as well as those operating interprovincially and internationally. Most carriers had some form of computerized rate calculation and/or billing. Two carriers utilized in-vehicle computers, and one carrier utilized satellite communications.

4.2 Carrier Data Collected

All carriers used some measures to assess current sales and market performance. There was a broad range of information used. At one end, simple activity measures, such as volume of activity by client, were used. At the other end, more complex data were used including factors such as gross sales and load counts analyzed against type of trips, geographic area, and different time periods.

A number of carriers used service indicators such as on-time delivery and general customer satisfaction.

All carriers contacted used basic data to measure their operating performance. Some companies used operating measures such as fuel consumption per unit. A few used more complex data on operations including aggregation of data on different operational levels such as by trip and by lane.

4.3 Industry Data Used

According to the carriers surveyed, little information was available on the sales and market performance of their competition. Some information was available through the trucking associations and media. Word of mouth and general market-place intelligence were also used.

Similarly, little information was available when entering new markets. Some telemarketing was used to determine market potential. Leads from existing clients and market intelligence obtained by the sales force were also generally used.

There was limited information used or available on the operating performance of competition. Information available through associations and media was used by a few carriers. There was general agreement on the inadequacy and irrelevance of current published data. The carriers generally expressed a desire for information against which valid comparisons could be carried out.

4.4 Value of Market Data for Comparative Purposes

Carriers were asked to rate the value of information on a scale of 1 to 5, with 1 being the highest value and 5 being no value. The results for the value of marketing data are shown in Table 2. It should be pointed out that the specific market data elements shown in Table 2 only include information that can potentially be generated from IVHS. Moreover, the results in the table are only intended to provide an indication of the market data elements that were important to the carriers interviewed.

Table 2
Value of Market Data for Comparative Purposes

	Very Important		to		Not Important
	1	**2**	**3**	**4**	**5**
Market Characteristics	**92%**	**0%**	**8%**	**0%**	**0%**
Size of Market					
- Revenue	50%	17%	8%	17%	8%
- Number of Shippers	25%	33%	0%	8%	33%
- Number of Shipments	42%	33%	8%	17%	0%
- Weight	50%	17%	8%	8%	17%
Origin-Destination of Commodity	25%	8%	50%	0%	17%
Type of Commodity	50%	33%	8%	8%	0%

Carriers consistently rated the value of information on market characteristics of the industry as very high. There was general concern that any information would need to be of high quality, reflecting a poor opinion on the quality and relevance of the current data which was available.

Carriers also pointed out that for the information to be of any use, the data had to be segmented by carrier type in order to make valid comparisons.

It is interesting to note that, although there was an overall high value placed on industry marketing data, there was not general agreement on the importance of specific items that can be generated from an Road Agency IVHS. In terms of market size, more than 50% of all carriers felt that industry data was very important (ranked 1 or 2), while only about one third of the carriers ranked industry commodity origin and destination as very important. Even for the carriers interested in commodity origin/destination information, some felt it would only be useful if it was very specific and helped them balance empty movements. More than 80% of the carriers ranked information on commodity type as very important. This probably reflects their need to be able to segment the market for meaningful comparison.

4.5 Value of Operational Data for Comparative Purposes

The results of the value of the operational data that could potentially be generated from IVHS are shown in Table 3.

Table 3
Value of Operational Data for Comparative Purposes

	Very Important		to	Not Important	
	1	**2**	**3**	**4**	**5**
Operating Characteristics	83%	8%	8%	0%	0%
Number of Empty Moves	58%	0%	17%	8%	17%
Freight Load Factor	25%	17%	25%	8%	25%
Type of Equipment	33%	25%	25%	17%	0%
Driver Characteristics	33%	8%	17%	17%	25%
Vehicle Speed	0%	25%	25%	17%	33%
Distance Travelled	17%	25%	17%	8%	33%
Safety	75%	0%	8%	8%	8%

It can be seen from Table 3 that most carriers value industry information on operating characteristics very highly. However, there was a wide range placed on the value of specific operational characteristics that can potentially be generated from IVHS. Information on safety ranked the highest with information on distance travelled ranking the lowest.

More than 50% of the carriers felt it was very important (ranked 1 to 2) to have industry information on empty movements. The remaining elements of freight load factors, equipment type, driver characteristics, and vehicle speed were less important but were still ranked as important (1 to 3) by at least 50% of the carriers.

4.6 Data Availability

It was clear that data must be available to the carriers quickly if it is to have value. This is the case for both operational and market data. Most carriers rated data as very valuable if it was received within 3 months. However, the value of the data to the carriers was reduced significantly if it took longer than 3 months for it to be available.

4.7 Financial Data

Road Agency IVHS, as currently conceived, could not be used to collect financial data. However, information was obtained from the carriers on the value of financial data to obtain a better perspective of their data needs. In fact, financial data on the trucking industry ranked higher in value than market and operational data for most carriers. This reflected the need that carriers express to be able to compare their companies against the industry. However, carriers clearly expressed that the comparisons must be relevant, i.e. they must be made against appropriate segments of the industry to ensure they were comparing themselves to similar operations.

The standard financial indicators are used by the carriers to measure their own financial performance. These included detailed breakdown of revenue and expenses. Ratios used include: operating ratio, profit-loss ratio, tangible net worth, and debt to equity. In addition, such non-financial indicators as age of fleet, fuel consumption and price were noted.

5.0 Conclusions

1. The preliminary investigation undertaken for this paper indicates that strategic information would be of value to carriers. As such, the potential for IVHS to meet carriers' needs for strategic information should be examined in the early stages of Road Agency IVHS design.

2. The need for strategic data appears to vary according to factors such as the size and type of carrier. A full-blown survey of carriers using proper methodology should be undertaken to quantify these differences.

3. There is a strong indication that carriers want information to allow them to compare their operations against industry standards. However, these comparisons must be relevant. The carriers interviewed reported that there is not an adequate information source currently which allows carriers to do this.

4. Although the strategic information required by carriers could potentially be met through a Road Agency IVHS, there are some possible barriers that must be overcome. First of all, there must be enough carriers participating to provide a good base of data. Secondly, the carriers which do participate must supply the type of information required for full analysis of the industry e.g. commodity type and trip origin-destination.

5. Although the strategic information required by carriers could potentially be met through a Road Agency IVHS, it is important to recognize that new technologies being developed may ultimately provide superior solutions. Other means of collecting this data should also be explored in parallel with Road Agency IVHS.

6. Strategic information must be timely to be of value to carriers. This is also the criterion for data to be utilized by government for policy development. Therefore, any data which is not available in a timely manner will have questionable value.

7. Road Agency IVHS could provide a mechanism to standardize the different administrative procedures that exist between various States and Provinces. The administrative issues should be pursued in the Advantage I-75 and AVION projects.

END NOTES

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EDI in Transportation

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The views presented in this paper are the opinions of the author and may not necessarily reflect the policies of Transport Canada.

Introduction

Fundamental changes are occurring in the way we live, work and do business, based on the rapid adoption of open, networked systems of personal and business communications. These changes affect the way we view the transportation system and they are becoming an integral part of it. Moreover, in a globalized world, where the lines of trade and communications have continually gotten shorter and shorter, transportation is an integral part of the trading network in getting the goods to market and the people to their destinations.

Canada is a trading nation so the efficiency of its transportation network is of vital importance to our competitiveness. With over 25% of our gross domestic product coming from foreign trade and over 75% of our trade being done with the U.S., the emphasis on trade efficiency cannot be overstated. And the importance of foreign trade to our economy will continue to grow with the implementation of the NAFTA and the ratification of GATT.

In order to contribute to a competitive trade oriented economy, Canada needs a modern, efficient multi-modal transportation network. This will mean utilizing any and all new technologies which can contribute to the seamless flow of freight from any point in this country through our ports system. Electronic Data Interchange is one such technology which has an important role to play in linking the transportation modes into a strong and efficient distribution chain.

EDI What It Is and What It Can Do

There are many benefits to be gained from the implementation of EDI systems. EDI is intuitively appealing because of the rather obvious benefits of not doing the same thing any more times than necessary. Throughout industry in general, approximately 70% of printed computer output is re-keyed into another computer. This could be avoided if EDI was used. It has been estimated that the total cost of processing all of the paper associated with one shipment in the transportation industry averages $49 and that this can be reduced to only $5 with the application of EDI.

The direct benefits from the use of EDI include the savings associated with the elimination of data re-entry. EDI also improves the accuracy of the data because there are less keying errors. The reduced paperwork means that there is less handling, filing, copying and mailing of documents and this reduces costs. Within an organization, the changes in information flows and the speed of decision making will change the roles of many employees, releasing them from the tedious tasks associated with form filling.

The greatest benefits from EDI however, are indirect. These relate to the changes in the way business operations are done once EDI has been implemented. For example, the instantaneous communication associated with EDI reduces cycle time in the manufacturing process and makes it possible to introduce just-in-time inventory programs which substantially reduce costs. EDI can also provide better audit trails and speedier production of management information. According to most EDI users, the most important and most surprising benefit of EDI is the improved trading partner relationships. The effort needed to develop compatible EDI systems requires mutual commitment and the faster service associated with it opens the door to longer service contracts in the future.

EDI opens up completely new opportunities for supplier-customer relationships which bypass intermediaries, lock suppliers in or competition out. Strong partnerships also significantly reduce transaction costs, which means savings to both parties; a win-win situation. As examples, the clothing manufacturer, Benetton uses EDI to collect sales data directly from its retailers and place orders with its textile suppliers. In another application of EDI in the air cargo business, manufacturers

have on-line access to the business procedures necessary for exporting goods. In the U.S., EDI applications such as ATA 2000 already provide airlines with on-line access to information on the availability of replacement parts around the globe. Whole new businesses and products are beginning to emerge from the adoption of EDI which include network and application suppliers, consultants and associated service companies.

History of EDI Development

As a way of doing business, EDI in transportation has evolved from electronic communication in the railroad industry which was used for automatic dispatch and train control. Today, it has found a wide variety of other applications in the rail industry as well as the other modes.

One of the biggest proponents of EDI has been the port systems around the world which has been using the technology to manage the flow of containers from ship to shore. Large container ports such as Singapore, Rotterdam and Hamburg have been using EDI for some time in load planning and vessel control.

Following the lead of other countries, Canada embarked upon its own EDI pilot initiatives at the ports of Vancouver, Halifax and Montreal. These were generally aimed at improving the efficiency of port operations and streamlining the flow of paper associated with the movement of cargo through their boundaries. Although these pilot projects have achieved only limited success, renewed interest in EDI came with a report on the competitiveness of Canadian container ports vis à vis our U.S. neighbours.

The increasing intensity of competition between Canadian and U.S. ports for container traffic made it imperative that something be done to improve Canada's competitive position. As a result of the report on the issue, a co-operative effort called Advantage Canada was borne bringing together the railways, ports, trucking companies, etc. to look at new ways of integrating the multimodal network to remove any of the bottlenecks which exist. The objective has been to achieve a seamless network that gets goods to market quicker and more efficiently at less cost. Some examples of initiatives in line with the objectives of

Advantage Canada include the introduction of double stack container services by the railways and road-railer transport.

Included as a recommendation by the task force on container competitiveness was a suggestion that EDI be developed as a means of streamlining the paper process and improving the linkages between the modes. TECST (Total Electronic Commerce Service for Transportation) was borne amongst the ports, railways, the Canadian Trucking Association, the Canadian International Freight Forwarders Association, The Canadian Shipping Federation, the CITL and Transport Canada as a way to promote and co-ordinate the development of EDI in Canadian transportation.

Current Use of EDI in Canadian Transportation

The Air Mode

The most sophisticated uses of EDI in transportation are found in the air mode where computerized airline reservation systems are expanding into broad information networks associated with other areas of doing business in the travel industry such as hotel reservations and car rentals as well as entertainment tickets and other aspects of travel planning.

In cargo handling, airlines are using EDI for clearing invoices through FIATA and this could be expanded to direct communication links with major customers.

The Rail Mode

The railways have begun to use EDI in conjunction with their move towards providing better quality service in order to compete more effectively with trucking companies. EDI in the rail industry has generally been concentrated on the biggest rail shippers which are in resource industries. This has been limited to dispatching cars in order to make more effective use of their overall fleets. According to a survey of shippers for the NTA Review, rail shippers wish to have more access to information regarding shipments in transit i.e. where they are and when will they arrive.

The Truck Mode

In the trucking industry, EDI has been most prevalent in the automotive sector and other areas using EDI themselves such as food distribution, retailing and pharmaceuticals. EDI has been concentrated among the largest carriers which have their own informatics departments. In future smaller carriers will have to become EDI literate in order to provide the service clients will expect if they are going to survive.

The Marine Mode

EDI in this mode has been championed by port authorities around the world in order to improve operational efficiencies. Examples include EDI for load planning and dispatch as well as customs clearance. With the use of EDI becoming more common, these port systems are becoming centralized information networks to reduce the administrative paper burden of dealing with the flow of cargo through ports and as a way of making the physical interchange between modes more efficient and faster.

In Canada, port information networks have been introduced at Vancouver, Halifax and Montreal. Pilot projects such as CANSIF, EDIPORT and EDICOM have been moving ahead with varying degrees of success. The different approaches, however, are leading to a lack of co-ordination which could present difficulties in moving to a unified national approach.

Current Status of EDI Development

As a way of doing business, EDI has not taken hold in Canada to the extent it has in the U.S.. American companies are ahead of Canadian companies in this area. Examples include companies such as United Parcel Service which has recently introduced a sophisticated electronic network complete with electronic notepads for filling out forms such as bills of lading. At CSX, one of America's largest integrated transportation companies, the average turn around time for processing claims has been reduced from 79 to 26 days with EDI on its Mercury software which offers customers a number of services such as transmission of bills of lading, shipment tracing, car ordering, etc..

In Canada, a shipper's survey done by KPMG Peat Marwick for the recent National Transportation Act Review revealed the following comments:

1. Capturing sales data at the time of sale and making it available on a real time basis is revolutionizing logistics management. All of the interviewees indicated that in the application of this technology, Canadian firms are less advanced than their U.S. counterparts.

2. As with the use of bar coding, the application of electronic data interchange is not as extensive in Canada as in the U.S.. In fact, many respondents indicated that they have "forced" their truckers into using EDI in order to be competitive.

3. A parallel observation was made concerning the Canadian railways. Despite the extensive electronic monitoring of cars throughout the Canadian system, the Canadian railways are not able to predict the expected time of arrival of a particular car at its destination. Clearly this puts a shipper at a disadvantage vis à vis a competitor who can obtain that information with a high degree of reliability. U.S. railways generally do a better job of tracking cars.

4. All respondents were pleased with the railways' positive response since the NTA. On the other hand there is still room for improvement:

   - Railways are not able to provide expected arrival times for rail cars;
   - Turnaround times in the Vancouver intermodal terminal is unacceptable.

5. In general, the interviewees felt that the Canadian trucking industry had a poor image compared with U.S. truckers:

   - Not aggressive and flexible; reluctant to explore different relationships with customers;
   - Slow to implement new technology (eg. computer aided dispatch, EDI).

Education and awareness have progressed to the point where everyone in transportation knows about EDI; however, little is being done to follow up by actual implementation. More must be done in the transportation industry to provide seminars and education programs which explore novel EDI applications and how these could help provide business solutions to some of the administrative processes in the industry today. Rather than focus on simply the awareness of EDI, education in this area must evolve to present examples of applications specific to all transportation modes and provide information on how to do EDI along with guidelines to support implementation.

The concepts of re-engineering and streamlining have hindered progress by keeping companies in a wait and see mode. They have been reluctant to set up systems if they are simply going to be changed in the future. With the pressures of reduced traffic levels from the recent recession and the burden associated with reduced revenues, companies throughout the transportation sector have not had the time or the resources to look at introducing EDI into their business systems. With the continuing pressures on the bottom line today, transportation companies are re-evaluating their streamlining plans; and as part of that, they are taking a second look at EDI and electronic commerce in general.

One of the recent buzzwords in informatics associated with re-engineering has been "out-sourcing" where information processing is sent out of house to be done at a centralized facility at lower cost. Such systems will inevitably be integrated via EDI and this will lead to further applications in the future.

Standards have been an issue of concern which has actually hindered development of EDI rather than facilitate it. Standard formats are generally required to transact business by EDI. In the U.S. these standards are governed by ANSI, the American National Standards Institute, with the X-12 governing transportation messages. Due to the increasing globalization of commerce; however, the UN has been promoting a worldwide EDIFACT standard "EDI for Administration, Commerce and Transport". The competition between the UN and ANSI for recognition has left newcomers confused and uneasy about adopting EDI until a clearer picture emerges. This has also hindered EDI development in Canadian transportation. Fortunately, there has now been a resolution to this issue with a decision that the ANSI standards

will gravitate towards the EDIFACT by 1996, which will become the single universally accepted standard for all commercial transactions worldwide. Although EDIFACT will be universally accepted, work must still go on to review these and develop new standards in many areas. TECST will be recognized as the formal channel for providing the views of the transportation industry to the standards-making process now being co-ordinated by the EDI Council of Canada regarding Canadian input.

Another concern amongst transport carriers about EDI development in Canada has been related to the competition amongst the port pilot projects for a lead role in determining applications and specifications for EDI implementation as well as the course of development for this technology in the transport sector. The administrators of the pilot projects at Halifax, Vancouver and Montreal have agreed to a co-operative effort in developing a unified national approach to EDI development at Canadian ports and work is now progressing in this direction.

Future of EDI in Transportation

EDI is an important part of strengthening the multi-modal chain in transportation. The technology however; has now migrated to the broader world of electronic commerce which incorporates the use of such innovative technologies as bar-coding, imaging, E-mail, EFT, smart cards, etc.. The integration between communications and computers, which is just beginning to emerge, is sure to revolutionize many areas of the transport business and EDI will be at the heart of this revolution.

Already, a whole host of new and exciting services are available in various sectors to make industry more efficient and cost effective. Applications such as the use of EDI in logistics management for automatic inventory control and ordering, as well as in customs service, cargo tracking and load planning and dispatching are just beginning to change the face of transportation in Canada and around the world. The use of EDI to streamline transportation and customs work at border crossings under the NAFTA is also being explored. Other innovations, such as the use of advanced communications to do business in a globalized environment, are improving competitiveness and helping to gain control over access to markets. In other areas, revolutionary

changes are being introduced in the way we live and work such as tele-commuting, tele-shopping and tele-conferencing, which are impacting on personal travel.

New applications are sure to emerge in the future related to areas such as trade efficiency and intelligent vehicle controls as well as the whole concept of an electronic highway. It will be imperative that Canadian transportation companies play a strong role in this change in order to strengthen their competitive position.

Increasing EDI services by government will help provide a catalyst in this area. Already many services are available via EDI such as taxation, customs and contract bidding for procurement. Other areas are being explored such as a single point for address change notification, health care and welfare administration. There are many areas where government interfaces directly with the transportation industry such as subsidy administration, statistical reporting, licensing, regulation and financial management. These must be considered as well. The Canadian government supports EDI as a way of doing business and this will become an increasingly important part of its streamlining efforts.

In the transportation industry in general, the need to streamline business operations in an increasingly competitive world is pushing Canadian companies to take a second look at EDI. Quality service is another important aspect of remaining competitive in today's business environment and EDI has an important role to play in this area as well. EDI can contribute to letting customers know where their goods are in transit at any point in time and when they will arrive at their destination; an important part of just-in-time manufacturing. It also improves the efficiency of cargo transfers and load planning at interchange points. It can contribute to more efficient dispatching and to fewer empty backhauls, which in itself is a major cost factor to any transportation company.

In company administration, EDI will improve the efficiency of the paper flow in transportation which is another major burden. There will be less inputting of information and faster access along with fewer clerical errors with EDI. Not only will this way of business reduce administrative costs, it also builds stronger business partnerships. Transportation is a service industry and quality service is important in

building strong, healthy relationships which can grow in the future. EDI will also help to forge these partnerships with shippers because the transportation company will be networked right in to their distribution chains.

Conclusion

EDI has a strong role to play in assuring the competitiveness of Canada's transportation companies in the multimodal distribution network. Companies are forging ahead to adopt EDI in order to streamline operations and reduce costs and to provide quality service which is so important in maintaining and building upon the customer base. The Canadian government is supportive of EDI and has begun offering services in this mode and will continue to add new services which interface with the transportation industry.

In the future, EDI in transportation is expected to evolve with the development of new applications in electronic commerce using bar coding, imaging, E-Mail and bulletin boards which bring together computers and communications technologies. This will move towards interactive EDI where immediate 2-way communication links are established. Transportation companies will be stronger and shippers will be better served as these concepts unfold into the paperless world of doing business electronically.

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TRANSPORTATION PLANNING FOR MINOR LEAGUE BASEBALL STADIUMS

Christine Whalen[1], Dean Cooper[1], and William J. Sproule[2]

INTRODUCTION

Minor league baseball is experiencing a resurgence in North America. Many cities are building new baseball stadiums or expanding existing facilities. This paper examines some of the transportation aspects of minor league baseball stadiums including attendance, parking, modal split, auto occupancy, and arrival and departure characteristics. Current literature is reviewed and is supplemented with field studies in Edmonton and other AAA Pacific Coast League cities(1).

TRANSPORTATION PLANNING FACTORS

For a new or expanded stadium, the key ingredients for transportation planners will be the location and data on the stadium and the types of events planned. This includes the time that events are to occur and their potential conflicts with other traffic activities. Additionally, planners consider that the following are most critical when planning transportation facilities and developing operations plans:

- potential transit usage
- auto occupancy factors
- acceptable walking distances
- parking requirements
- distribution of arrivals over time
- acceptable exit time following the event

An insight on existing facilities and their specific circumstances becomes an invaluable guide in planning. Some information is available in the literature(2,6) for selected large or major league baseball and football stadiums, but very little information is published for smaller or minor league baseball stadiums. As a result, work was undertaken in Edmonton, Alberta to determine if the characteristics and guidelines for larger stadiums would be applicable for minor league baseball stadiums.

EDMONTON FIELD STUDIES

Edmonton has a Triple A (AAA) minor league baseball team in the Pacific Coast League (PCL). Triple A baseball is one level below the major league and teams are affiliated with a major league team and during the season players may be "called up" to the parent team. The parent team for the Edmonton Trappers is the Miami

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The PCL is divided into two divisions, a Northern and Southern Division, and each division has five teams. The Northern Division is made up of the Calgary Canons, Edmonton Trappers, Portland Beavers, Tacoma Tigers, and the Vancouver Canadians. The Southern Division is comprised of the Albuquerque Dukes, Colorado Sky Sox, Las Vegas Stars, Phoenix Firebirds, and Tucson Toros.

There are two other AAA leagues – the American Association, and the International League. Ottawa has a team in the International League.

The Edmonton Trappers play their home games at John Ducey Park. The stadium is located on the edge of the downtown area, southeast of the CBD along the Saskatchewan River, and adjacent to the South Rossdale residential community. The stadium is an older city owned facility with seating for 6,200 spectators, but the Trappers and the City have an agreement in principle to build a new baseball stadium. The proposed development would see the demolition of the current stadium and the erection of a new 10,000 seat stadium on the site(7). To assist in the planning for the proposed stadium, field studies were undertaken to determine auto occupancy rates, arrival and departure characteristics, and the number of vehicles parked on-street in the Rossdale area and in all off street lots within walking distance of the stadium. An in-stadium survey was also conducted to determine modal split and spectator characteristics. The field studies were done during eight baseball game event days, and the in-stadium survey was carried out on two baseball game event days. In addition, a mailback survey was sent to other teams in the PCL to determine attendance characteristics and available transportation information.

MINOR LEAGUE BASEBALL STADIUMS

The planning of a stadium is a complex problem. In addition to meeting the geometric and functional requirements of the teams and spectators in the stadium itself, the planner must consider how to get the spectators to and from the stadium. Five elements are examined in this paper – stadium usage, estimating crowd size, travel mode, parking, and access requirements.

Stadium Usage

One of the initial steps in a transportation analysis is to determine the number of days per year that the stadium will be used, the time of day when events will take place, and the number of spectators that can be expected.

Minor league baseball games are generally scheduled during weekday and Saturday evenings or on Sunday and holiday afternoons. Games are scheduled so as to reduce conflicts with normal working hours and attract the largest crowds. PCL baseball begins in April and ends in September with the championship series. Each team plays 144 games during the season, half of which are played in their home stadium. The average number of home game dates for PCL teams varies from 60 to 72 depending on rainouts and double headers. During the 1993 season, over 80% of PCL home games were played during the evening with a start time of either 7:00 p.m. or 7:30 p.m. Evening double headers generally begin at 6:00 p.m. Lower levels of minor league baseball have fewer games during the year but exhibit similar day and game time characteristics. Games are about 2 – 2$^1/_2$ hours in duration. Minor league baseball games are scheduled outside of normal peak hour traffic and peak parking demand

periods. As a result, there are opportunities for sharing parking facilities at many stadium sites[6].

How many persons attend a game and what affects the attendance? Attendance can be examined in a number of different categories – annual total spectators, average game, highest game, paid attendance, etc.

One of the most important factors which influence attendance at minor league stadiums is a winning team. Fans will go to see a good team play regardless of any inefficiencies in the transportation system and any other inconveniences[2].

Annual attendance at a minor league stadium is influenced by won–lost percentages, publicity and sales promotion, a new team or a new stadium, a team which has built up a loyal following, and admission cost[2,4].

Day to day attendance is influenced by weather, won-lost percentages, special promotions such as giveaways or reduced ticket prices, holidays, and presence of other activities in the city [4].

Attendance figures vary considerably from one day to another as well as from one year to another. Attendance figures for the 1992 season for the Pacific Coast League teams are displayed in Table 1. The PCL stadiums have seating capacities between 6,200 (Edmonton) and 21,000 (Portland). The average attendance for the 1992 season varied between 2,707 (Portland) and 5,328 (Albuquerque). The average attendance as a percentage of capacity of the stadium varies from 12.9 percent (Portland) and 76.6 percent (Vancouver).

Estimating Crowd Size

Three terms could be used to describe the number of spectators at a game – capacity crowd, average crowd, and design crowd.

"Capacity" is the total number of seats in the stadium. In the planning of a stadium the seating capacity would be determined by examining the economics of operation, league requirements, and the market potential in the area.

The "average" crowd is a measure of the success of the team. The average crowd is useful in site selection procedures and a cost analysis for a stadium project.

The third term, the "design" crowd is a value that the transportation planner would use to determine access and parking requirements and traffic operations strategies. Careful selection of the design crowd is necessary. Overestimating the crowd would result in uneconomical facility usage, and underestimating would overload the facilities for many games which may be unacceptable to spectators.

When planning transportation facilities for a new or expanded stadium, the design crowd value is usually less than the capacity crowd. There are typically only a few games during a season that would attract a capacity crowd. A concept similar to the 30th highest hour for highway design has been used. The design crowd for a major league baseball stadium is typically the crowd attending the 10th highest game[2]. The 10th highest game corresponds to a design crowd of 80 to 85 percent of the stadium capacity.

Table 1 Pacific Coast League Team Attendance Summary

PACIFIC COAST LEAGUE TEAMS	STADIUM NAME	STADIUM SEATING CAPACITY	TOTAL ATTENDANCE 1992 SEASON (HOME GAMES)	TOTAL NUMBER OF HOME GAMES GAME DATES 1992 SEASON	AVERAGE ATTENDANCE 1992 SEASON (HOME GAMES)	AVERAGE ATTENDANCE AS A PERCENTAGE OF CAPACITY
NORTHERN DIVISION						
Calgary Canons	Foothills Stadium	7,500	277,307	61	4,546	60.6%
Edmonton Trappers	John Ducey Park	6,200	254,095	62	4,098	66.1%
Portland Beavers	Civic Stadium	21,000	184,097	68	2,707	12.9%
Tacoma Tigers	Cheney Stadium	10,000	329,000	71	4,634	46.3%
Vancouver Canadians	Nat Bailey Stadium	6,500	333,564	67	4,979	76.6%
SOUTHERN DIVISION						
Albuquerque Dukes	Albuquerque Sports Stadium	10,510	362,283	68	5,328	50.7%
Colorado Springs Sky Sox	Sky Sox Stadium	10,000	187,645	68	2,759	27.6%
Las Vegas Stars	Cashman Field	9,370	382,238	72	5,309	56.7%
Phoenix Firebirds	Scottsdale Stadium	10,000	278,798	72	3,872	38.7%
Tucson Toros	Hi Corbett Field	8,000	300,134	67	4,480	56.0%

REGULAR SEASON GAMES ONLY (PLAYOFFS GAMES NOT INCLUDED)

SOURCE: - 1993 Trappers Program
- Mail-out Survey, August, 1993

Assuming the 10th highest game approach, an analysis was made to determine if a similar relationship between design crowd and stadium capacity occurs at minor league baseball stadiums.

Table 2 shows the attendance as a percentage of capacity for the 15 highest games at John Ducey Park in Edmonton and at Cashman Field in Las Vegas. It can be seen that the 10th highest game falls between 80 and 85 percent of capacity for the teams and seasons listed. It is therefore assumed that a design crowd equivalent to the 10th highest game be used for a stadium expansion and a design crowd equivalent to a 80 to 85 percent of capacity be used for a new stadium. However, the consequences of a capacity crowd should be examined and parking and traffic facilities should be able to handle this ultimate load[3]. Often a capacity crowd game is known to occur in advance and can be handled with advanced announcements or temporary parking facilities.

Travel Modes

In order to develop access and parking requirements for a stadium, estimates of the number of spectators by travel mode to and from the stadium must be made. Spectators generally have a choice among private automobile, transit, taxi, walking, or bicycling. The use of a particular mode will be influenced by stadium location, transit availability, parking cost, and parking availability.

The automobile is the primary mode used by spectators and studies at larger stadiums have indicated that 40 to 100 percent arrive by private automobile. The general average is almost 85 percent[6]. However, at several stadiums transit is a popular alternative. There are two basic types of transit for baseball games – regular transit and special service. Regular transit is service that takes place whether or not there is a baseball game at the stadium. Although service frequency will often increase to handle game spectators, the route(s) are already serving the stadium area.

Special transit includes all other types of transit service which takes place on baseball game days only and serves uniquely to take spectators to the stadium before the game and return them to their point of origin once the game has ended. Special bus service includes charter buses, special route bus service, express service, and shuttle buses. Special transit services are not common at minor league stadiums, but as stadiums increase in size, special transit can help alleviate some traffic and parking problems.

Taxis, walk, and bicycle modes are used by only a few spectators, although the percentage of spectators using taxis or walking is typically higher if the stadium is downtown.

The mode split for selected major and minor league baseball stadiums is summarized in Table 3. As observed for larger major league stadiums, the private automobile is the primary travel mode for spectators at minor league stadiums. The surveys at John Ducey Park indicated that over 85 percent of spectators arrived by private automobile.

Another aspect of travel mode is auto occupancy rates – the number of spectators per auto or vehicle. For planning facilities, it is necessary to convert the number of spectators by mode into numbers of vehicles. The suggested design occupancy rate for baseball is 2.5 persons per vehicle[3,5], however vehicle occupancy rates do vary from city to city as shown in Table 4. The auto occupancy rates at John Ducey Park averaged 2.34 persons/vehicle for weekday games and 2.73 persons/vehicle for

Table 2 Edmonton and Las Vegas Attendance as a Percentage of Stadium Capacity

RANK	EDMONTON TRAPPERS (CAPACITY = 6,200)				LAS VEGAS STARS (CAPACITY = 6,200)			
	ACTUAL APPROXIMATE ATTENDANCE 1991 SEASON	ATTENDANCE AS A PERCENTAGE OF CAPACITY	ACTUAL APPROXIMATE ATTENDANCE 1992 SEASON	ATTENDANCE AS A PERCENTAGE OF CAPACITY	PAID ATTENDANCE 1992 SEASON	ATTENDANCE AS A PERCENTAGE OF CAPACITY	PAID ATTENDANCE 1993 SEASON	ATTENDANCE AS A PERCENTAGE OF CAPACITY
1	6,200	100.0%	6,200	100.0%	14,135	150.8%	14,321	152.8%
2	6,200	100.0%	6,200	100.0%	9,828	104.9%	10,088	107.7%
3	6,200	100.0%	6,200	100.0%	9,377	100.1%	8,277	88.3%
4	6,200	100.0%	6,200	100.0%	9,018	96.2%	8,024	85.6%
5	6,200	100.0%	6,200	100.0%	8,810	94.0%	8,019	85.6%
6	5,863	94.6%	6,200	100.0%	7,927	84.6%	8,004	85.4%
7	5,826	94.0%	5,549	89.5%	7,698	82.2%	7,946	84.8%
8	5,684	91.7%	5,269	85.0%	7,645	81.6%	7,849	83.8%
9	5,586	90.1%	5,212	84.1%	7,604	81.2%	7,767	82.9%
10	5,184	83.6%	5,086	82.0%	7,526	80.3%	7,691	82.1%
11	5,175	83.5%	5,070	81.8%	7,493	80.0%	7,576	80.8%
12	5,061	81.6%	5,053	81.5%	7,491	80.0%	7,192	76.7%
13	4,775	77.0%	5,037	81.2%	7,399	79.0%	6,767	72.2%
14	4,702	75.8%	4,996	80.6%	7,314	78.1%	6,668	71.2%
15	4,500	72.6%	4,783	77.2%	7,309	78.0%	6,526	69.7%

Table 3 Mode Split for Selected Baseball Stadiums

MAJOR LEAGUE BASEBALL STADIUMS					
STADIUM		% AUTO	% TRANSIT & CHARTER	% WALK & TAXI	% OTHER
Oakland, California	(1)	97%	3%	0%	0%
New York (Shea Stadium), NY	(1)	65%	33%	2%	0%
San Diego, California	(1)	97%	3%	0%	0%
New York (Yankee Stadium), NY	(1)	40%	55%	5%	0%
Anaheim, California	(1)	100%	0%	0%	0%
Atlanta, Georgia	(1)	87%	11%	2%	0%
Los Angeles, California	(1)	85%	15%	0%	0%
MINOR LEAGUE BASEBALL STADIUMS					
STADIUM		% AUTO	% TRANSIT	% WALK	% OTHER
Albuquerque, New Mexico	(2)	98%	0%	2%	0%
Colorado Springs, Colorado	(2)	98%	1%	1%	0%
Columbus, Ohio	(1)	90%	9%	1%	0%
Edmonton, Alberta	(3)	86%	4%	4%	6%
Las Vegas, Nevada	(2)	97%	1%	0%	2%
Phoenix, Arizona	(2)	95%	3%	0%	2%
Tacoma, Washington	(2)	90%	5%	3%	2%

(1) Source: Traffic Considerations for Special Events, ITE, 1976.
(2) Source: Mail-out Survey, August 1993.
(3) Source: In-Stadium Survey, May 1993.

Table 4 Auto Occupancy Rates for Selected Stadiums

LEAGUE	STADIUM	AUTO OCCUPANCY RATE (persons/vehicle)
MAJOR LEAGUE BASEBALL (1)	Oakland, California	3.2
	San Diego, California	2.8-3.0
	Anaheim, California	3.4
	Los Angeles, California	2.6
	Atlanta, Georgia	3.0
MINOR LEAGUE BASEBALL	Edmonton, Alberta (2)	2.5
	Colorado Springs, Colorado (3)	3.2
	Phoenix, Arizona (3)	3.0

(1) Source: Traffic Considerations for Special Events, ITE, 1976.
(2) Source: In-Stadium Surveys, May 1993.
(3) Source: Information Form Replies, August 1993

weekend games. The weekend games tend to attract more families. The overall average of 2.5 persons/vehicle seems to agree with the suggested design value.

Parking

To develop estimates of parking requirements, the proportion of spectators who will be driving to the stadium must be estimated. This would be as part of the modal split analysis. Generally, as the number of parking spaces is increased the transit usage decreases. By provided a large number of parking spaces with good access, the automobile mode becomes more attractive. If transit use were to be encouraged, a limited amount of parking may assist this policy decision. This approach has been effectively implemented at Toronto's Skydome Stadium. However, for stadiums which have poor or no transit service, it is important to recognize that insufficient parking may, in the long term, result in lower attendance at games.

In a parking analysis, it is first necessary to make an accurate inventory of available parking spaces within a "reasonable" walking distance from the stadium. The literature suggests special event spectators are willing to walk between 450 and 700 metres which translates to walking for 10 to 15 minutes[3,9].

Information received from two minor league teams, the maximum walking distance seems to agree with the stated interval. The Edmonton Trappers and Phoenix Firebirds baseball club officials estimated the maximum walking to be approximately 450 metres. However, on occasion, walking distances as high as 600 metres have been observed.

The effect of providing too few parking spaces must be examined. Besides encouraging the transit, automobile users may be willing to walk farther distances and vehicle occupancy rate may increase. The cost of providing additional parking could be weighed against these options. When the inventory information is combined with the parking requirements and policy decisions or targets, the number of additional spaces required can be estimated. The additional spaces can be accommodated through the use of a combination of facilities[8]:

- on-site parking facilities
- remote parking with shuttle bus operation
- available parking facilities near the stadium to be used as shared parking facilities (example: office building parking facility)

Table 5 shows the number of parking spaces and a ratio of seats to parking spaces for selected stadiums. Stadiums within the downtown area or a stadium which is well served by the public transit network provide on average one parking space for every 7 to 16 stalls. A stadium which has poor or no transit service and little existing parking facilities may have to provide as much as one parking space for every two seats[8]. The number of parking spaces per seat in minor league PCL stadiums ranges from 3.6 (Las Vegas) to 34.8 (Albuquerque).

Access Requirements

The arrival and departure characteristics of spectators must be considered to determine requirements that will be used in the design of entrances, exits, and parking lots.

Table 5 Parking at Selected Stadiums

STADIUM		SEATING CAPACITY	NUMBER OF PARKING SPACES OPERATED BY THE STADIUM	NUMBER OF SEATS/SPACE
MAJOR LEAGUE STADIUMS				
Atlanta Stadium, Atlanta	(1)	58,850	4,000	14.7
Astrodome, Houston	(1)	53,000	25,000	2.1
Dodger Stadium	(1)	56,000	16,000	3.5
Riverfront Stadium, Cincinnati	(1)	56,200	4,550	12.5
Shea Stadium, New York	(1)	55,000	7,400	7.4
Veterans Stadium, Phildelphia	(1)	65,300	11,000	5.9
MINOR LEAGUE STADIUMS				
Albuquerque Sports Stadium, Albuquerque	(2)	10,510	302	34.8
Cashman Field, Las Vegas	(2)	9,370	2,608	3.6
Cheney Stadium, Tacoma	(2)	10,000	1,500	6.7
John Ducey Park, Edmonton	(3)	6,200	1,000	6.2
Scottsdale Stadium, Phoenix	(2)	10,000	300	33.3
Sky Sox Stadium, Colorado Springs	(2)	10,000	2,000	5.0

(1) Source: Parking for Institutions and Special Events, E.M. Whitlock, 1982.
(2) Source: Information Form Replies, August 1993.
(3) Source: I.D. Engineering Company Ltd. Study, May 1993.

The arrival pattern to a stadium is influenced by the surrounding street network as well as the internal circulation of the stadium site. Given that the internal and surrounding street network is designed properly, the arrival pattern of baseball patrons is dependent on weather, pre-game activities, general admission seating (patrons wanting to get a good seat), and pre-game giveaways to the first X number of patrons[5].

The literature on larger stadiums indicates that the peak inbound traffic occurs approximately 60 minutes before the start of the sporting event. The 15 minute peak period normally occurs 30 minutes before the beginning of the game. During this peak 15 minutes, approximately 35 percent of the inbound traffic occurs[4]. A survey of the arrival pattern was conducted at John Ducey Park and is illustrated on Exhibit 1. The 15 minute inbound peak period occurs between 20 and 35 minutes before the start of the game when approximately 30 percent of the inbound traffic occurs.

The departure or exiting pattern of spectators is influenced by the weather, the score, and post-game activities. However, usually the exiting pattern of spectators is sharp and immediate after the game, unlike the arrival pattern of patrons which is spread out over more than 60 minutes. This creates a great impact on the transportation network. Not only must the street network surrounding the stadium be able to accommodate this instantaneous increase in traffic but so must the internal circulation network, the parking ramps, and exit facilities. The exiting patterns for six baseball games at John Ducey Park are shown on Exhibit 2. There is a peak exiting time which occurs between 10 minutes prior to the end of the event to 20 minutes after the end of the event. During this peak period over 75 percent of the vehicles left the parking lots and entered onto the street system.

To measure this outbound exiting or departure traffic, the term "dump time" or "dispersal time" is often used as a measure of service. The dump time is the length of time from the end of the game until all the parking lots are empty and the last vehicle has left the area. Studies at John Ducey Park indicate dump times of 35 to 60 minutes with an average dump time of 35 minutes.

For planning and design, a dump time would be specified and the internal circulation of the stadium, the parking lot exits, and streets and intersections serving the stadium area would be planned or operated to achieve the dump time. The literature suggests a design dump time of 30 to 60 minutes.

CONCLUSIONS

Minor league baseball stadiums have many of the same characteristics as larger major league stadiums only on a different scale. The same basic approach that is used for the planning of transportation facilities at major league stadiums can be used for minor league baseball stadiums. Several conclusions can be summarized:

1. Minor league baseball games are scheduled during weekday and Saturday evenings, and Sunday and holiday afternoons. They do not conflict with peak hour traffic periods.

2. Attendance at minor league baseball games varies considerably from team to team, and game to game.

3. The use of 10th highest game is suggested for the planning of stadium transportation facilities. This is about 80 to 85 percent of seated capacity.

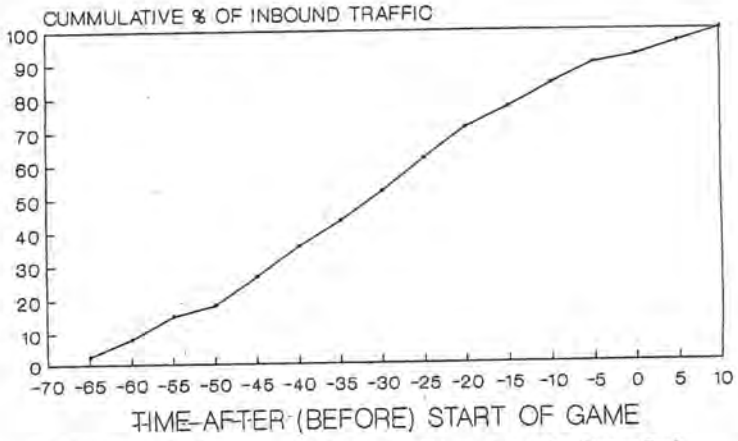


Exhibit 1 Arrival Pattern of Spectators at Edmonton's John Ducey Park

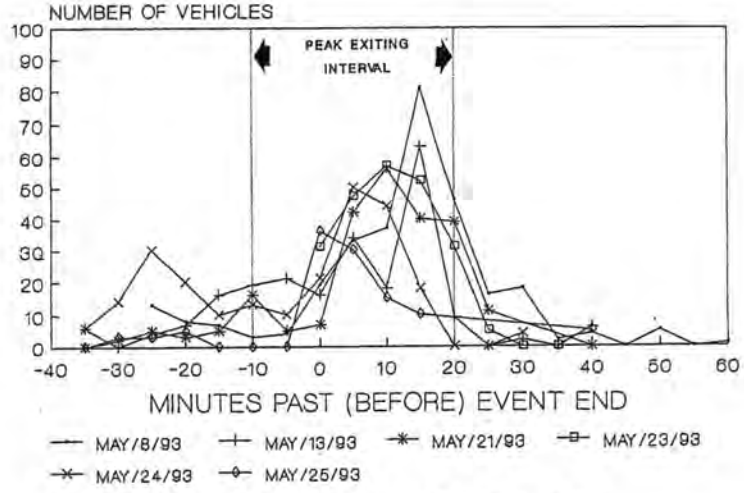


Exhibit 2 Departure Pattern at Edmonton's John Ducey Park

4. The private automobile will be the primary access mode for spectators. The average occupancy rate will be about 2.5 persons/automobile.

5. The peak arrival of spectators at a game will be about 30 minutes prior to the game.

6. "Dump time" is a measure of service for exiting spectators and for planning purposes a dump time will be specified for the design of exit facilities.

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Traffic Management for Major Traffic Projects During Construction

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ABSTRACT: The transportation situation in Shanghai is a serious problem. Streets, mostly built several decades ago, are crowded with various types of vehicles almost all day long. The urban transportation facilities do not satisfy the needs of economic growth, especially the rapid development of the Pudong economic zone. Recently, this problem has become even sharper. Many major infrastructure projects, which are necessary to improve transportation and the environment and help Shanghai become a center for finance, commerce and trade, are under construction in the downtown area.

In order to minimize the disruption of existing traffic during construction, this paper discusses various schemes of traffic management for major projects. Using mixed qualitative and quantitative methods, various schemes are simulated and analyzed. Each simulation result is evaluated with a multi-objective criterion, which is helpful for decision making. Two successful applications to the Inner Ring Viaduct and the Chengdu Road Viaduct are demonstrated.

KEY WORDS: Traffic Management, Simulation Model, Evaluation

I. Discussion of Traffic Management Schemes

Statistics show that traffic congestion in China is extremely serious. The percentage of road area to total urban area is less than 3.6%, only a fraction of the percentage in developed countries. In Shanghai, the total length of the 300,000 motorized vehicles and 6 million bicycles is over ten times the total

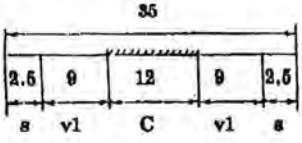
length of all roads. Under these conditions, construction of major projects is obviously extremely difficult. Therefore, it is very important to do research on traffic management during construction. We consider a scheme which combines "self-digestion" with traffic diversion.

1. Self-digestion schemes

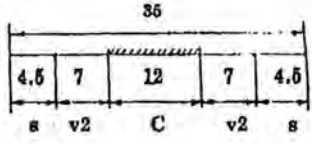
Because of the over-saturation of traffic loading on most roads in Shanghai, it is difficult to accept extra vehicles diverted from a road under construction. A "self-digestion" scheme means that motorized traffic flow is maintained as usual, but the space for bicycles and sidewalks is reduced.

Example 1: The first phase of the Inner Ring Viaduct Project plans to use 12m as the construction width, out of the total available width of 35m. The remaining width should retain four lanes for two-way traffic. We have proposed two kinds of "self-digestion" schemes, as follows:

Scheme A:



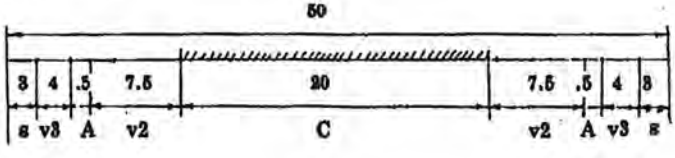
Scheme B:



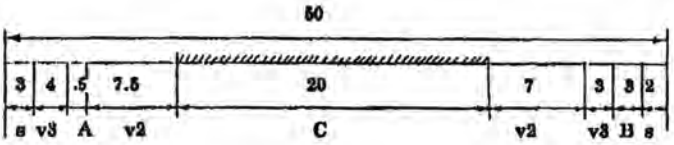
C : Under construction
v_1: Mixed motorized vehicles and bicycles lane
v_2: Motorized vehicles lane
s : Sidewalk

Example 2: Similarly, two schemes for the Chengdu Road Viaduct Project (total width 50m) are as follows:

Scheme A:



Scheme B:



C : Under construction
v_2: Motorized vehicles lane
v_3: Bicycles lane
A : Separation belt
B : Bus stop
s : Sidewalk

2. Traffic flow diversion schemes

It is impossible to maintain the usual traffic flow on some roads. In this case, we must divert some of the vehicles from the original traffic flow. If the traffic loading in the neighbouring area is saturated, we have to build a new path to accept the diverted vehicles. For example, in the first phase of the Inner Ring Viaduct Project, besides the schemes listed in Example 1, we also preset a diversion scheme. According to our statistics from the scene, trucks loading less than two tons constitute about 17% of total motorized vehicles there. We suggest opening a new path between Lan Gao Road and Wu Ning Road to lighten the pressure on Zhong Shan West Road, as well as letting 10% of the vehicles diverge naturally to neighbouring roads.

3. Mixed schemes

If the loading in the neighbouring road network is not too heavy, a scheme combining "self-digestion" with diversion may be better and more practical. In the second phase of the Inner Ring Viaduct Project and Chengdu Road Viaduct Project, we propose several mixed schemes for different roads or regions.

4. Special schemes for intersections crossing railways

Some viaducts must cross a railway. For example, the Chengdu Road Viaduct will coincide with the Gong He Xin Road Overpass which crosses a railway. Every day there are more than 60 pairs of passenger trains, as well as many pairs of freight trains passing this point. It is impossible to interrupt the

railway and the overpass for construction. A practical scheme is suggested as follows: constructing bridges for two side ramps first, and linking these bridges to the neighbouring traffic network (Tian Mu Road Overpass and ramps), then removing the original overpass, and finally building the viaduct itself.

5. The influence of public transportation

Buses and trolleybuses are the major transport tools for Shanghai residents. A good scheme should not disrupt the usual public transportation too much. Suggested arrangements include removing some stops, establishing temporary stops, changing routes, etc.

II. Quantitative Analysis of Traffic Management Schemes: Simulation Experiments

We have developed an Urban Traffic Simulation Model (UTSM), which is the key subject of this paper.

1. Characteristics of UTSM

UTSM is a microscopic, stochastic, time-scanning simulation model, programmed in Turbo-PASCAL. It is suitable for any urban traffic flow satisfying the following conditions:

(1) Intersections must be in T-shape or cross shape, with signal control.
(2) Vehicles must be in single lane or double lane.

UTSM has the following features:

(1) As a microscopic model, it simulates the movement of a single vehicle, rather than global variables that describe traffic flow, such as capacity, density, etc. Both motorized vehicles (including cars, trucks, buses, and motorcycles) and bicycles are simulated. For bicycles, we use a batch treatment that converts 4 bicycles into one car.
(2) The basic unit in a road network is a "link" (input link, network link, or output link).
(3) A modular structure is used.
(4) The simulation in UTSM combines discrete events with a continuous system.

2. Simulation experiment

The Model: A proper simulation model must be set up before making an experiment. The scale depends on the planning scale of a project and the practical schemes based on the experience of the engineers and experts who are in charge of the project, as well as the capacity of UTSM.

Validation: The accuracy of a model should also be checked against actual data from field observations. Table 1 shows a comparison between simulated and observed values of traffic flow and speed in the north part of Chengdu Road Viaduct. If the validation is successful, we have confidence to use the model to do other simulations.

Table 1

Link	Segment of Gong He Xin Road	Driving Speed		Traffic Flow	
		Simulated	Observed	Simulated	Observed
7	Liu Ying - Zhong Shan Bei	9.4	-	2185	2455
8	Zhong Shan Bei - Liu Ying	17.4	16.3	1891	2254
14	Zhong Shan Bei - Zhong Xing	17.4	-	756	1048
13	Zhong Xing - Zhong Shan Bei	17.8	15.2	2277	2744
19	Zhong Xing - Tian Mu Xin	15.4	-	1143	1480
20	Tian Mu Xin - Zhong Xin	16.9	-	1036	1280

Output: For each link, certain statistical results, which are the key measures of a scheme, are the simulation output, as follows:

(1) Average travel time: $t = \sum_{k=1}^{K} t_k/k$

where t_k: time duration for kth vehicle passing through the link
K: total number of vehicles during simulation

(2) Average speed: $v = l/t$
where l: length of the link

(3) Average delay time: $d = \sum_{j=1}^{J} d_j/J$

where d_j: delay time of the jth vehicle
J: total number of waiting vehicles during simulation

(4) Average number of stops: $s = \sum_{i=1}^{I} s_i/I$

where s_i: number of stops for the ith vehicle
I: total number of vehicles which stop one or more times

(5) Saturation coefficient: $\lambda = V/kc$
where V: traffic flow
k: number of lanes
c: capacity of a single lane (here we take $c=1312\delta$ [pcu/hr], with δ a reducing coefficient of intersection influence)

(6) Loading coefficient: $\mu = Q/c$
where Q: volume of a single lane at an intersection point
c: capacity of a single lane at an intersection (here we take c=1326 pcu/hr)

Table 2 shows some simulation results for the north part of the Chengdu Road Viaduct.

Table 2

Scheme I: Motorized Vehicles Only

Link	Segment of Gong He Xin Road	Average				Saturation Coefficient
		Speed (km/h)	Delays (s)	Travel Time (min)	Flow (veh/h)	
7	Liu Ying - Zhong Shan Bei	18.0	4	1.80	1211	0.87
8	Zhong Shan Bei - Liu Ying	19.2	1	1.69	1260	0.90
14	Zhong Shan Bei - Zhong Xing	19.5	1	3.03	951	0.68
13	Zhong Xing - Zhong Shan Bei	19.3	2	3.16	924	0.66
19	Zhong Xing - Tian Mu Xi	19.0	2	2.53	1128	0.84
20	Tian Mu Xi - Zhong Xing	19.4	1	2.48	1113	0.80

Scheme II: Motorized and Non-Motorized Vehicles

Link	Segment of Gong He Xin Road	Average				Saturation Coefficient
		Speed (km/h)	Delays (s)	Travel Time (min)	Flow (veh/h)	
7	Liu Ying - Zhong Shan Bei	8.9	60	8.65	2105	0.96
8	Zhong Shan Bei - Liu Ying	17.4	1	1.86	1891	0.86
14	Zhong Shan Bei - Zhong Xing	14.1	2	4.32	716	0.83
13	Zhong Xing - Zhong Shan Bei	14.0	4	4.35	2332	1.06
19	Zhong Xing - Tian Mu Xi	11.9	19	4.04	981	0.70
20	Tian Mu Xi - Zhong Xing	14.2	2	3.38	1122	0.51

A comparison of average speeds on Gong He Xin Road between the actual situation and our simulation results for Schemes I and II is given in Table 3. The reduction rates are 8% and 15% respectively.

Table 3

	Motorized Vehicles	All Vehicles
Actual	20.8	15.7
Simulation	19.1	13.4

The above output is just for a single vehicle, which describes the service level of a scheme. We can go beyond this to obtain statistical output for total

vehicles, which reflects the benefits of a scheme. The global output is listed as follows:

A. Average measures

Suppose that there are n links and the total length $L = \sum_{i=1}^{n} l_i$, where l_i is the length of the ith link.

(1) Travel time: $T = \Sigma\ t_i$
(2) Delay time: $D = \Sigma\ d_i$
(3) Mean speed: $V = L/T$
(4) Mean volume: $Q = \Sigma\ (q_i l_i)/L$
(5) Capacity: $C = \Sigma\ (c_i l_i)/L$
(6) Saturation coefficient: $\lambda = \Sigma\ (\lambda_i l_i)/L$

where t_i, d_i, q_i, c_i, and λ_i are the average travel time, delay time, volume, capacity, and saturation coefficient along the ith link respectively.

B. Indices for all vehicles at rush hours

(1) Total travel time: $T_v = \sum_{i=1}^{n} (t_i q_i)$

(2) Total delay time: $S_v = \sum_{i=1}^{n} (s_i q_i)$

III. Evaluation with Multiple Objectives

Suppose that there are n schemes, m links, and k objectives. The evaluation procedure can be described as follows:

Step 1: Set up objective matrices.

$$A_l = \left(a_{ij}^{(l)} \right)_{mxn} \qquad (l = 1,2,...,k)$$

Step 2: Find an ordering mapping $A_l \rightarrow \tilde{A}_l = \left(\tilde{a}_{ij}^{(l)} \right)_{mxn}$, where $\tilde{a}_{ij}^{(l)}$ are integers and represent the optimal order of $a_{ij}^{(l)}$ in the ith row.

Comparing the magnitude of the elements of in the ith row: $(a_{i1}^{(l)}, a_{i2}^{(l)}, \ldots, a_{in}^{(l)})$, if A_l is an objective matrix of speed, we take the optimal number of 1 for the maximum element of $a_{ij}^{(l)}$, 2 for the second largest one, and so on. If there are

two or more elements that have the same value, then they receive the same optimal ranking number. If A_l is some other objective matrix, the procedure is similar, but the minimum element, not the maximum, may be optimal. In any case, the best choice receives value 1, the second best 2, and so on.

Step 3: Find the optimal schemes for each single objective.

Take $\bar{a}_j^{(l)} = 1/m \sum_{i=1}^{m} \bar{a}_{ij}^{(l)}$ (j = 1,...,n, l = 1,...,k)

Suppose that $\bar{a}_{j1}^{(l)} \preceq \bar{a}_{j2}^{(l)} \preceq \ldots \preceq \bar{a}_{jn}^{(l)}$,

then the best scheme for the lth objective is scheme j1, the second best is scheme j2, and so on.

Step 4: Find the optimal schemes for multiple objectives.

Make an ordering mapping $\{ \bar{a}_j^{(l)} \} \rightarrow \{ \hat{a}_j^{(l)} \}$, where $\hat{a}_j^{(l)}$ is an integer and represents the optimal order of the jth scheme for the lth objective.

Take a weighted summation

$$\lambda_j = \sum_{l=1}^{k} w_l \hat{a}_j^{(l)}, \quad (j = 1,...,n), \quad \text{where } \Sigma w_l = 1.$$

Suppose that $\lambda_{j1} \preceq \lambda_{j2} \preceq \ldots \preceq \lambda_{jn}$, $(1 \preceq jn \preceq n)$.

Then scheme j1 is best, scheme j2 is second best, and so on.
We may make an ordering mapping again $\{ \lambda_j \} \rightarrow \{ \tilde{\lambda}_j \}$, where $\tilde{\lambda}_j$ is also an integer, which represents the optimal order of the jth scheme for the multiple objectives.

Consider the Inner Ring Viaduct as an example. We simulated nine schemes with five objectives (average speed, average delay time, average travel time, average number of stops, and coefficients). Denote P_1, P_2, ..., P_8 as the eight new schemes and P_0 as the current situation. Table 4 shows the results when $w_1 = w_2 = \ldots = w_5 = 1/5$.

Table 4

Scheme	P_0	P_1	P_2	P_3	P_4	P_5	P_6	P_7	P_8
λ_j	5.2	7.6	5.8	4.6	3.4	5.2	2.6	3.4	1.2
$\tilde{\lambda}_j$	5	7	6	4	3	5	2	3	1

In order of priority, the first four schemes are P_8, P_6, P_7, and P_3. If we take the weights as $w_1 = w_3 = 1/4$ and $w_2 = w_4 = w_5 = 1/6$, then we obtain a slightly different result, as shown in Table 5.

Table 5

Scheme	P_0	P_1	P_2	P_3	P_4	P_5	P_6	P_7	P_8
λ_j	5.08	7.58	5.75	4.67	3.50	5.17	2.42	3.42	1.17
$\tilde{\lambda}_j$	6	9	8	5	4	7	2	3	1

In this case, the three schemes of highest priority are still P_8, P_6 and P_7, but the fourth one is P_4 instead of P_3.

We recommended P_8, P_6 and P_7 to Shanghai Municipality. P_8 is a mixing scheme: 7m as motorized vehicle lanes, 4.5m as mixing lanes for manpowered vehicles and sidewalk, natural diversion for 10% of the vehicles, and partial diversion for trucks loading less than two tons. These schemes have already been successfully applied to the first phase of construction of the Inner Ring Viaduct several months ago.

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Drivers of Change in Transportation
– Users (Customers) of the System –

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"The Customer is King!" "The Customer is Always Right!" We have heard these statements time and time again. Truth or Consequences? **BOTH!** It is **TRUTH** and the **CONSEQUENCES** are disastrous if we do not pay heed to the ultimate customer of our transportation systems.

The Ministry of Transportation of British Columbia is a provincial agency whose responsibility is:

> **To provide and maintain safe and efficient movement of people and resources on an integrated, multi-modal provincial transportation system, in conjunction with the economic development of the province, and in a socially and environmentally acceptable manner.**

Historically, we have always known what the drivers of British Columbia needed in a transportation system... and we gave it to them. **NO QUESTIONS, PLEASE!!!** This is normal for government, right? Well... a new day is dawning and we have experienced a major **"Paradigm Shift"** occurring in the public's expectations and demands.

With the advent of the Service Quality movement, the ministry examined its mandate and mission in light of growing public demand. In February 1992, Transportation and Highways conducted eight customer focus group sessions to get feedback from the public and commercial users (**our customers**). What did they think about our transportation system? Are we delivering what they want? Do they know who we are and do we provide value for their tax dollar?

It's one thing to be engineers and have the expertise of building highways and bridges; it's another thing to understand how drivers relate to and experience what we give them. We needed to view the system from the driver's perspective. Drivers (public and commerical) view driving our highways as a **"wholistic, integrated, continuous experience"**. They told us what characteristics are important to them as they drive the provincial system. These characteristics then lead to certain expectations they believe should be **NORMAL** for a provincial system. We followed up with a provincial satisfaction telephone survey (800 people) to confirm what we heard in the focus groups. **What a revealing story!!!**

Some of the key finds looked like this: Maintenance and design can be better. Safety concerns reflect growth and the increased number of drivers on highways. The public wants continuous dialogue and a more vital, interactive consultative process. There is a resistance to increased taxes though opinions on the use of tolls were split 50/50. They gave the ministry positive ratings on signage, road information, construction standards, bridge building and repair. We were weak in maintenance, planning, use of public funds and public communication.

The overall conclusion focused on **"value for money"** as a chief issue; **Safety concerns** are on the increase; **Regional sensitivities** are acute; the ministry has a **leadership role** in advocating driver safety; highways should be **upgraded to minimum standard with provincial consistency**; **Involve the public more**; and, develop **strategic communication plans** to keep the public informed.

The ministry has responded to their immediate concerns. Along with this, we have also begun to incorporate public and commercial feedback into our daily business plans. There are **projects and initiatives** responding to specific concerns voiced by our customers (maintenance issues, rest areas, safety, planning, inland ferry service and road information). District, Regional and Branch offices are doing **continuous surveys** (over the counter, mailouts, etc.) to keep the feedback cycle in motion and adjust programs to meet and satisfy the drivers needs. Several District offices have computerized **Customer Complaint Followup** to address and resolve customer needs and expectations. Data then goes into mid and long term programs (ie. dust control, winter maintenance, etc.). The ministry is moving toward greater **public involvement and consultation** (Biking policy, Gulf Island Trust and the Vancouver Island Highway Project).

All in all, we see that the drivers of change, especially in how we at Transportation and Highways complete our mandate, is the actual users (customers) of the provincial transportation system. **Isn't this the way it should be any way?** Before we asked our customers, we didn't think so; now we do!

Royal Commissions and Canada's Transport Policy Community: The Changing Dynamics of Political Innovation

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Introduction: Placing Royal Commissions in Context

Royal Commissions have been a mainstay of Canadian transportation policy making. Once in each generation since the First World War, government has charged such a body to develop a new transportation strategy. This paper takes stock of the latest such effort, the "Royal Commission on National Passenger Transportation" chaired by Louis Hyndman. The potential influence of the Hyndman commission's report will be evaluated in a comparative context that spans both time and space. By connecting the Hyndman commission's efforts with the work of its predecessors, one gains insight into the domestic political forces that will serve to either constrain or facilitate its influence on reinventing government's role in Canadian transportation.

Earlier royal commissions have influenced policy reform through a combination of analytical insight and political resonance with the interests and ideas held by members of the transport policy community, those government, industry, and civic organizations and individuals who perceive a stake in the transport sector. Coleman and Skogstad (1990) have characterized the policy community as a locus of politics, the societal space where problems are contested and solutions are crafted.[1] Hayward (1991:401) notes that the policy community approach to comparing policies cross-nationally "usually fits the facts better than do rival approaches."

In Canada's transport sector, the changing political and economic organization of producers, consumers, and government itself has led to a very different interpretation of each royal commission's analysis, due in some measure to the ideas and interests that greeted such findings. No commission's blueprint for policy reform has been implemented as proposed. In each era, certain recommendations were incorporated into public policy while others were left to gather dust on library shelves. The policy community framework suggests that the connection between recommendations and implementation is not random. Rather, by focusing on the way in which public and private decision makers interact in the period following release of commission findings, it is possible to predict which policy items will be ordered off the menu of innovations and which ones will be left untested.

If the response pattern predicted by the policy community model holds true, then the Hyndman commission will not impact transport policy based upon the strength of its analysis *per se*. The attributes that will motivate policy actors (*e.g.*, administrative leaders in the federal and provincial bureaucracy, political parties, government, and

organized transport consumers and producers) to take up a particular recommendation for reform turn out to lie mainly in these recipients of policy advice, rather than in the donor's intentions.

Focusing on prior episodes of transport policy development that followed the release of royal commission reports will help sharpen the image of a policy community and its function in the selection and implementation of reforms. But given the increasing openness of Canada's economy, the transport policy community may have taken on a new orientation for this latest round of reform. Instead of assuming that the ideas and interests of various public and private policymakers are formed within a domestic frame of reference, one must now take the perspective of world markets and global competition into account. Contrasting the Hyndman commission's recommendations with the work of a contemporary French effort, the *Débat national sur les infrastructures du transport,* will offer an international counterpoint to the issues raised here in Canada. Not only can looking across the Atlantic sharpen our understanding of how new transport options relate to their respective policy community, but looking abroad will also highlight the new economic influences on the Canadian transport policy community. As a result of heightened international competition, both Canada and France will wind up choosing new transport policy options based upon an unprecedented inflow of signals from abroad. Thus, exotic foreign options will increasingly influence innovations on the domestic policy menu.

The analytical horizon set out by the Hyndman commission makes periodic reference to the global economic forces that will influence Canada's transportation sector in years to come, but it does not identify how the policy community will interpret those signals and value the stakes associated with the outcomes. The economic analysis that forms the Hyndman commission's principal research tool tends to focus on the degree of insulation from market signals that regulatory barriers and subsidies can create. Now that those markets are becoming global, the quality as well as the quantity of insulation between Canadian transport practices and those elsewhere becomes increasingly important. The Hyndman commission's recommendations can be thought of as opening a new policy making episode. But as previous episodes have demonstrated, the timing and direction of actual change depend on an interaction of political and economic forces that emanate from well beyond the commission's analysis.

How Earlier Policy Communities Greeted Recommendations for Change

The Hyndman Commission is the fourth royal commission to investigate Canada's transportation policy in the twentieth century. The varied fates of its predecessors suggest that the balance of power between governments and societal interests, e.g., transport investors, consumers, and producers, can serve as useful indicators of which policy options will be developed and implemented and which ones will languish in obscurity. As Canada's transport policy community has evolved, each royal commission confronted a different set of opportunities and constraints for policy innovation.

In 1917, the (Drayton-Acworth) "Royal Commission to Inquire into Railways and Transportation" released its findings into a transport policy community where the national government dominated all other interests and organizations. World War I created an unprecedented centralization of political authority in Ottawa, turning the federal cabinet into a temporary "constitutional dictatorship" with near absolute political powers (Smiley, 1980: 50). At the same time that Ottawa's power was at a modern apogee, the economic demands of wartime had pushed an already over-extended

railroad industry to the brink of financial collapse. This royal commission's recommendations to nationalize the privately owned Canadian Northern Railway, Grand Trunk Railway, and Grand Trunk Pacific Railway thus came at a time when government was exceptionally powerful in relation to transportation producers.

This configuration of a powerful central government and a weak private sector facilitates a "state directed" policy network in which government was in a position to overcome any challenge to its policy preferences. And those preferences were in near perfect harmony with the royal commission's findings. Ottawa sought to assert a new form of economic sovereignty through railway nationalizion. The goal of the new policy was to use nationalization as a policy instrument that could impose the costs of railway reorganization on the British investors who owned the Grand Trunk and Grand Trunk Pacific railways (Perl, 1994). This redistribution was needed to bail out domestic financiers of the Canadian Northern Railway. Persuasive circumstantial evidence suggests that government's activity in this state directed policy network extended to shaping the findings of the royal commission itself.[2]

From 1917 through 1923, Ottawa continued to direct policy development in implementing only those findings of the Drayton-Acworth commission that corresponded with government's preferences. For example, Drayton and Acworth's call for vesting the power of appointments to the national railway's board of directors in the existing directors was studiously ignored. Board members were appointed by the cabinet, without advice from the Canadian National's sitting directors.

A state directed policy network thus facilitates government autonomy in policy making, and when government's preferences either overlap with, or extend to, guiding a royal commission's analysis, the likelihood of translating favoured recommendations into new policies is quite high. Indeed the Drayton-Acworth commission's primary function was legitimating new policy that had been developed within the federal government. But as the balance of power between government and societial interests changed, a new policy network emerged to greet the next royal commission's findings.

The 1930s demonstrated that an economic crisis could not legitimate Ottawa's political authority in the way that a wartime emergency had. For in peacetime, no matter how desperate the economic circumstances were, Canadian federalism short circuited Ottawa's public policy initiatives like unemployment insurance and interventionist regulation of the national economy. In the transport sector, this division of powers prevented government from addressing the emerging competition between railways and motor carriers. Constitutional practice treated inter-provincial rail transport as a responsibility of national government, while the rapidly expanding road transport sector came under provincial jurisdiction. In addition to this diffusion of public authority, the private providers of transport had now consolidated into two national carriers, Canadian Pacific Railway (CP), and Canadian National Railways (CN).

The result of this shifting balance of power could be termed a disjointed duopoly, in which the division of public responsibilities, where Ottawa and the provinces each controlled separate modal policy levers, was paralleled by the division of Canada's transportation market between CP and CN. But whereas Canada's two transport producers could have adjusted their output by redistributing modal and regional shares, the distribution of government's regulatory powers was not organized to accommodate such a change. The resulting mismatch in political and economic capacity left this policy community poorly positioned to undertake any real innovation.

Neither Ottawa, the provinces, nor CP and CN, could forge an alliance to translate any of the Duff commission's recommendations into workable policies. Reforms that applied consistent regulatory and fiscal rules to both road and rail transport would have required a new division of powers over transport, more political effort than any government was prepared to undertake. Absent that level of political commitment, attempts at reorganization would necessarily be balkanized.

The 1932 Duff commission approached its task with sensitivity to the constitutional division of powers in transportation. Although intermodal competition was becoming a serious policy issue, the Commission recommended against federal intervention in either automotive finance or regulation because "Under the constitution of Canada regulation of road transport falls within the exclusive jurisdiction of provincial authorities (Government of Canada, 1932; 56). The analysis went on to provide an elaborate disclaimer of federal responsibility in road transport to avoid challenging the provinces' responsibility.

Instead of seeking to integrate, or even harmonize, the fiscal and regulatory policies on both sides of the jurisdictional divide between railways and roadways, the Duff commission focused its attention on restructuring the railroad industry alone. The target of such "rationalization" was duplicative freight and passenger services Perhaps because both CP and CN feared that such consolidation would lead to amalgamation, they opposed most of the commission's policy recommendations. The most that Ottawa and the railways could agree upon implementing was a relatively modest consolidation of passenger services in Ontario and Quebec. Disjointed duopoly turned out not to fit with the objective of reforming railway operations on a national scale.

As a result, Canada's transport policy community chose to leave most of the Duff commission's suggestions untested. But even though this royal commission changed little in the short run, its analytic principles served to legitimate provincial responsibility for road development and worked to entrench the separation of government's powers in the transport sector. In its deference to Canadian federalism, the Duff commission became a midwife to modal segregation in Canadian transportation policy.

By 1961, when the Macpherson royal commission was established, Canada's transport policy community was more dynamic than ever. Provinces had used their fiscal and regulatory jursdiction over road transport to implement policies that stimulated truck, bus, and automobile transport. The success of these efforts had come largely at the expense of the rail mode, and by 1960 the relationship between government, consumers, and producers in the transport sector was at a turning point.

Roads falling under provincial jurisdiction were poised to surpass federally sponsored railways as Canada's most important means of surface transport. Along with the dispersion of fiscal and regulatory authority among Canada's ten provinces that accompanied the rise of road transport in relation to railways, the private sector had also been transformed by a new diversity of interests. Trucking firms, bus companies, and the wide range of automotive related producers joined the railroads as major transport producers. This diversification of interests in both the state and society set the scene for what Pal (1992: 112) has termed a "clientele pluralist" policy network where "state agencies are both weak and dispersed ... [relying on private sector] associations for information and support ... in policy-making." The diverse preferences and diluted levels of authority found in a clientele pluralist network increase the likelihood of group alliances because no single firm, government, or consumer organization can achieve its objectives alone. The Macpherson commission's analysis took little account of these

alliances, and hence neglected the political fault lines underlying the transport sector's economic development.

The Macpherson commission copied the Duff commission's double standard of investigation into federal and provincial transport policies. It examined both the political and economic dimensions of Ottawa's transport responsibilities (i.e., the rail mode) while recognizing only the economic consequences of the provinces' finance and administration of road transport. With provincial sponsorship for roads neglected, railway subsidies appeared unjustifiable, leading commissioners to conclude "The railways' role as an instrument of national policy promoting settlement and ... traffic by the incentive of cross-subsidization ... is obsolete" (Government of Canada, 1966: 18).

Extensive evidence concerning the growth of automotive transport and its competitive pressure on the railroad industry was presented to justify findings that CP and CN must be liberated from their existing public service obligations (i.e., subsidized freight rates and unprofitable passenger service) and given a narrower commercial mandate. The Commission worked from a syllogism that associated a transport monopoly with government initiative. Railroads had been created as a monopolistic industry to advance a public agenda of national development, industrial growth, and territorial cohesion. Road transport had effectively put an end to the railroads' transport monopoly. Therefore, the policy objectives of national development could no longer be achieved effectively through government direction of the railroad industry.

The ongoing, and indeed expanding, provincial policy objectives in road investment were never elaborated with the care and precision of earlier federal initiatives. Assessing the competing calculations that guided federal and provincial infrastructure finance, the Commission stated "... our investigations have revealed surprisingly little evidence of a consistent and considered economic approach to this allocation of public assistance among the various modes" (Government of Canada, 1966: 13). What was left implicit was the potential redistribution of fiscal and regulatory input between federal and provincial governments. For if the commission's market oriented policy reforms were adopted by Ottawa in the rail sector but provincial policy remained constant, then the provinces would become the principal sponsors of Canada's transport infrastructure and further stimulate the fastest growing component of its transport industry. From the policy community's point of view, those producer and consumer interests that were well represented at the provincial level would gain leverage at the expense of interests that linked into the federal government.

Whereas economic logic would have followed up on the source of growing modal competition, the political taboo of crossing the federal-provincial jurisdictional boundary prevented any prescription to the provinces. As a result, recommended reforms sought to accommodate rail policy to the exogenous economic logic of expansive provincial highway programs that bore a striking resemblence to the "obsolete" development efforts at the federal level. The federal government was charged with implementing fiscal, administrative, and regulatory reforms that would allow railways to shed loss making functions in order to compete more effectively with road transport. But at the same time, the provinces' policies stimulating road transport were left virtually untouched. The fit between this bifurcated logic and the divided interests of the transport policy community turned out to be the key to predicting which recommendations would be adopted. In the policy community's dynamic of clientele pluralism, only those findings which produced an initial consensus among interests allied with one level of government, and then encountered either indifference, disunity, or agreement among the clientele associated with another level of government, made it

off the policy drawing board. Thus, the federal government, CN, and CP managed to reach a consensus about shedding railroad cross subsidies to preserve passenger service. Since the clientele of provincial transport policy initiatives (i.e., road users) were either indifferent to, or supportive of, such a reform, policy was implemented.

Conversely, when the commission proposed federal regulatory reforms that divided interests allied with Ottawa while also uniting the provincial policy community in opposition, these recommendations were not implemented. The Macpherson commission had recommended a new transportation act which would centralize regulatory authority for interprovincial transportation within a single federal agency. Ottawa responded by creating the Canadian Transportation Commission (CTC). This agency was charged with formulating a national transport policy based upon the competitive advantages of each mode. But clientele pluralism worked to prevent any reconciliation of federal railway policy with provincial highway policy, leaving it impossible for the CTC to articulate a national transportation policy.

Richard Schultz attributes the failure to implement Section 3 of the National Transportation Act, which would have incorporated regulatory responsibility over interprovincial road transport under Ottawa's jurisdiction, to a combination of intergovernmental rivalry and internal division within the federal government, the hallmarks of clientele pluralism. Schultz confirms, "Naturally, the provinces would oppose the loss of the only mode of transportation which they could regulate, especially in light of the role they envisaged for trucking in regional economic development." (Schultz, 1980: 24)

Policy Reform in Today's Transport Policy Community

By the time of the Hyndman commission's report in 1992, Canada's transport policy community was more diverse than any to have yet encountered such a blueprint for reform. Canadian National and Canadian Pacific were no longer all-encompassing transport conglomerates that provided a full range of services. In response to the Macpherson commission's recommendation to do away with cross subsidy, Ottawa had cooperated in excising their unprofitable "cost centres" and establishing them as independent public enterprises. Passenger train service became the responsibility of VIA Rail Canada, Maritime ferry services were turned over to Marine Atlantic, and Newfoundland's freight and passenger services were placed in the care of Terra Transport. These uneconomic entities made easy targets for budget cutters in the Mulroney government. Indeed, the Hyndman commission was launched at the same time that Ottawa cut VIA Rail Canada's route structure in half and its train miles by eighty percent.

In aviation, deregulation and privatization have also diluted the national focus of Canada's two major carriers. Air Canada and Canadian Airlines International now represent distinctive regional coalitions of capital and labour, pitting central Canada against the West as each firm struggles to survive the air industry's crisis of overcapacity. Further, although both remain Canadian owned corporations, the globalization of the aviation industry has motivated each company to build international alliances that bring foreign political and economic interests to the table of Canadian transport policy making. While Canadian Airlines may appear to be the more dependent on such a foreign linkage, with its future currently riding on an alliance with American Airlines, Air Canada's stake in Continental makes it increasingly interdependent with a U.S. carrier over the long run.

In the automotive sector, the North American Free Trade Agreement will trigger a relative decline in Canadian vehicle assembly while also boosting the manufacture of specialized component parts (Molot, 1993). Within a decade, automotive manufacturing will no longer be central Canada's engine of economic growth.[3] And trucking deregulation has opened Canada's borders to U.S. operators whose lower cost structure have enabled them to capture a significant share of the domestic road transport market (Madar, 1989).

In short, the Hyndman commission's recommendations have been placed before the most heterogeneous transport policy community in Canadian history. Such diversity tends to be associated with policy networks characterized by pressure group pluralism. Where clientele pluralism had been structured by the dominant characteristic of Canada's domestic politics, namely federalism, pressure group pluralism breaks away from any consistent organizing principle. Instead of communities of interest clustered around government's involvement in transportation, be it federal or provincial, the dynamic of pressure group pluralism is based on *ad hoc* political alliances that form and unravel under the momentum of sudden events. As a result, neither public nor private actors are likely to posess an incentive for proactive public policy development because the implications of a given proposal are likely to remain uncertain until a moment of crisis (e.g., bankruptcy of a major firm, an obvious environmental disaster, or the isolation of a particular region or societal segment from national transport services).

Transport policy reforms are clearly less predictable within a pressure group pluralist context than under any other policy community environment. Under these circumstances, accomplishing change requires coordinating public and private initiatives under conditions of minimal certainty. Thus, the Hyndman commission's policy prescriptions will not become reality as a result of the stable set of preferences that once attracted firms, consumers, and governments to previous reform initiatives. Instead, the translation of recommendations into reality is most likely to be influenced by transitory preferences, ideas and interests.

Because of the growing openness of Canada's economy in general, and the globalization of transport competition in particular, some of the inputs that trigger temporary coalitions in the policy community will originate from abroad. Assessing the Hyndman commission's key recommendations along with those of a parallel French transport policy review can suggest whether the principles guiding domestic policy redesign are compatible with those being applied to policy reforms abroad. Because of its pressure group pluralist dynamic, Canada's policy community could follow foreign influences just as easily as the cues set out by domestic policy reformers.

Contrasting Canadian and French Modes of Transport Policy Analysis

Both Canadian and French governments sought advice on modifying their transport policy regimes during the same time period, because by the end of the 1980s, firms and government agencies in both nations exhibited little confidence in being able to adapt to a rapidly changing economic climate. Forces ranging from more open and acute international competition to growing concerns over the costs of environmental degradation had led policy actors to question their ability to interpret the conflicting signals being generated by a "new world order." In the transport sector, getting these signals wrong could lead to costly mistakes given the large amounts of long-lived capital that are required to build and operate new networks. Interestingly, railway passenger service became a bellwether for both Canadian and French insecurity over transport policy making more generally.

In Canada, the passenger train's fortunes had been on the wane for about two decades, fueled by a prolonged period of disinvestment. Despite evidence that new policy initiatives could reverse such decline in the U.S., the Mulroney government opted to downsize VIA Rail Canada dramatically (Perl, 1993). Government's loss of faith in public enterprise, and in the rail mode as a passenger carrier, was presented as an act of fiscal responsibility, one that would become apparent in the context of a more comprehensive review of future national passenger transport needs. Hence the rationale for the Hyndman commission's entire review exercise could be seen to originate from the need to legitimate the Mulroney government's abrupt "solution" to Canada's long term passenger train problem.

But in France, it was the passenger train's success that triggered a similar policy review. Here, the development of a high speed rail network had provoked dissent about the government's responsibility to other segments of the transportation system. While government provided the national railway, SNCF, with abundant resources to expand upon the initial triumph of the *TGV*, critics charged that regional train services operated by conventional technology, commuter rail services, and urban transit were being allowed to deteriorate. This divergence of public support led critics to attack government's "two speed" transport policy in which a favored class of travelers could speed across the country by bullet trains while the numerical majority of public transport users was left to suffer deteriorating ordinary trains, buses, and urban transit. Thus, Louis Hyndman and Gilbert Carrere were each appointed to oversee policy reviews that could establish new national transport priorities. These goals would, presumably, make it easier for both government and industry to deal with increasingly contested and contentious trade-offs.

The different ways in which these commissions undertook a broadly similar task offer important evidence about the divergent premises that guided their analysis. Both commissions were charged with undertaking public consultation, but the scope of such investigation, and the relationship between public and expert opinion in these investigations, suggests that the Hyndman commission viewed Canadian public input as being less compatible with the substance of transport policy development than did the Carrere commission in France.

The Hyndman commission began its work by holding public hearings at 30 locations across Canada during which 382 deputations were made. These hearings were publicized by modest advertisements in the public media, and received very limited news coverage in advance of the proceedings. After such hearings, when media coverage was likely to spark further public interest, the option to submit written briefs or call a toll free line and offer opinions over the phone was taken up by 546 written responders and 134 callers.[4] The commission confined its public outreach to a series of 14 focus group sessions which became the basis for a nationwide telephone poll of 2,400 individuals' attitudes on transport issues.

Although the Hyndman commission actually received the bulk of its public input through an active outreach effort, the telephone poll instrument led to a highly structured form of interaction with the public. Evidence that even this feedback was mediated by an evaluation mechanism that was far from neutral suggests that the Hyndman commission placed a low value on direct public input (Dunbar, 1993). An explanation for this scepticism regarding public input into transport policy reform can be found in the commission's subsequent diagnosis of Canada's transport ills being caused by a widespread addiction to government subsidies. Although not stated in as

many words, the commission recommendations regarding each mode make it clear that the capital and operating subsidies furnished by governments have distorted the ways in which both producers and consumers evaluate transport's costs and benefits (Government of Canada, 1992). This interpretation of subsidies' effect would leave little room for public input into policy evaluation because consumers and producers would be unfit to express preferences that had not been clouded by subsidy. The opinions of producers and consumers hooked on subsidized mobility were judged to be an unreliable guide for analysis.

The Carrere commision took a different approach to public consultation. Like its Canadian counterpart, it held public hearings around France, receiving more than 3,000 deputations at seven such events. It took a more active role in publicizing these events, so that 400 articles about its activity were published in major French newspapers. When differences in population size are taken into account, these efforts generated public input that is roughly comparable to that received by the Hyndman commission. The French placed less emphasis on polling, mounting a telephone survey with 1,000 respondents. But where the Carrere commission's consultation efforts diverge dramatically from Canadian practice is in their interactive mode of outreach.

The bulk of the Carrere commission's consultation efforts were devoted to convening round table discussions in which over 50,000 elected officials, bureaucrats, consumers, and producers discussed their views on transport policy with one another, and with commission staff (Government of France, 1992: vi). By focusing its attention directly on the French transport policy community, the Carrere commission revealed a different premise about the role that consumers and producers should play in the initial formulation of new policies. Indeed, the devotion of such extensive resources to soliciting input from the policy community suggests that the commission staff valued perceptions based on contemporary experience at least as much, and perhaps more, than economic models built upon idealized principles.

In other words, it appeared that policy community perceptions, ranging from cabinet ministers situated at the apex of decision making to Metro drivers working on the front lines of urban transit, meant more to French policy innovators than to their Canadian counterparts. Rather than discounting contemporary reports as having been dulled by the narcotic of subsidies, the staff of the Carrere commission appear more concerned about compensating for excessive abstraction in prior policy formulation, where theoretical rigidity had either discounted or entirely screened out important inputs from prior policymaking.

These initial indications of a divergent conception of contemporary transport problems are borne out by the ways in which the Hyndman and Carrere commissions connected the data gained from their public consultations to subsequent policy analysis and recommendations. The Hyndman commission physically distanced public input from its policy recommendations by dividing the two into separate reports that were published more than a year apart. The title of the interim report, *Getting There*, suggests that public input would constitute a means to an end. But when the end itself was arrived at in the final report entitled *Directions*, there was virtually no attempt to connect these earlier means with policy recommendations. While this might have been redundant if the public consultations summarized in *Getting There* had pointed unambiguously to the conclusions reached in *Directions*, just the opposite occurred. A leap of analytical premises occurred during the transition from *Getting There* to *Directions* that required a more explicit justification.

The Carrere commission issued a single report, one which explicitly integrated its consultation exercises with analysis. This combination of listening and learning was justified as a valuable means to breaking down organizational barriers that had inhibited effective policy analysis in the past. In his introduction, Gilbert Carrere wrote "... transportation is no longer a purely technical and financial enterprise. Its social and economic dimensions are too important to be left exclusively to transport producers and [policy] specialists" (Government of France, 1992: i). Instead of encouraging specialists to interpret evidence along traditional lines of specialization, in which the interaction between transport modes was artificially segregated and the relationships between the transport sector and the broader economy and society were also compartmentalized, the Carrere commission adopted a new analytical framework.

Problem Redefinition : Subsidy Addiction Versus Organizational Sclerosis

In their analyses and conclusions, the Hyndman and Carrere commissions identify the central problem facing transport policy makers in different ways. For Hyndman, the malady is an addiction to government subsidies and the cure is a steady withdrawal from this economic sedative. The report's introduction states, "...one of the main thrusts of our principles is to achieve the benefits from treating transportation like any other business where people buy and sell services, instead of as a government function" (Government of Canada, 1992: 65). In the commissioners' view, the direct and indirect government subsidies used to replace earlier cross-subsidy arrangements had dulled Canadians' awareness of economic reality in transportation. This subsidy habit fostered a debilitating delusion in which firms, consumers, and government each perceived only benefits from getting "something for nothing" out of existing transport policies. In an increasingly competitive and integrated world economy, the cost of further self-indulgence was judged to have become prohibitive.

For the Carrere commission, France's transport maladies could also be traced to government characteristics that impeded effective policy, but instead of economic sedation, transport producers and consumers were suffering from the effects of organizational sclerosis. The ossification of the public institutions responsible for transport policy making had led to insulated regulatory and fiscal decisions in which a single objective (e.g., the creation of a TGV network) was pursued without considering its effects on the transport system as a whole. The results, where "... the pricing of each transport mode's infrastructure use takes account of different [and unrelated] factors prevents the market from operating efficiently" paralleled Canada's inefficiencies, but were seen to arise directly from flaws in government's organization (Government of France, 1992: 14).

Under the influences of such overly narrow policy evaluations, the Carrere commission found an excess of transport demand stimulated by the systematic underpricing of transport services. "Too often," the report found, "either nobody decides [what the true cost of transport should be] or those who should not be deciding [are in a position to control pricing, i.e., those who have a vested interest in a particular model]" (Government of France, 1992: 20). Given that organizational sclerosis had distorted transport pricing primarily through financing transport infrastructure in an uneconomic manner, the Carrere commission saw these facilities as creating long run distortions that would inhibit a "free market" from correcting past inefficiencies. Simply minimizing government's

involvement in the transportation sector would accomplish nothing because transport consumption and production would remain connected to each other through distorting factors, the "blindness of the market,...pressures and volatility of public opinion,... and the uneven power of [existing] public authority" (Government of France, 1992: 1).

The proposed cures for subsidy addiction and organizational sclerosis turned out to have little in common. The Hyndman commission prescribed a course of economic shock therapy designed to break Canada's subsidy habit once and forever. Public finance, regulation, and government ownership were identified as the principal routes by which subsidy reached the transport sector. Each of these three policy instruments was targeted for radical redesign to stop this flow of sedatives to Canada's transport market. The Hyndman commission recommended phasing out all transportation finance from general revenues over a ten year period.

Transitional assistance was recommended to ease the pain of subsidy withdrawal, but economic restructuring was intended to achieve "zero tolerance" for subsidies. If some carriers, modes, or even an entire infrastructure (e.g., rail branch lines) could not pay their own way out of unsubsidized revenues in the long run, then there was no place for such firms, technology, or facilities in Canada. Interestingly, the Hyndman commission found that the most heavily regulated and cross-subsidized component of Canada's intercity public transport sector, the bus industry, to be the most economically efficient (Government of Canada, 1992: 221). Deregulation and privatization across the board were assumed to enhance the environmental and economic cost advantages of the bus mode, even though these had developed under a restrictive system of provincial government controls and partial public enterprise (e.g., Terra Transport in Newfoundland, Gray Coach and Ontario Northland in Ontario, S.T.C. in Saskatchewan, and Pacific Coach Lines in British Columbia).

For the Carrere commission, organizational rehabilitation within government was the surest route to curing inefficiencies in the transport market. Its goal was more effective public arbitration, i.e., the ability to set rules of the game that would take account of intermodal cost effectiveness and assess externalities in a comprehensive economic and social context. The commission defined such effective arbitration as government's capacity to evaluate the claims of all parties involved in a policy issue, to take account of all objective elements of the situation, and to compare and contrast alternative options in an equitable manner (Government of France, 1992:27). By making such an assessment process more transparent, government decisions would gain greater legitimacy.

Conclusion: Is Organizational Sclerosis a Canadian Policy Problem?

When seen in historical perspective, the Hyndman commission's preference for market led solutions appears to be a logical counterpart to the diverse pluralism of Canada's contemporary transport policy network. Coordination, integration, and cooperation, the hallmarks of the Carrere commission's alternative approach, are indeed more difficult to achieve in Canada's environment of heightened economic competition and fractured political jurisdictions. But if the Carrere commission's insight into organizational sclerosis has any applicability in Canada, and the Hyndman commission's reconstruction of public input would indicate that it does, then market signals will continue to be distorted by false administrative and regulatory output.

These signals may be generated by prior fiscal mistakes, such as the ongoing economic distortions of overdeveloped road infrastructure (Government of Canada, 1992: 106). Or they may come in the inability to implement needed changes for lack of public legitimacy.

The Hyndman commission's wide gulf between suggested input from the public and recommended policy output offers government little support in getting from "here" to "there." While the anarchy of Canada's policy networks may currently appear to constrain more purposive attempts at government led policy reform, the strengthening connection with international economic forces is likely to facilitate just such change. For if France and other European nations renovate their transport policy making institutions to achieve the European Community's commitment to sustainable mobility, and if the U.S. also follows through on ambitious regulatory and fiscal reforms (e.g., the Intermodal Surface Transportation Efficiency Act's goal of integrating road and rail transit planning with land use and environmental policy objectives), then pressure will mount for Canada to match these efficient outcomes. Given the current distance between Canada's transport policy community and the rarified, indeed condescending, economic logic of the Hyndman commission, it is safe to predict that this latest royal commission to inquire in transportation will raise more questions than provide solutions. Instead of dismantling subsidies and other forms of public finance based upon abstract notions of what an efficient market should look like, Canada's policy is far more likely to adapt to the competitive signals sent by foreign policy innovations. Some of these innovations will call for government's leadership in facilitating change, but all of them will require a policy making process that is free of the organizational sclerosis highlighted by the Carrere commission. The Canadian transport policy community's free flowing style of political and economic relationships needs to be matched by a less rigid, more inclusive public sector approach to problem solving.

Notes

[1] A concise overview of the policy community model is presented in Leslie A. Pal, *Public Policy Analysis: An Introduction, Second Edition*, (Scarborough: Nelson Canada, 1992), pp. 111-114.

[2] On February 22, 1917, less than two months before the royal commission tabled its report, the Prime Minister sent a cable marked "secret" from London reading: "ask Drayton [one of the 3 commissioners] consult with [Finance Minister] White and [Justice Minister] Meighen respecting railway report." Although the details of this consultation remain unknown, government appeared ready to seek some form of input or influence, and was willing to intrude upon the commission's independence to get its message across. This cable from Borden in England to Blount in Ottawa, dated February 22, 1917, can be found in the National Archives of Canada, Papers of Rt. Hon. Sir Robert Borden (MG 26, H 1a), Volume 31, p. 12919.

[3] Simon Reich predicts that what will remain of Canadian auto manufacturing in another ten years will certainly be more productive and better integrated into the global economy, but will also contribute so much less to the economy that "... the situation might become one where Canadians look back with fond memories to the time where their industrial base was described as an American subsidiary" (Molot, 1993: 92).

[4] These findings were summarized in a preliminary report entitled *Getting There: Interim Report of the Royal Commission on National Passenger Transportation* (Government of Canada, 1991).

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Bringing the Public Back into Public Transportation Decision-Making
Some Case Studies and Reflections

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Introduction

Transport policy has traditionally been played out in a context of elite politics where the decision-makers are a combination of key politicians, top government bureaucrats, and commercial interest groups. This elite politics often encompasses several jurisdictional levels such as between federal and provincial levels, or between provincial and municipal levels. By contrast Parliament or legislatures, public interest advocates, and public opinion play a much diminished role in transport policy-making.

Evidence from Ontario suggests that changing the mode of policy-making to include a broader range of public input can dispel conventional wisdom and revitalize unresponsive decision-making arrangements, thereby facilitating more innovative policy outcomes. Policies that facilitate the shift to a more balanced transportation system, in which the technical and economic attributes of each transport mode can be applied most productively, thus appear correlated with the inclusion of additional social actors in the policy-making process. In particular, social involvement based on concerns for the environment and energy have played key roles in the development of new transportation priorities.

This paper will examine three case studies of transport/transit policy-making at the provincial and urban level that illustrate how the interplay of ideas, interests, and institutions worked to foster (not entirely successfully) a different transport policy direction. The first case study concerns a provincial consultation exercise at the level of the public bureaucracy. It illustrates the greater access to the bureaucratic level by private interest groups--the old elite politics. The second case study illustrates citizen activism to contain and reverse a decision by a transit agency to eliminate a significant portion of its electric transit infrastructure. This case and, flowing out of it, the third case, forming a publicly funded coalition of

advocates for better public transportation, illustrates a linking between politics and social movement that has the potential of institutionalizing a new mode of transport policy-making.

These three examples raise the possibility that innovation can flow upward even at the federal level so that federal transport policy decision-making might one day encompass a broader range of social actors, the claim here being that broader public input would lead away from the present fly-drive fixation of Canada's transport policy elite.

Normative Assumptions

The normative assumptions of this paper should be made explicit at the outset. Given global warming, the urgency of energy conservation, and my commitment to the compact urban form, in my advocacy I have worked towards promoting public transportation and the reduction of auto-dependency. At minimum, a transportation policy would attempt to link land use to transportation, would begin to reduce auto-dependency, would promote the most energy-efficient modes of the movement of people and goods, and, in the Canadian context where many cities still have a compact urban form, would limit urban sprawl [1]. In the context of this paper, the argument is that including the public in transportation decision-making can enhance the likelihood of achieving the normative goals just mentioned.

The Ontario Round Table on Environment and Economy

The first case study of citizen involvement is the Ontario Round Table on Environment and Economy. A round table is a first cousin to a royal commission and other bodies that are designed to give non-partisan advice to government on policy--advice to be followed, in theory, by legislative actions. Such bodies generally start with high hopes on the part of the public. High hopes evaporate when such bodies are compromised as exercises in delay and/or are tainted by commissioners and an executive with gross biases that undermine their credibility.

The Ontario Round Table seems to have had a credible enough start. It was established in 1988 by the Government of Ontario "...to create a long-term strategy that will support both a vigorous economy and a healthy environment [2]." That strategy was to have emerged from a consultation process aimed at consensus building. Consultation here means bringing together selected key representatives of government, industry, and public advocacy--groups that are often adversaries; consensus was a hope if not a prayer. In the process of achieving its mandate, the Round Table held public meetings and solicited briefs from whatever source, but it also embarked on convening six sectoral task forces,

one of which was devoted exclusively to transportation. The Sectoral Task Force on Transportation was, in effect, a mini-round table. For the diverse group that it was, the transportation task force came up with a quite comprehensive view of transportation's contribution to environmental degradation and clearly identified many key steps that could change the situation [3].

There are two positive aspects to the kind of activity represented by the Ontario Round Table. Firstly, this endeavour does bring together the players, perhaps for the first time, permitting them to explore areas of agreement and divergence, to assess each other, to dispel stereotypes and misapprehensions, to bargain and negotiate, etc. Secondly, the reasonably comprehensive list of recommendations of the Sectoral Task Force on Transportation is a useful compilation of possible initiatives carrying the imprimatur of the Round Table and thus some modest authority. Still, I think it safe to say that advocacy groups did not really expect much would come of the round table process, in particular because it is not clear that any particular department in government has a responsibility to implement any recommendations that are forthcoming. Furthermore, the selectivity of participants still has an elite ring to it. More significantly, in speaking with one political insider regarding the sectoral task force, I was bluntly told that the report of the transportation task force had many good ideas, but, where there was any major opposition to a recommendation, no action would be taken. In my interpretation this apparent veto power did not extend to the advocacy members of the task force, thus my characterization of the round table process as still being elite politics. Nevertheless, the presence of advocacy groups and citizen representatives in the round table process is an acknowledgement of the increasing political significance of non-elite stakeholders in transport policy decision-making.

The Trolleybus Fight and the Revival of Transit Advocacy in Toronto

Metropolitan (or Metro) Toronto, Canada's largest municipality, is strongly public transit-oriented. It has a dense system of transit routes, a commuter rail system, high ridership per capita, and makes extensive use of electric transit technologies with subways being the most significant of the electric transit modes. Transit is especially important to the central portion of Metro, the City of Toronto itself, with its streetcar lines and, until recently, trolleybuses. The transit-oriented character of the City of Toronto is in part a consequence of a major citizens' movement of the late 1960s which fought the infamous Spadina Expressway, a battle that was won in 1972 through the intervention of the Premier of the time, Bill Davis. This expressway fight (which also lead to the cancellation of some other related urban expressways) was the first successful revolt against freeways in North America. In 1967 the transit authority undertook a streetcar phase-out programme, but citizen efforts helped to reverse that plan and a core streetcar system was accepted by the transit authority in October of 1972. The citizen

activism of the period in turn lead to a brief period of reform municipal government in the City of Toronto [4].

The transit agency for the Metro area is locally known as the TTC or the Toronto Transit Commission. It is governed by a board of seven Commissioners now elected from the Council of the Metropolitan level of government. While legally separate from Metro Council, it is financially responsible to it. The Province is a player in transit decision-making because it pays 75% of all capital projects and shares half of the operating subsidy of the TTC with Metro (the TTC recovers approximately two-thirds of its operating costs from the farebox).

In the early 1970s the TTC surprised the industry by initiating a modest modernization of its small trolleybus network, a move that sparked modernization of the rest of North America's remaining trolleybus networks. But in the early 1980s the TTC turned against the trolleys and has remained opposed even when extensions and modernizations are now occurring again in the industry. In 1983 the TTC proposed terminating its trolleybus network in favour of natural gas buses. Trolleybuses have clear environmental and energy benefits: they are highly energy efficient, have no on-street pollution, and are virtually noiseless. These features are attracting several U.S. cities to consider new trolleybus systems [5].

At the beginning of this paper I argued that transit decisions are commonly elite decisions. I would argue that this kind of decision-making has typified TTC's major capital projects since the early 1980s. My case in point is the elite alliance regarding the development and promotion of the natural gas bus. The transit industry, particularly in the U.S., has for a long time been searching for an alternative to the workhorse of the transit industry, the diesel bus, as a result of increasingly tough air quality standards. In Ontario a local bus manufacturer teamed up with a branch of the Ministry of Transportation (MTO) to develop a compressed natural gas (CNG) bus. This local manufacturer has a U.S. manufacturing arm and thus the Province perceived some export potential for Ontario-developed technology. This alternative-fuel bus needed both proto-type testing, but, more significantly, some sales and a happy operator.

The alliance between the manufacturer and the Ministry eventually took in the General Manager of the TTC, as well as the powerful Chair of Metro Council. Because TTC diesel buses still had considerable years of life expectancy, in the mid-1980s the TTC targeted its aging trolley coach fleet as ready for conversion to the new "clean" CNG buses, a conversion that would net a sale by the local bus manufacturer--not a competitive tender by the way--for about 120 CNG buses. TTC staff reports were issued detailing the high costs of trolleys and recommending closure of the trolley network. The electric bus technology was depicted as outmoded in comparison to the new CNG-powered bus alternative.

To its credit, the City of Toronto has always opposed elimination of trolley coaches, and this form of transit had especially strong support from its mayors. The election of a new mayor in fall of 1990 who was not particularly interested in the issue appears to have resulted in the alliance making its move. The transit Commission voted 4 to 3 to mothball the trolleybuses. Public protest, however, started to build. A local transportation advocacy group (Transport 2000 Ontario) started a Transit Advocacy Centre which became the focal point rallying the public to put pressure on the Commission to reverse its decision. The focus was on the Chair of the Commission who was regarded as being the swing vote.

The Transit Advocacy Centre and its sponsoring organization began to research the range of issues that the trolley conversion encompassed--technical questions such as the alleged energy cost savings of the CNG bus and the alleged "clean" quality of the CNG bus. Ordinary citizens began gathering petitions to save the trolleys, and ratepayer groups began to voice their support for retention. Pressure was sufficient that the Commission granted a one-time only public meeting on the issue for the evening of April 28, 1992, a meeting which filled the large Toronto City Hall Chamber. Limited to five minute deputations, some 30 speakers gave remarks ranging from emotional appeals to highly documented refutations of every major argument that TTC staff had presented to date to justify the conversion. In the end, the Chair of the Commission changed his position and voted to reinstate trolleys on two routes (out of nine) using the most modern trolleys then in Toronto, trolleys on lease from Edmonton. The two routes started running again in September of 1992.

With a bit of success under their belts, many of the citizens involved in the trolley fight began meeting on a regular basis but now under the name of the Better Transit Coalition. While two routes had been restored, the revitalization of the network had still to be fought for, and, in addition, there were other transit issues to address. The meetings of this group also had the strong support of a downtown Toronto Metro Councillor affiliated with the New Democratic Party (NDP) and who has a long established record of encouraging grass-roots organizations of all kinds.

More Transportation Advocacy and Some Political Attention

There is a second strand to transportation advocacy in Toronto, the rise of bicycle users and of environmental transportation groups. Bicyclists in the City of Toronto achieved a critical mass in 1974 resulting in the establishment of the Toronto City Cycling Committee as an office of the planning department. Bicycle advocacy builds on the local and social character of bicycle use. BUGs or bicycle user groups have formed by the dozens, at workplaces, on streets or on some other community basis [6]. The bicycle community has been fighting very

hard to obtain recognition from municipal and provincial planners and politicians demanding their fair share of road and other public space.

Continuing urban sprawl and highway building, deteriorating air quality, and the increasing dominance of the automobile has also lead to the founding of at least two new local environmental transportation organizations, one of these being bicycle-oriented. Several established large environmental organizations have also become more interested in urban transportation issues in recent years [7]. One outcome of this bicycle and environmental activism was the Second International Conference on Auto-Free Cities held in Toronto May 22-24, 1992 organized by Transportation Options. At this conference the public, planners, politicians, and activists had an opportunity to meet and hear numerous experts and generally to digest alternative visions of what a city might be like, especially if cars were subordinated to walking, bicycling, and transit use.

The citizen activism represented by the Better Transit Coalition, and the Auto-Free Cities conference did not go unnoticed by government staff and politicians. In fact, the conference drew on staff and politicians from all three levels of government (local, regional, and provincial) as presenters and participants. The present provincial governing political party, the NDP, has had a considerable history of involvement with grass-roots organizations in its many years as an opposition party (the NDP is in power for the first time in Ontario). What was perceived as grass-roots transportation ferment lead one of the policy advisors at the Ministry of Transportation (in a political not a civil service position) to take a strong interest in these new transportation activist groups. This advisor attended a number of their meetings and in general kept in touch with their activities. Because this advisor became known to the activist community, he quickly became the recipient of requests for funding for various projects. Rather than responding to the transportation groups separately, this policy advisor recommended to the groups that they form a coalition and then approach MTO for funding jointly. The invitation to form a coalition was received favourably by the transportation groups and they began to hold meetings to form the new umbrella organization.

The Rise of the Better Transportation Coalition (BTC)

In April of 1993 the BTC received its incorporation, held its first general meeting, and elected its first Board of Directors [8]. In the end, it was agreed that the Coalition would be composed of member organizations, that it would first focus on Greater Toronto issues but that the organization would become provincial-wide as quickly as possible, and that other organizations and individuals could join as non-voting members. After MTO funding was granted to the BTC, two full-time staff were hired in June, 1993. The name Better Transportation Coalition was selected because the coalition had concerns which encompassed non-motorized

forms of mobility and land use planning as well as transit.

The funding of the BTC is a first for MTO. Still, the funding of community organizations and citizens' groups on a project and/or operating grant basis reaches millions of dollars in a ministry such as Environment and Energy. In speaking with MTO staff to which the BTC reports, it is clear that it was sold to the Ministry generally as a significant "value-adding" activity. That is to say, the BTC was seen as exactly what I described earlier as the major benefit of public interest activity by citizens--citizen input improves decision-making.

As an initial activity, MTO asked the Coalition to represent transit users on its Transit Integration Task Force. The goal of the Task Force was to co-ordinate the multiple transit agencies operating in the Greater Toronto Area (GTA) to the end of having a multi-agency fare scheme and "seamless" travel in the region. Participation at the Task Force turned out to be a significant learning experience for the BTC forcing it to quickly develop a perspective on regional transit planning. The issues of fare and service integration lead to the question of how regional transit planning actually happens in the GTA. It appeared to the BTC that the province simply reviews disconnected capital funding proposals from transit agencies and their associated municipal governments without any reference a wider plan. Operating grants remain fixed by a farebox return formula. The BTC wondered why there was no regional planning authority that might, for example, develop an official plan subject to citizen and municipal input and reviewed on an annual basis? While some suggestions as to a regional planning model were made by the BTC at Task Force meetings, the BTC did not expend more energy in this direction because it became apparent that the Ministry had no objectives in this regard.

The lack of a regional plan also struck the BTC as a result of taking a position on the TTC's and Metro Toronto's $7-billion subway expansion plan. Let's Move--recently renamed the Rapid Transit Expansion Program--has been highly political from its inception as an election promise made by a previous provincial government. When the provincial government changed hands in the fall of 1990, the new NDP government quickly endorsed continuing the Let's Move program without a critical evaluation of it. As presently constituted, four of the seven components in the Let's Move program are subways and a fifth is an elevated rail rapid transit technology. Environmental assessments of these components have mostly been completed. Final engineering design and formal funding are next. The Premier of the province has endorsed these projects to achieve the priority of generating construction jobs.

These projects suffer from major deficiencies. Firstly, the recession and free trade mean that the huge real estate developments projected for Let's Move lines

(translated as estimated new employment) simply will not happen for many decades. Secondly, as a result of the recession, TTC ridership has fallen resulting in major service reductions. The BTC asked, would it be wise to build Let's Move when components of it could turn out to have very low ridership for a long time which would mean higher operating costs on these segments than projected? It asked itself if investment in GO commuter rail route and service expansion might not be more cost-effective in meeting work trip travel demand even within Metro Toronto itself? Why build the Eglinton West line when whether it is to be subway or LRT is still not decided and when its final destination is still a mystery [9]? Finally, the BTC noted that on several proposed subway routes projected ridership only justifies LRT but that on-street LRT was rejected as an alternative because that would take lanes away from cars.

In the case of two Let's Move projects--the Sheppard West subway, and the Scarborough RT (elevated) extension--the BTC filed requests for full environmental hearings (they were not alone in filing). The BTC had specific concerns regarding ridership projections and, in the case of the RT, had concerns regarding the complete lack of consideration of the light rail alternative, a consideration that is required under environmental assessment law. There has never been a full environmental hearing of a transit project in the Province of Ontario to my knowledge. Full or joint environmental hearings on the two Let's Move projects questioned by the BTC would have an enormous impact on transit planning in the province.

Discussion

Let us now review our case studies in the light of the claims that I made at the beginning of this paper.

1. Transit planning is too often elite decision-making.

Occasionally, the public's nose gets into the decision-making tent. The Round Table was a form of carefully controlled access to that tent, an exercise that has proven to be more of a side-show than a main attraction.
With respect to tangible vested interests, one cannot beat the trolleybus caper. Here was a real alliance of insiders planned and plotted the replacement of Toronto's trolleybus network to the end of obtaining a quick purchase of natural gas buses conveniently made by a local manufacturer. The public interest clearly showed up the strategy, but the public has not yet won this one.

MTO's encouragement and support of a transportation coalition is indeed a large step in fostering the development of public interest groups with a transportation focus. The significance is that resources are the key to an effective public input

into government decision-making. To be effective at influencing change, public interest groups need to be strong organizations with an office, staff, volunteers, time to research and develop positions, means to publically express their positions, access to their constituencies, etc.

2. An inclusionary decision-making process facilitates innovative policy outcomes.

The Round Table demonstrated that even a modest "brainstorming" activity can produce many serious, responsible, and innovative ideas. The vested interests tied to auto domination--industrial and governmental--are clearly not anxious to move quickly here in spite of all the evidence of environmental damage and all the evidence of real economic and social costs of the automobile-driven society.

The case of the trolleybus shows that it is even extremely difficult to keep decision-makers honest let alone innovative. The last card of the elite alliance was the economic one--electric transit costs too much even though it might be good for the environment. (Note that that argument never applies in the TTC's culture to subways.) The elite alliance's most recent move was to deflect action to modernize and modestly extend the TTC's trolleybus network by ordering up a study to compare diesel, CNG, and trolley buses.

The case of the BTC turns out to be a natural experiment. Sold internally within MTO as adding value to decision-making, the BTC has the heavy burden of proving its sponsors right. The BTC has taken up this challenge. With respect to the Transit Integration Task Force, the BTC entered the process in good faith with no particular alternative blueprint to propose. The process was intensive and the BTC concentrated a great deal of energy in trying to be supportive of the effort and at the same time be innovative. It remains to be seen if its recommendation for a publically accountable region-wide transit planning agency will be adopted by the province in some form.

Very shortly, Metro Council will be deciding the fate of the Let's Move subway expansion. The chances that it will be fully funded now look very slim. The cost of digging subways is enormous, even if spread out over several decades and even considering only Metro's share. It is a local election year and voters are in no mood for any kind of tax increase. The BTC's questioning of Let's Move came late in the political and planning game; after all, as a coalition it is only just now coming up to its first birthday. What is interesting about the BTC's opposition is that it springs out of what I regard as a developing internal culture of its member groups, a point that I would like to turn to at the end of this paper.

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3. An inclusionary decision-making process may revitalize an unresponsive decision-making process.

Must governmental organizations be forever unresponsive and uncreative as the stereotype of bureaucracy insinuates? I would suggest that one consequence of opening up governmental decision-making to the public is that it may simultaneously loosen up decision-making within government itself. I wish the Round Table all the best in its quest to reform governmental processes. One key problem is that the environmental issue crosses ministerial boundaries. It appears to take a very highly placed champion to get an inter-ministerial initiative underway, given the unwritten law which prohibits one ministry from stepping on another's turf [10]. The BTC case offers more hope. As noted earlier, the intent of the sponsors of the BTC at MTO is that the BTC would provide the point of view of transit users in ministry decision-making exercises. The BTC has taken its critical role seriously with resultant clashes with some transportation planners and some politicians. It remains to be seen whether the positions that the BTC is beginning to take will spark debate and exploration of new transportation alternatives at the various levels of government.

4. An inclusionary decision-making process will lead to a more balanced transportation system.

I am assuming here that present transportation decisions at all levels of government are dominated by a fly-drive mentality, fly-drive interests, and the mega-project disease. For the asserted proposition to be true, I must show that the public in general is ready for more change in the area of transportation than politicians and planners are prepared to imagine or give them credit, let alone what fly-drive vested interests are ready to give up. I believe that, indeed, the public is ahead of both planners and politicians in their willingness to be less auto-dependent. It is not possible in this paper to present a full argument in this regard, but the emergence of a transportation movement would certainly be some support for this position [11].

Commentary

One of the significant new features of modern society--or as some would have it, post-modern society--is the rise of urban social movements for social change. In this perspective social change is seen not as the result of an old class politics, but as arising from interests of a more diverse sort. Castells suggest that urban social movements develop over demands based on collective consumption (goods and services directly or indirectly provided by the state), in the defense of cultural identity, and/or with regard to political mobilization over local government itself [12]. Since the 1970s we have witnessed the rise of many new social movements

in Canada--the women's movement, the peace movement, the environmental movement, and others. To say that there is now a transportation movement at work in Ontario and perhaps elsewhere would sound strange and even bizarre to many people. Yet such a movement has emerged in the U.S. and in Europe [13] and now it is happening in Canada.

My case studies focus on a number of groups in Toronto which in one manifestation have come together as the BTC. I want to stress that the members of these groups are not just another kind of environmentalist; they are that, but they are also deeply concerned with transportation in their role as citizens. In Castells' typology, these groups are clearly concerned with a collective good provided by the state. I have puzzled over the question of why the late date of such a social movement modest as it is given that environmentalism is several decades old. My tentative answer is twofold.

Firstly, consumers of public transport are supremely atomized, especially users of transit. While there may be pain associated with poor transit and road congestion, users only occasionally form affinity groups on this issue [14]. Secondly, transport is socially organized so that its true costs are largely hidden and government decision-makers face few market disciplines regarding their transportation decisions. Transportation movement members do not embrace their issue out of some special economic insight, but have come to it out of more general environmental concerns. They become aware of transportation's invisible and destructive economics once they begin to think through their position [15]. Whatever the individual motivations, the expressed concern is the link of transportation to the built environment. People associated with the transportation movement are demanding a more dense urban form where streets are not the monopoly of the automobile [16].

I find the demise of the Let's Move subway plan for Metro Toronto to be apocryphal. As a new coalition, the BTC arrived too late on the scene to convince local politicians of a better alternative. Instead, Let's Move fell apart because it was a mega-project financial monstrosity based on a fantasy of a boom in high rise office construction. Now the BTC faces the test of selling a very different concept. Interestingly enough, there appears to be a BTC internal culture developing which is much in keeping with what is happening in general in the transit industry in North America. I call it the three G's after the three R's of reduce, recycle, reuse. These are the principles of: improve surface transit; use light rail transit; put commuters on trains. In shorter form it is: go local, go LRT, and go commuter rail. Remember that the overall objective is to reduce car dependency.

One of the consequences of the huge cost of Let's Move is that GO Transit has been starved of capital funds. Yet, Toronto, like so many other North American cities, has miles of underutilized railway lines. Commuter rail service can be up-graded and/or initiated, even within Metro, at a fraction of the cost of subways to provide fast transit service over considerable distances, exactly what Los Angeles has started to do using GO Transit as a model!

As an intermediate form of rapid transit between Metro's internal communities not now served by subway, on-street LRT in its own lanes (off-street where absolutely necessary) could be built for a fraction of the cost of subways. For Metro planners and politicians to conceive of LRT in this way would be a major breakthrough. It is an absolute no-no at the present time to even contemplate giving up road space to a transit-only use. Yet, for most of the Metro Toronto outside the older downtown cities, road allowances are generous, frequently at 120 feet in width. LRT may come in at as little as one-tenth of the cost of a subway, and a relatively good average speed can be obtained with fairly frequent station stops through the use of priority signalling for transit.

As the construction of the Line 5 subway in Montreal testifies, building rapid transit on the hope of development that does not materialize can produce a white elephant. When ridership remains low on such lines, high operating costs must then be compensated by reduced service elsewhere. The third G, go local, tells us that transit should be designed for frequent local service, transit that is not oriented solely to the journey to work but should accommodate the many short movements that people make throughout the day so that car use is not necessary. It is clearly a challenge to obtain operating funds for frequent all-day local transit service.

Anthony Perl at the University of Calgary has put his finger on an important contrast in transit policy. He has pointed out that policy takes a very different direction depending on whether transit is seen as a substitute for the car, or as a supplement to the car. The transportation movement that I have identified tends towards the former rather than the latter viewpoint [17].

New social movements produce major social change largely through the political system. Transportation movements in Toronto have their work cut out to significantly alter how transportation is planned and how transit is delivered if transit is to become a substitute for the car. Bringing pressure to bear politically will require much stronger organizations than the movement currently has.

There is one other tool, however, at their disposal. If these organizations can get an environmental hearing on one or more of the major subway projects of the Let's Move program, then the hearing judgements may set standards for future

major transit projects that will require the kinds of considerations citizens' groups now see as absent and now see as giving license to costly mega-project subway solutions. Current environmental legislation is very comprehensive in requiring objective comparisons of all possible alternatives transit modes. Almost all Let's Move environmental assessments seriously violated that legal requirement. A test hearing could produce a discipline to the transit planning process by setting planning standards and processes that planners and politicians now avoid.

I have argued the case for the benefits of citizen input in transportation decision-making at the urban level, but those benefits are equally needed at the federal level. Federal government transportation policy has been mired for decades in the fly-drive syndrome, so much so that it will take major public pressure to obtain recognition of the importance of the rail mode, for example, for its environmental and cost benefits, and to recognize the importance of helping urban areas move towards greater reliance on public transit for mobility. The nascent transportation movements, now mainly found in selected urban centres, will therefore need to add the federal level to their political activities. Political effectiveness at the federal level requires the same coalition building necessary at the urban level, and also the same access to resources to be politically effective. There is an opportunity for citizen groups to redirect government infrastructure investment to the rail mode. For example, runway expansion at Pearson might be redirected towards bringing GO commuter rail into the airport and providing regional inter-city train services that would substitute for the need for short-haul flights that now burden that airport. We know that the recent federal Royal Commission on National Passenger Transportation disregarded its public input both at its hearings and in its own polling [18]. They were mandated to consider passenger transportation as a network but never addressed the concept instead arguing that every transportation link should pay for itself. Will there be any renaissance of the rail passenger mode in Canada, even following the U.S. pattern? Will national and regional train service disappear sacrificed to the airways and highways and even to a mega-project built-from-scratch high speed rail line? Or will there be a train revival and incremental development? Canada certainly is not without adequate models on which to draw. The integrated character of Europe's public transport system, largely rail based, is there for all to enjoy. Even in the U.S. the latest national transportation legislation has required a major role for citizen input into the transportation decision-making process, a tribute to the hard work of environmental and transportation movement organizations there.

The transportation movement groups that I know have started from different points--an orientation towards the rail mode, as bicycle users, concern for air quality, an interest in urban design, environmentalism in general--but from whatever starting point, and thinking in system terms, these diverse individuals have been driven to see the links between transportation and land use, to confront

the question auto-dependency, and to shape a vision of what a North American transit-based city might be. Knowledge of or travel to Europe helps form this awareness of the alternatives. This kind of thinking surely borders on the counter-hegemonic, to use a Gramscian term, or is a form of counter-power, an "insurrection of subjugated knowledges" as Foucault might put it. There is here a potential for a more thorough transformative politics. Among the members of the transportation movement there is a very strong personal commitment to changing the local, the city, and regional quality of life. It is difficult not to be over-dramatic, but, given the huge contribution of transport to the production of greenhouse gases, how can these concerned citizens not think that saving of the planet may also be what is really at stake when they act to foster better public transit and the more compact urban form?

Endnotes

[1] For a quantitative assessment of differences between cities in the U.S. and Canada, see Goldberg and Mercer (1986).

[2] Quoted at p. 4 in the Ontario Round Table on Environment and Economy, Challenge Paper (1991). The concept of a round table on environment and economy stems from the United Nations' Brundtland Commission report entitled Our Common Future published in 1987.

[3] Ontario Round Table on Environment and Economy, Sectoral Task Force Report: Transportation (1992). The final Round Table report is entitled Restructuring for Sustainability (1992).

[4] On the reform period in Toronto politics, see Magnusson and Sancton (1983), and Sewell (1993). The effort to keep streetcars was fought by a small citizen's group called the Streetcars for Toronto Committee which, with the support of the City of Toronto, was able to change the position of the General Manager of the TTC resulting in the retention and later modernization of the streetcar system. The modernization plan included converting some low-ridership streetcar lines to trolley coach operation. The fight to save the streetcars is described in Chapter 15 of Fischler (1979).

[5] Trolleybuses can be found in San Francisco, Seattle, Vancouver, Edmonton, Hamilton, Ontario (recently mothballed), Toronto (recently cut), Dayton, Ohio, Boston, and Philadelphia. New trolleybus systems are being considered in California for Los Angeles, Long Beach, Oakland, and Sacramento.

[6] Bicycle user groups in the City of Toronto number at least 200 and they range in size from 2 to 150 members. The BUG at the Canadian Imperial Bank of

Commerce in Toronto has 125 members all linked through the firm's electronic mail messaging system.

[7] The oldest public transportation advocacy group in Toronto is Transport 2000 Ontario. The two recent environmental transportation groups are Environmentalists Plan Transportation, and the bicycle-oriented Transportation Options. The mainline environmental organizations with strong transportation interests are Greenpeace, and the Sierra Club. Two organizations interested in air quality, which, of course, strongly relates to transportation, are the Lung Association, and Pollution Probe.

[8] Keynote speakers at the first general meeting included an official from the Ministry of Transportation and the noted urbanist Jane Jacobs.

[9] One alternative is to take the Eglinton West subway to Pearson airport. But why do that when bringing GO commuter rail to the airport would be less costly and have additional advantages?

[10] While the Minister of the Environment and Energy did pronounce in favour of trolleybus retention in Toronto, there was no interest in this Ministry that I could detect to work on a policy that related transit technology to air quality, either through an environmental assessment process (after all, the decommissioning of the trolleys would make Toronto air much worse than it already is), or through a more proactive process of requiring transit agencies to participate in achieving air quality standards (this happens in the U.S. but only where a jurisdiction is a non-attainment area).

[11] In Europe, Werner Broeg has assembled research showing that people he calls "opinion shapers" overestimate the contribution of the private car to everyday mobility and, furthermore, that most citizens believe policy-makers do not correctly assess their views regarding transport planning which are more favourable towards substituting public transit for car use. Broeg is associated with Socialdata, Institut fuer Verkehrs- und Infrastruktur-forschung Gmbh, Hans-Graessel-Weg 1, 8000 Muenchen 70, Germany.

[12] Manuel Castells, The City and the Grassroots (1983). While Castells refers to urban movements, the more general term in use is "new social movements." The literature on this subject is large and international. For a recent overview, see Carroll (1992); for a critical review of new social movement theory specifically, see Weir (1993).

[13] For example, in part as a result of the work of a large coalition of organizations, in 1991 the U.S. Congress scrapped the old rigid highway funding

program and replaced it with new legislation providing for flexibility in the use of highway funds for a broad range of transportation projects. Citizen input is also mandated by the legislation (Campaign for New Transportation Priorities, 1993). In France, one public transportation advocacy group is the Federation des Usagers des Transports, 15, rue de l'Echiquier, 75010 Paris.

[14] By contrast transit agencies, planners, equipment manufacturers, and politicians have long standing ties and patterns as to how things get done.

[15] For example, virtually no one in Ontario is aware that over the last 50 years of highway and municipal road building, the Province has spent more for road building in virtually every year than it took in from license fees and gas taxes, and that the accumulated debt associated with this construction requires some $1.0 billion a year in interest payments alone. See McCullum (1990).

[16] Freund and Martin (1993), Engwicht (1993), and Vanderwagen (1992).

[17] Anthony Perl, Department of Political Science, University of Calgary, contrasted transit as a substitute for cars and transit as a supplement to cars made in a paper presented at a panel discussion (Session II) at the Second International Conference on Auto-Free Cities held in Toronto on May 22-24, 1992.

[18] See the paper by Dunbar (1993).

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BRITISH COLUMBIA ROAD-USER UNIT COSTS

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Introduction

Road user costs of vehicle operation, accidents and travel time are a large part of total road costs. In their quest to entrench economic analysis in planning, project evaluation and project prioritization, the British Columbia Ministry of Transportation and Highways (MoTH) developed preliminary road user cost data in 1991-1994. This data supported a variety of trial applications (Bein 1994).

Road user costs are the product of vehicle-km travelled, accident rates and severity, and vehicle travel time by the respective unit values of: vehicle operating costs per km; accident costs per fatal, injury and property damage only accident; and, value of travel time per hour. This paper describes:

- the methodology of studies initiated by MoTH to define the values of road-user unit costs
- the results of these studies; and
- the areas slated for refinement of the unit costs.

The Value of Travel Time Savings (VTTS)

The Value of Travel Time Savings (VTTS) is a major component of the benefits of almost all economic evaluations of transport investments. Before recommending the appropriate VTTS for evaluation of highway investments in British Columbia, we reviewed numerous empirical studies as well as the assumptions about VTTS used for road project evaluation in various countries and government jurisdictions (Waters, 1992a, 1992b). The base figures for the British Columbia VTTS figures and various adjustments are shown in Table 1. We also derived values of commercial vehicle time savings (VCVTS)(Waters and Megale, 1994) shown in Table 2.

The Non-Work VTTS

While there is little dispute over the value of time saved while working (discussed below), the valuation of time saved which is not used productively is

more contentious. Over 35 empirical studies of VTTS, supplemented by reviews similar to ours but carried out by others (recent reviews include Bates and Glaister, 1990; Chui and McFarland, 1990; Lawson, 1989; Miller, 1989; and MVA Consultancy, et al. 1987),show that the VTTS as a percentage of the wage is a common and convenient comparison. In a substantial range of empirical estimates, VTTS cluster between about 30 to 60 percent of the average wage. Road project evaluations usually adopt a specific figure for VTTS; this is sufficient to give consistency in evaluating alternate road projects for an agency. British Columbia originally adopted a VTTS equal to 50 percent of the average wage in B.C. However, for compatibility with the value of life assumption, which was lowered from recommended $2.8 million to $2.0 million for policy reasons – explained under accident cost section – a VTTS of 40% of the wage was chosen for the trial application period. By way of comparison, the United Kingdom and New Zealand adopted 40 percent. The B.C. assumption is also broadly consistent with the VTTS used in Australia. Transport Canada has recommended 50 percent of the wage, and the U.S. Federal Highway Administration (FHWA) recommends 60 percent.

Variations in the Non-Work VTTS

The base VTTS may vary depending on traveller characteristics, traffic conditions, and trip purpose. Certainly the VTTS is higher for those travelling on business. There are various types of non-work trips including commuting, school or shopping trips, as well as leisure travel. The VTTS may vary among these trip types, although the evidence is not clear-cut (e.g., see Miller, 1989 for a review). Some studies find the VTTS for commuting higher than for other trips, but this may confound higher values due to congested operating conditions. British Columbia VTTS figures do not distinguish between non-work trip purposes.

People's VTTS are influenced by the conditions under which time is saved. Waiting time is valued two or three times higher than in-vehicle travel time. We adopted twice the base VTTS for waiting time. The VTTS is different for drivers and passengers. Because passengers do not have the strain of driving, and can allow their thoughts to wander of even engage in reading or other activities, the passenger VTTS is valued as less than that for drivers. There is also evidence that VTTS is higher under congestion (Miller, 1989). For convenience, we equate VTTS under severe congestion (service level "F") as equal to the VTTS for waiting time (twice the base VTTS), and the VTTS for service levels "D" and "E" are interpolated between the base and waiting time VTTS.

Many studies find a link between VTTS and income levels of the traveller. The VTTS rises with income, although not necessarily in proportion. Nonetheless, government agencies are uncomfortable with valuing time savings to more wealthy groups as more valuable than similar time savings to low income groups. Therefore, most public agencies adopt a uniform VTTS across income groups. This is explicit policy in the U.K. (Sharp, 1988) and New Zealand (Travers Morgan, 1992, p.41), and also is the policy recommended by Transport Canada (1990). British Columbia may be adjusting for income in urban transportation project analysis, once guidelines are completed.

There is one other long-standing contentious issue in valuing time savings: whether or not small and large time savings are valued the same. We followed standard practice and valued large and small time savings the same. The most compelling argument is that highway improvements often entail a number of

small time savings over a trip, or over time on the same link, which can accumulate to substantial time savings. If small time savings were not valued, most road improvements and traffic management schemes would not be carried out.

The Value of Work Time Savings

Valuing work time savings is not as controversial. Incremental time savings or delays are assumed to ultimately translate into increases or decreases in output, respectively. Despite very limited empirical investigation of the actual impact of travel time savings on production, it is customary to value work time savings as equal to drivers' wage rates, including fringe benefits and other wage burdens. The work VTTS are valued in terms of the costs of employing people per hour.

The British Columbia values of work time savings recognize that time savings or delays not only affect the utilization of drivers, but also the utilization of vehicles and equipment. Delays waste the time of capital as well as labour. The value of commercial vehicle time savings (VCVTS) includes an allowance for vehicle capital and operating costs which vary with time as distinct from use. The British Columbia VCVTS also recognizes that the output lost or gained by delays or time savings should be valued in terms of consumer prices rather than in producer prices or resource costs. Hence the VCVTS figures are increased by an allowance for provincial sales tax and GST, since embodied freight costs affect the delivered price of final goods and services, and the marginal value of the outputs to consumers are measured gross of sales taxes.

The net result is that British Columbia's VCTVS for road project evaluation tend to be higher than figures adopted in most other jurisdictions. We think this is accurate, i.e., that most highway cost-benefit studies have under-valued the benefits of road improvements for commercial vehicle traffic. The VCVTS figures are calculated for several vehicle sizes and configurations. Table 2 presents the figures for a few vehicle categories.

Two figures are reported. A "maximum" value assumes that time savings to commercial vehicles are fully converted to increase output. A minimum value assumes that time savings result in no production benefits. In the latter case, the VCVTS is limited to the value of non-work time to the driver. The usual assumption in road project evaluation is that time savings are used productively, i.e., the maximum value as calculated here. This includes the value of driver time (wages plus fringes and indirect taxes) and the value of vehicle time (the time related costs of ownership and operation of vehicles).

Accident Costs

The accident (or crash) costs were adapted from U.S. cost estimates (Miller, et. al., 1993, Miller, 1993). This section highlights some of the original costing methods and explains how the costs were adapted. The cost estimates encompass medical and ancillary services, emergency services, lost productivity (wages and household production), lost quality of life, workplace disruption and related employer costs, insurance administration and legal recovery, travel delay for uninvolved motorists, and property damage. They exclude mental health services and productivity lost by caregivers of injured people.

Methods

Medical and Ancillary Payments. Miller et. al. (1993) computed medical payments from 1982-1985 data from the U.S. National Highway Traffic Safety

Administration's National Accident Sampling System (NASS) and the Detailed Claims Information (DCI) file of the National Council on Compensation Insurance. The estimates factored in long-term costs. Average medical costs per crash injury matched the independent estimates in Rice et al. (1989).

Table 1 Values of Travel Time Savings Recommended for Road Project Evaluation in British Columbia (1990 Cdn $)

Category	Work Travel Time	Non-Work Travel Time	Adjustments (for non-work travel time, adults only)
Passenger car & light trucks			Congestion costs multiply figures by:
Driver	1.20 x wage = $16.98/hour	0.50 x wage = $7.09/hour	1.33 for level of service D 1.57 for level of service E
Passenger	Same as driver	0.35 x wage = $4.95/hour	2.0 for level of service F
Children under 16		0.25 x wage = $3.54/hour	Congestion adjusted for work time: add 0.33 x wage for service level D
Retired (over 65)		0.35 x wage = $4.95/hour	add 0.67 x wage for service level E add 1.0 x wage for service level F and for waiting time
			Congestion adjustment for bus passengers applies to adult passengers, urban areas only.

Table 2 Examples of British Columbia Value of Commercial Vehicle Time Savings

	Bulk commodity		Dry cargo freight	
	2 axle diesel	8 axle diesel	2 axle diesel	8 axle diesel
Hourly value of vehicle time	$7.22	$12.74	$4.64	$10.38
Hourly value of driver time	$22.54	$23.44	$32.51	$31.42
Maximum value of time savings	$29.76	$36.18	$37.15	$41.80
Minimum value of time savings (40% wages net of fringes)	$7.25	$7.32	$8.62	$8.25

The medical and ancillary costs by injury severity were adapted to B.C. by multiplying them by the ratio of average hospital per diems in B.C. and the U.S., 0.686. B.C. hospital per diem in acute care hospitals without long-term care units averaged Cdn $380.30 in 1987/88 according to Statistics Canada (1989). The comparable U.S. value was $554.67 according to the U.S. Statistical Abstract. The medical and all other costs were inflated to 1991 costs estimates by multiplying times an exchange rate of 1.18.

Productivity Losses. Days lost per injury in the short-term and due to permanent disability came from the U.S. estimates. Using the age and sex distribution of those injured, average lifetime earnings (used to compute losses for fatalities and permanent disabilities) were computed at a 8-percent discount rate (the rate used in B.C. highway investment modelling.) Wage rates came from BC. income data.

Lost Quality of Life. As Miller (1993) documents, for benefit-cost analysis, groups ranging from the U.S. Office of Management and Budget to the National Safety Council to academics agree that health and safety benefits should be based on a concept economists label "willingness to pay". The willingness to pay method has been adopted for accident costing in the U.S, New Zealand, and the U.K.

The willingness to pay concept considers the average amount people actually pay for small reductions in risk to be the amount society should spend to reduce the public's risks by a small amount. It examines, for example, how much people pay for optional safety features on their cars, tradeoffs people make between time and safety when they choose a speed, or the extra wages paid to induce workers to take risky jobs. Generally, analysts estimate the value of a statistical life, the amount to spend for an expected value of one life saved.

Miller and Guria (1991) examine the variability in fatal risk reduction values between countries and conclude that the values are reasonably comparable provided one multiplies by the ratio of personal incomes per capita in the different countries. They also conclude that the values have large variability, meaning the average value across studies in several countries probably is more reliable than the value from a single study in a country.

Miller (1993) uses an after-tax value of Cdn $2.83 million per statistical life, the mean and median from an analysis of 47 values. The standard deviation of the values is Cdn $.84 million. Subtracting mean lifetime after-tax earnings, fringe benefits, and household production yields the value of pain, suffering, and lost quality of life per statistical death prevented. This value was adapted by switching to the 22% average income tax rate in B.C. from the 15% rate in the U.S.

An alternative would be to use four Canadian studies (see Cousineau et al., 1992; Martinello and Meng, 1992). Their values range from Cdn $2.8-4.6 million (in 1991 after-tax dollars, computed at a 27% national plus provincial tax rate).

One way to judge if a $2.8 million value is reasonable is to compute a value that clearly is below the value of statistical life. Both working and waiting in traffic are preferable states to death, so they must have lower values/hour. B.C. is valuing both these activities at the wage rate – $14.72/hour. In the U.S., the average traffic fatality loses 38 years of expected life span. That implies a $4.91 million value/life if all future hours are valued at the provincial wage rate. If we

discount hours in future years at an 8% discount rate, the value drops to $1.65 million. Unless the value of life is higher than this threshold, to quote Ezra Hauer at the 1991 Transportation Research Board meeting, "it is better to be dead than stopped in traffic." The recommended value of statistical life values an hour of life at 1.7 times the wage rate if an 8% discount rate is appropriate. At a 3.5% discount rate, it values life at the wage rate.

To value lost quality of life for nonfatal injuries, Miller et al. used physician ratings of the typical functional capacity loss on six dimensions: mobility, cognitive, daily living (ability to grasp, bend, and lift), sensory, cosmetic, and pain. Population survey data (primarily Canadian data from Drummond et al., 1987) were used to combine the losses and the probability of disability into a percentage utility loss resulting from the injury. The quality of life lost is the product of the value of statistical life and the utility loss.

Administration and Legal Costs. Values for B.C. were derived by multiplying insurance administrative and legal costs times 1.122. This number is the ratio of an extremely rough Cdn $3,827 estimate of B.C. costs in these categories per reported injury (computed from Insurance Company of British Columbia, ICBC, data) divided by the U.S. average of US $3,411. The B.C. cost estimate assumes the Ministry of Health medical claims administrative percentage and the B.C. life insurance payout and its associated administrative percentage match those in the U.S.

Property Damage and Loss. Crash damage was estimated from auto insurance data on losses and average deductibles. To get B.C. values, the U.S. values by crash severity were multiplied times .82, the ratio of average costs per damaged vehicle (Cdn $1,581 according to ICBC divided by US $1,928 from Miller et al.).

Costs by Severity. Costs per injury and per property damage only (PDO) vehicle were computed as the product of the adjusted U.S. unit costs by injury severity times the severity distributions of injuries in police-reported fatal and nonfatal crashes in the U.S. from Miller et al. The unit costs were:

Injury Severity	Cost (Cdn)
O - Property Damage Only	$1,947
C - Possible Injury	23,955
B - Evident Injury	45,823
A - Incapacitating Injury	185,500

To compute costs per crash, we used data from B.C. police reports showing: (1) in a sample of 940 fatal crashes, 1.21 fatalities and 1.28 nonfatal injuries per fatal crash; and, (2) in a sample of 27,052 nonfatal injury crashes in the province, 1.53 nonfatal injuries per nonfatal crash.

Results

Costs for B.C. in Canadian dollars are $3,065,679 per fatality (in 1991 dollars), $125,958 per nonfatal injury in a fatal crash, $66,473 per nonfatal injury in a nonfatal crash, and $3,282 per vehicle in a PDO crash. A fatal B.C. crash costs an estimated Cdn $3,870,698, a nonfatal injury crash $101,704, and a PDO crash $5,646.

The fatality cost includes a value of statistical life of Cdn $2,836,090, plus $156,420 in direct costs paid by society and $73,188 in foregone income taxes. The value of statistical life obviously is much higher than the associated earnings losses.

Sensitivity analysis at a 4% discount rate yielded values of $3,824,624 per fatal crash, $88,855 per nonfatal injury crash, and $5,162 per PDO crash. These numbers include costs of $3,040,303 per fatality, $113,951 per nonfatal injury in a fatal crash, $58,075 per nonfatal injury in a nonfatal crash, and $3,001 per PDO vehicle.

An obvious concern about these costs is how applicable U.S. injury distributions from 1982-1985 are to B.C. Surprisingly, as Table 3 shows, they are quite similar despite a much higher safety belt use rate in B.C. (15% versus 90%). The fatality and hospitalization rates and percentage of injuries hospitalized are so close that they raise questions about the effects of belt use. The similarity might result from such causes as more frequent drunk driving or a higher proportion of rural crashes in B.C., belted drivers taking extra risks because their belts will protect them or failure of high-risk drivers to buckle up.

Table 3 Comparison of U.S. and B.C. Injury Incidence and Severity

Rates/1000 Population	U.S.	B.C.
Fatalities	.18	.17
Hospitalizations: Injuries on Roadways	2.12	2.09
Injuries*	20.23	20.35
Police-reported Injuries	14.68	13.35
FATALITIES		
% of Hospitalizations	9.3	8.0
% of Police-Reported Injuries	1.29	1.29
HOSPITALIZATIONS		
% of Injuries*	10.5	10.3
Length of Stay	8.6	9.4
PERMANENT DISABILITY		
% of Nonfatal Injuries	2.9	3.1
INJURIES NOT REPORTED TO POLICE		
% of Nonfatal Injuries*	41	34

* B.C. data for all injuries = claims made to ICBC minus an average of 15,000 whiplash injuries/year not paid. If B.C. figures were based on claims made, they would be 24.52 %, 8.5%, and 45.5%.

Implementation

For policy reasons, MoTH adopted lower values than found in the research reported here. The Ministry has been using previously a $0.5 million value of statistical life. The administrators responsible for highway safety evaluations felt that a value of statistical life lower than $2.8 million would smooth the transition. 16 out of 47 studies reviewed above reported values of life that are one or more standard deviations below the mean. This was used as a rationale to adopt a value

of life for MoTH appraisals at $2 million, i.e. one standard deviation below the mean. To maintain integrity of the economic analysis framework, values of travel time were lowered accordingly.

Vehicle Operating Costs

VOC Model Selection

Vehicle operating cost (VOC) models are analytically the most complex of all road user cost models. VOC modelling needs of MoTH in planning, programming and project evaluation were assessed in order to determine the relevance of internationally available VOC models. The determination of VOC relies on surveys, mechanistic modelling and statistical analysis. Naturally, estimates obtained by models developed from these efforts differ. Technological, regulatory and economic factors limit the transferability of previously developed international VOC data to MoTH requirements. The following models were reviewed with respect to VOC model transferability and suitability to British Columbia (Bein 1993): the Texas Research and Development foundation (TRDF) model; the World Bank's HDM-III; the Australian ARFCOM and NIMPAC; the Swedish VETO; the British COBA; the NZVOC from New Zealand; and, the South African VOC methodology.

Mechanistic models (HDM-III, ARFCOM and VETO) rather than models based on statistical estimation (TRDF model, COBA) were found most suitable. VETO appeared superior, but was not available for a personal computer. HDM-III is of a mixed mechanistic-statistical type, and it is well structured for calibrations. It became the model of choice, but fuel estimation with the ARFCOM model was adopted to replace HDM-III estimates of fuel consumption, because they are inaccurate in some cases. HDM-III's main drawback, however, is that it is limited to prediction for free-flowing traffic speeds.

Data Collection

The HDM-III VOC model requires calibration of the following components: vehicle speed; fuel consumption; tire consumption; oil consumption; maintenance labour and parts consumption; depreciation; and interest. In order to accomplish the calibrations five groups of data must be gathered: (1) provincial fleet statistics - to decide which vehicle types are representative; (2) typical characteristics and utilization of each representative - to input into the model; (3) vehicle operating speed data - to calibrate the speed submodel; (4)benchmark cost data (empirical estimates of VOC components) - to compare uncalibrated model results with; and (5) unit costs of representative types resources consumed in the course of vehicle operation (fuel, tires, etc.) - to multiply model predictions of these resources and arrive at the operating costs.

Published and readily available data were utilized, which were supplemented by many small-scale surveys. Benchmark data was collected from transport carriers in the industry and from published data. However, benchmark data from the industry is not very detailed and had to be averaged over round trips with average payloads and road characteristics. The calibration process and the data are described in more detail in a forthcoming report (Bein 1994a).

Representative Vehicle Characteristics

Vehicle characterization depends on what fleet is assumed and which vehicles are selected to represent it. Economic analysis of road transportation projects spans a

twenty year plus horizon. Every year the fleet changes somewhat, and long-term changes over the analysis period may be drastic. Since these changes are not known in advance, the following approaches are practical:

(A) Use present fleet as a representation of the future.
(B) Use new registrations as future representatives.
(C) Use present fleet, new registrations and a projected fleet to represent the present, the future and the distant future, respectively.

Most agencies employ approach A. Approach C is used in road project appraisals in Sweden. MoTH adopted approach B to avoid projections of the future and bias towards present vehicles. Fleet statistics were analyzed and eleven representatives were selected for HDM-III and ARFCOM calibrations. Once vehicle characteristics, utilizations and unit resource cost data are input into HDM-III, calibrations can be performed using benchmark costs. Table 4 summarizes the British Columbia vehicle characteristics.

Table 4. Characteristics of Selected Typical British Columbia Vehicles

Vehicle Type	Medium Car	S/2 Axle Truck	5-Axle Truck	3-Axle Bus
Tare Weight (kg)	1,190	4,160	13,037	11,750
Load (kg)	100	4,000	10,300	2,000
Maximum GVW (kg)	NA	10,500	39,500	16,000
Desired Speed (km/hour)	111	105	105	111
Aero. Drag Coefficient	0.42	0.71	0.83	0.66
Frontal Area (m^2)	2	5.50	8	7.80
No. of Tires	4	6	18	8
Wearable Tire Volume (dm^3)	NA	10.81	12.16	9.92
Retread Cost/Tire Cost	NA	0.70	0.40	0.50
Max. No. of Recaps	NA	2	2	1
Maximum H.P. (metric)	112	175	370	250
HPDRIVE	54.40	140	296	175
HPBRAKE	18.10	147	553	224
Maximum R.P.M.	4,961	2,600	1,980	2,100
Calibrated R.P.M.	3,721	1,950	1,485	1,575
Average Utilization (km)	18,000	40,000	160,000	100,000
Average Utilization Hours	NA	1,243	3,063	3,600
Hourly Utilization Ratio	NA	0.65	0.75	NA
Service Life (year)	8.50	7	5	18
Average Life (km)	76,500	140,000	400,000	900,000
No. of Passengers	1	0	0	20
New Vehicle Price ($)	14,627	36,000	119,600	327,500
Fuel (cents/L)	50.50	35.20	35.20	35.20
Lubricant ($/L)	1.08	2.20	2.20	2.20
New Tire ($/Tire)	105	260	350	550
Maintenance Labour ($/h)	45	54	54	42

Note: All $ figures in 1990 Canadian dollars.

Benchmark Costs and Calibration Process

Some of the benchmark costs are published (for example, CAA car costs, Trimac truck operating costs). In order to arrive at costs specific to vehicles and operating conditions in British Columbia, supplementary data was sought from fleet operators and suppliers. Calibration involved changing inputs and parameters of HDM-III until the results matched the benchmark data found in the survey data and in various publications. Calibration was accomplished by adjustment of model coefficients and, in some cases, unit price adjustment.

Benchmark data is not expressed as a function of road variables (grade, curvature, roughness and surface type), but HDM-III uses road characteristics as an independent variable. Care was taken in establishing the road conditions associated with each benchmark data item collected.

Results

Four typical vehicles were selected for deriving aggregate VOC curves for planning: medium car; small 2-axle truck; 5-axle tractor-trailer; and, 3-axle bus. The curves were derived by multiple regression analysis of results from repeated runs of HDM-III for the range of gradients. The HDM-III results were modified by replacing fuel consumption estimates with those from ARFCOM.

The British Columbia VOC curves are compared with those from other jurisdictions in Figure 1, for a car and a composite truck, for two gradients and a range of operating speeds, assuming International Roughness Index (IRI) = 2m/km. The Swedish composite truck consists of 8% 2.4 t GVW gasoline truck, 2% 2.5 t diesel truck, 40% 14 t diesel truck, 38% 46 t GVW diesel truck, and 12% 16 t diesel bus. The other jurisdictions' composite truck is similar, but not exactly the same. MoTH car curves resemble Swedish and New Zealand VOC. The scale effects are due to differences in unit resource costs, except B.C. shows stronger effect of grade than New Zealand, but weaker than Swedish VOC. (New Zealand car VOC are almost identical for grades 0% and 4%). MoTH composite truck VOC curves resemble more the New Zealand ones, but they are rotated relative to both the New Zealand and the Swedish curves. Texas curves are not comparable to any of the other ones in Figure 1

Road curvature effects can be ignored for light vehicles, but should be considered for trucks and buses. In Figure 1, the vehicle speed is limited by the gradient in accord with the HDM-III speed model. Site speed measurements are underway to verify the speed models.

Figure 2 graphs VOC – IRI relation. Again field experiments are necessary to verify the slope of the curve, because it is based on data collected in Brazil.

Conclusions and Further Research

MoTH has carefully developed unit costs of road user travel time, accidents and vehicle operation on British Columbia's highways. Applied in an economic analysis model, these costs facilitated calculation of user benefits of highway investments. Th costs also apply to appraisals of multi-modal transportation schemes, to evaluation of travel demand-reducing measures, assessment of road technologies, optimization of detailed design, and development of standards for safety, rehabilitation and geometri improvements.

Further research is needed in the following areas.

Figure 1 **Vehicle Operating Cost for a Car and a Composite Truck on Pavement with 0% and 4% Average Grades**

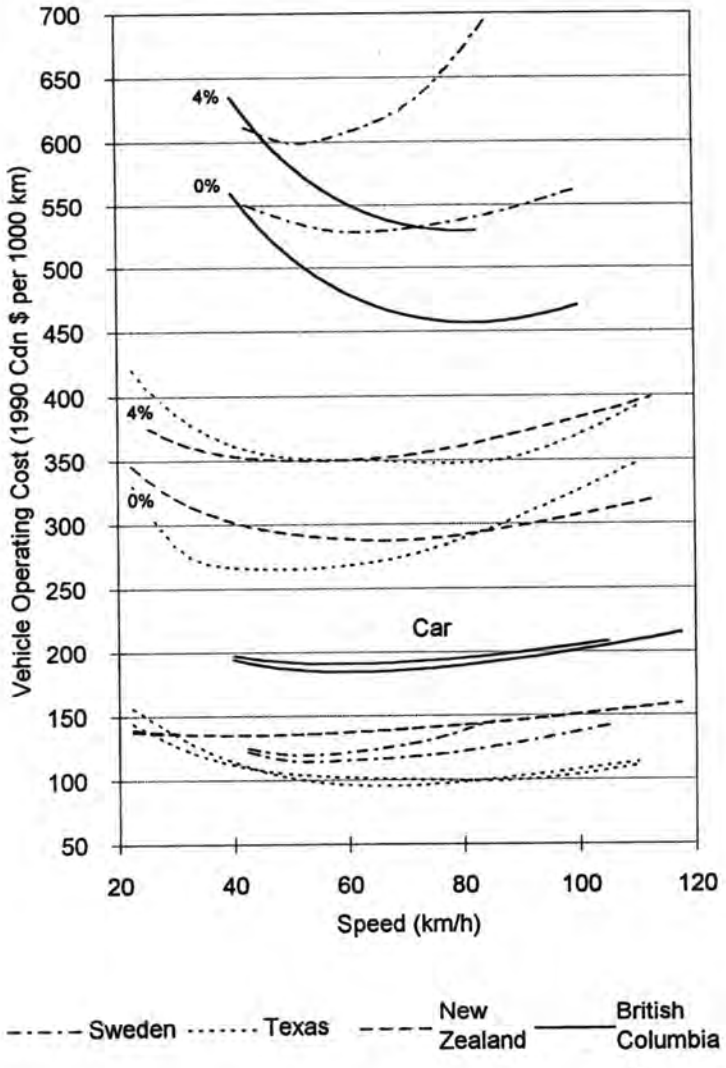
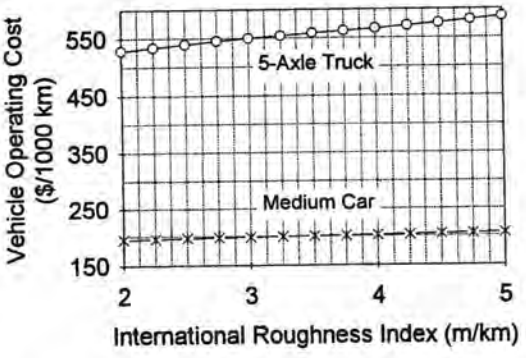


Figure 2 Vehicle Operating Cost as a Function of Roughness



Travel Time Value

The VTTS adopted for British Columbia is consistent with the results of many empirical studies and may be a step ahead of practices adopted by many other road authorities. As more is learned about people's value of time savings under various conditions, the VTTS figures can be modified accordingly. One research priority is to learn more about the value of time savings accruing to cargo in commercial vehicles. Also, more work is required on valuing time of transit buses and other urban commercial vehicles.

Accident Costs

The issue of what is the appropriate value of statistical life remains open. More recent research in transportation safety valuation and in costing of environmental effects on human mortality point to values of life higher than either recommended to, or adopted by MoTH. A follow-up study is in order.

The reported research also raises the question of the effect of seat-belt use on injury costs. B.C. has compulsory seat-belt use, but the crash costs are very close to those from the U.S., where seat-belts are not required by law.

Vehicle Speeds and Operating Costs

Field data collection is needed to verify HDM-III model predictions for empty and laden trucks on grades and on curvy roads, and for the slope of VOC surface roughness curves.

HDM-III VOC modelling needs improvement in the depreciation estimates. The optimal life method, which was implemented in South Africa, as related by Bein (1994a)., is the recommended approach. The use-related depreciation should be separate from time-dependent depreciation. The newly developed vehicle time costs account for the latter effect and would double-count it.

HDM-III is a model for free-flowing vehicle speeds and VOC. This is a serious limitation in urban transportation planning. ARFCOM does not suffer from this limitation. VETO would be a preferred alternative to using HDM-III.

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The authors are solely responsible for the contents of the paper.

THE FULL COSTS OF TRANSPORTING PEOPLE IN THE GREATER VANCOUVER REGION

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INTRODUCTION

As increasing numbers of people around the world spend more and more time on congested streets, and as governments' ability to provide sufficient road infrastructure to meet demand is hindered, many transportation planners and economists have begun to ask a set of probing questions:

- What are the full economic costs of transportation?
- Who is paying for our ability to move?
- Are the costs being borne fairly?
- What evidence exists of misallocation of resources?
- How can we improve our transportation system?

A number of agencies have begun formal programs to find the answers to these questions.

This paper presents the methodology and findings of one of the most comprehensive studies in this area. As will be shown, the study does not provide the definitive answers to the questions posed above, but does provide enough insight to begin to address some of the transportation problems society is facing. This work is also a useful starting point in developing newer and more comprehensive approaches to developing the information that is required to fully answer the questions.

THE TRANSPORT 2021 PROJECT

The Greater Vancouver Regional District (GVRD) and the Province of British Columbia initiated a process of developing a Greater Vancouver Transport Action Plan in 1992. This two-year project, entitled **TRANSPORT 2021**, had as its goal the formation of a transportation plan with which to guide the development of policies, programs and infrastructure for the movement of people in Greater Vancouver over the ensuing 30 years.

As part of this endeavor, the TRANSPORT 2021 staff commissioned a number of studies to help them develop their final recommendations for an effective long term transportation plan for the region. One of these studies was to conduct and analysis of the "full" economic costs of various modes of passenger transport. The specific objectives of the study were:

- To estimate the total economic costs of the different modes of passenger transport in the Greater Vancouver region.
- To determine how much of the costs are paid by the users of the different modes of passenger transport.
- To identify the groups that incur these costs either directly or indirectly.
- To identify the extent to which the movement of people is subsidized.

STUDY APPROACH

The study was undertaken within the context of an identification and quantification of costs. No attempt was made to present the findings in a benefit-cost analysis framework. The study did not attempt to determine exact costs, rather, the focus of the analysis was to identify all relevant costs and where necessary, make broad assumptions about the quantum.

The approach to this assignment was to modify a computer model developed by Mr. Todd Litman of Evergreen State College in Washington as part of his Masters Thesis. This structure of the model was modified to meet the needs of the study and to reflect data availability, which in many instances, was better than that used in the initial model.

Costs were assessed for the year 1991 for the movement of people in the following spatial and temporal groupings.

- Urban A.M. peak
- Urban off-peak
- Suburban
- Total

MODES OF PEOPLE TRANSPORT ANALYZED

Twelve modes of people transport were identified and included in the model as indicated in Exhibit 1.

Exhibit 1
Modes of Transport Used in the Model

Private Transport	Public Transport	Non-Motorized Transport
Average Car	Diesel Bus	Bicycle
Fuel Efficient Car	Trolley Bus	Pedestrian
Car Pool	Skytrain	Telecommute
Van Pool	Seabus	
Motorcycle		

It is important to note that these twelve modes are not complete substitutes for each other. However, many of these modes can be substituted for one another under certain conditions. For example, for very short distances, walking can be an effective substitute to driving. In addition, some modes (especially public transit) work in conjunction with one another.

Most of the modes are self-evident in terms of what they represent. Some of the others are not, and are described below.

- **Skytrain** - Skytrain is an Advance Light Rail Transit system which operates between the downtown area of Vancouver to North Surrey. The system is elevated for most of its length, except for the portion in the downtown area, which runs underground.

- **Seabus** - Seabus is a passenger ferry system which runs across Burrard Inlet from the downtown area of Vancouver to North Vancouver.

- **Telecommute** - Telecommuting does not actually directly involve the movement of people between their residences and places of work. People working out of their homes often have "clients" visit however, and hence do impose costs on the transportation system.

The study focuses on the private and public transport modal groups. The non-motorized modes of transport were reviewed, though the level of analysis was more of an overview of the costs.

BASIC STATISTICS

Basic statistics about the transportation system were collected from the Greater Vancouver Regional District, B.C. Transit and other sources. These statistics were used to portray costs in the appropriate unit basis (e.g. cost per passenger kilometre).

The Greater Vancouver region had a population in 1991 of about 1.76 million, with a total driver population of 1.16 million. The region contains about 1.03 million vehicles, which consumed 1.7 billion litres of fuel and travelled over 11,319 kilometres of roads.

During 1991, about 1.3 billion person-trips were taken in automobiles in the Greater Vancouver region. The average trip length was slightly less than 14 kilometres. This means that over 17 billion kilometres were travelled by residents and visitors in 1991. The annual average distance driven by a car is estimated to be 15,500 kilometres

The average occupancy in a car on any given trip was 1.43 people. About 8% of total automobile trips were made in the urban A.M. peak period, while 50% were made in the urban off-peak period. Private automobile travel accounted for over 90% of all trips made in motorized vehicles (i.e. public or private vehicles) in 1991. During the urban A.M. peak period, private motorized vehicles accounted for about 80% of total trips.

During 1991, about 127 million person-trips were made using public transit. A person-trip could involve the use of a combination of buses, Skytrain and Seabus. Thus while B.C. Transit reports 175 million riders on its bus system and 35 million riders on Skytrain, only 127 million person-trips were involved. The average distance travelled by a bus passenger was about 10 kilometres while the average distance travelled by a Skytrain passenger was 18 kilometres.

ASSESSMENT OF COSTS

The cost model was based on twenty key categories of cost grouped under six general headings, as indicated in Exhibit 2.

Exhibit 2
Cost Categories Used in the Model

Direct User (operating) Costs	Indirect Parking Costs	Transport Infrastructure	Time	Urban Sprawl	Environment & Social Impacts
Fixed Vehicle Costs	Residential	Road Construction	Personal	Infrastructure	Unaccounted Accident Costs
Variable Vehicle Costs	Commercial	Road Maintenance	Commercial Delays	Loss of Open Space	Air Pollution
Parking Fees and Fines	Government	Roadway Land Value		Future Transport Options	Water Pollution
		Transit Land Value			Noise Pollution
		Protection Services			

Direct User (Operating) Costs

Direct user costs (operating costs) represent the costs incurred by the owner of the vehicle/mode, including fixed costs, variable costs, and parking fees and fines. The following describes the costs included in each category and the principal sources of information.

Fixed Vehicle Costs - Fixed vehicle costs can be defined as time and ownership related costs. For private motor vehicles, these include insurance, licence and registration, depreciation and financing. In the case of public transit, the costs include insurance, depreciation, financing and management. For telecommuting, the costs pertain to the equipment required to enable working at home, namely a computer system and a fax machine.

The Canadian Automobile Association's "1992/93 Car Costs" was the source of most of the information regarding motorized vehicles. B.C. Transit provided information on the four modes of public transit. The B.C. Bicycle Association provided estimates for the costs of owing a bicycle, while KPMG developed estimates for the fixed costs of telecommuting. We did not ascribe any fixed costs to pedestrians.

Variable Vehicle Costs - Variable vehicle costs can be defined as the costs that vary directly with usage of the mode. For motorized vehicles, these include fuel (gasoline, propane, electricity, etc.), oil, maintenance, tires and labour costs. For bicycles, the costs relate to repair and maintenance, while for pedestrians, the cost pertain to shoes.

The sources of information are the same as those for fixed vehicle costs.

Parking Fees and Fines - Parking fees and fines represent the costs paid directly by users for parking facilities such as parking meters and parking lots, as well as municipal parking fines. Municipal records were used to obtain information on parking meters, municipally owned/operated parking lots and parking fines. Parking meters contribute about $5.4 million to municipal revenues annually while parking fines contribute about $7.3 million.

The total revenue from parking lots was more difficult to calculate. We used figures from the B.C. Assessment Authority on the total number of revenue parking stalls in the Greater Vancouver region, adjusted for the assumption that 50% of these revenue stalls were free stalls with a time limit. With a total of about 135,000 revenue parking stalls, this means that about 68,000 stalls represents the number that actually receive revenues. Discussions with parking lot operators indicated that average annual revenue from a parking stall varied from $200 to $1,200 per year with an overall average of about $500. This results in total annual revenues of about $33.9 million. Parking costs are assessed at the average for automobiles, at 120% of average for vans and 50% for motorcycles.

A summary of the costs is presented in Exhibit 3.

Exhibit 3
Summary of Direct User (Operating) Costs ($ per vehicle kilometre)

Mode	Direct Costs	Variable Costs	Parking Fees/Fines
Average Car	$0.228	$0.104	$0.004
Fuel Efficient Car	0.185	0.083	0.004
Car Pool	0.228	0.104	0.004
Van Pool	0.274	0.124	0.005
Motorcycle	0.205	0.052	0.002
Diesel Bus	0.883	2.442	0.000
Trolley Bus	1.666	4.510	0.000
Skytrain	8.014	1.300	0.000
Seabus	5.675	0.338	0.000
Bicycle	0.015	0.059	0.000
Pedestrian	0.000	0.104	0.000
Telecommute	0.154	0.000	0.000

Indirect Parking Costs

Indirect parking costs represent the costs of non-market parking such as that provided by business and government, as well as that provided at residential dwellings.

Commercial Parking - Commercial parking is defined as the the free parking provided to customers of commercial establishments such as shopping malls and company parking spaces provided for employees of a business. This cost category does not include the cost of parking in pay lots provided for company employees.

The costs of commercial parking were determined through discussions with parking lot operator. The range in capital costs is $1,500 to $30,000 per stall for surface level and underground parkade respectively. The range in annual costs is $360 to $4,830. The land consumed by commercial parking was assessed at $233,000 per hectare and amortized over 10 years.

The B.C. Assessment Authority has identified about 131,000 commercial parking stalls, but notes that they have omitted an unknown number due to data limitations. Accordingly, we based our estimate on the findings of American studies which indicate that about 85% of commuters are provided with free parking. The resulting estimate of the number of free parking stalls is 206,000.

The resulting calculations reveal a total cost of commercial parking of about $117 million per year.

Government Parking - Government parking is defined as the parking provided free-of-charge to employees and visitors. A total of about 57,000 parking stalls have been identified by the B.C. Assessment Authority. The methodology of calculating the annual cost of providing these parking stalls was the same as that for commercial parking. The total cost of government parking is estimated to be about $26 million per year.

Residential Parking - Residential parking is defined as the portion of residential dwellings used for parking. This includes the land consumed,and any improvements such as paving and construction of garages or carports.

Very little data exists on the number and type of residential parking stalls. Accordingly, a model was developed that assumes that three-quarters of all ground-oriented dwellings have a parking stall and all apartment units have a parking stall. The result of this calculation is an estimate of about 547,000 residential parking stalls.

The annual costs were determined by examining the typical construction costs for carports, garages and underground parkades, and the value of land consumed by parking. The annualized ownership and operating costs average about $750 per stall. The value of land consumed, amortized over 10 years, amounts to about $46 million. The total annual cost thus amounts to about $454 million.

The cost per vehicle kilometre for this non-market parking is as follows:

- Automobile - $0.050 per kilometre
- Van - $0.060 per kilometre
- Motorcycle - $0.025 per kilometre

Transport Infrastructure

Transport infrastructure costs include the costs of building and maintaining infrastructure, including the costs of land and protection services (police, fire, etc.).

Road Construction - Road construction costs are defined as the total annual costs of road construction that are not financed bu user fees such as fuel taxes and vehicle registration fees. The major difficulty with calculating these costs is that government accounts for capital expenditures on roads as an annual expense. Annual expenditures on roads also fluctuate significantly making the process of determining a typical level of expenditure difficult.

The methodology employed to calculate these costs was to determine the level of capital expenditure by the provincial and municipal governments over the previous 20 years. This figure was then multiplied by a factor of 2.0 to arrive at an estimate of the historical cost of all road infrastructure in the Greater Vancouver region. An estimate of the opportunity cost of capital employed was then calculated by using a long term interest rate of 10%. The previous two years of capital expenditures were used to develop a proxy of the necessary repayment of principal.

These costs were further adjusted by adding administrative costs, deducting transfers between parties (to avoid double-counting) and deducting provincial vehicle licences, fuel taxes and fines. The results of this analysis are as follows:

Interest Expense	$448 million
Principal Repayment	$217 million
Administration	$10 million
Taxes/Licenses/Et c.	$239 million
Total	$436 million

The costs are assigned by mode based vehicle kilometres and a road space index, which represents the the relative area occupied by different types of passenger vehicles. The index ranges from 1.0 for an automobile to 3.0 for a transit bus.

Road Maintenance - Road maintenance and rehabilitation costs include the costs associated with roads, bridges, street lights, traffic signals, drainage and traffic control. Also included are the costs of operating, maintaining and/or subsidizing the cost of two minor ferry operations.

The costs were developed from provincial and municipal records and totalled $173 million. Road maintenance costs were allocated to modes based on annual kilometres driven and an index of average axle weights.

Protection Services - Protection services costs include the annual operating costs of fire and police protection, and ambulance and court costs identified with traffic safety. The identification of costs was undertaken in conjunction with representatives of the municipalities, Ministry of Attorney General and Ministry of Health. The total costs were estimated to amount to about $43 million.

Protection service costs were allocated to modes based on annual kilometres driven and an estimate of the frequency with which the services would be required by mode. The frequency of use was estimated to be 10% of that of automobiles for buses, 5% for Skytrain and Seabus, and 1% for pedestrians. These figures are not based on hard evidence, rather they represent an informed guess of the individuals involved in the provision of the services.

Roadway Land Value - Roadway land value is defined as the annualized value of the land used for roads in excess of a basic transportation network. This cost category was perhaps the most difficult to deal with in that a standard, widely accepted methodology had never been proposed in the past.

Roads are used for walking, bicycling, utility corridors, emergency access and other activities besides driving. Roadway land costs thus should not be charged entirely to automobile users. We defined a basic road right-of-way as being 7 metres wide. The value of land dedicated to roads in excess of this amount is then considered to be a subsidy to vehicles.

The total area devoted to roads was determined from municipal and provincial records. This was then combined with information about the length of the road system to develop an estimate of the excess land. The calculations indicate that of the 28,188 hectares dedicated to roads, 20,265 hectares can be classified as excess land.

Part of the value of land is derived from its accessibility. Reduced accessibility through smaller roads would reduce land values. Therefore, roadway land should not be valued at full assessed value. No definitive studies have been undertaken to place a value on roadway land, hence the project Steering Committee decided that roadway land value should be discounted by 70% from the full assessed value. Insofar as roads account for about 8% of all land in the region, this has the impact of reducing average land value by about 6%.

The discounted value of the excess roadway land was estimated to be about $5.8 billion in 1991. The opportunity cost of this land was determined by assuming an interest only loan at 10%. The annual cost of the excess roadway land is thus about $580 million. These costs are assigned to the modes of transport using the roads on the basis of vehicle kilometres and the road space index previously described.

Transit Land - Transit land was valued in a similar fashion to excess roadway land. Land is used solely for transit purposes for the Skytrain right-of-way, Skytrain and Seabus terminals, bus loops and depots, and park-and-ride facilities. The discounted assessed value is about $70 million, resulting in an annual cost of $7 million.

The land cost associated with each of the transit modes are dealt with on an individual basis. These costs are assigned solely to the transit modes on the basis of passenger kilometres.

Time

Time costs include the cost of personal time involved in travelling within the region as well as the cost of delay time for commercial/business drivers resulting from peak period congestion.

Personal Time - Transportation economists typically value personal time at 50% of the average wage rate for drivers and 35% of the average wage rate for passengers. The average wage rate of residents of the Greater Vancouver region in 1991 was about $18 per hour. Accordingly, the value of time is $9 per hour for drivers and $6 per hour for passengers.

The value of travel time during the A.M. peak period was factored upwards by 1.5 to account for the higher value placed on time by individuals experiencing congested traffic conditions. This approach is currently in wide use in the B.C. Ministry of Transportation and Highways in estimating the impacts of highway investment.

Average speeds used in the calculation are as shown in Exhibit 4.

Exhibit 4
Average Speeds and Trip Length by Mode (kilometres per hour/kilometres)

Mode	Speed - Urban A.M. Peak	Speed - Urban Off-Peak	Speed - Suburban	Trip Length
Automobile	30	40	55	13.7
Motorcycle	35	45	60	13.7
Diesel Bus	20	25	35	12.2
Trolley bus	20	25	N.A.	8.3
Skytrain	43	43	N.A.	17.7
Seabus	20	20	N.A.	7.1
Bicycle	17	17	18	13.7
Pedestrian	3.4	3.5	4	13.7

While the distances shown for bicyclists and pedestrians are not realistic, the per kilometre costs are typical.

The total value of time was estimated to be $5.0 billion and was distributed by passenger kilometres by mode according to the factors discussed above.

Commercial Delays - Commercial delays are defined as the incremental delays to commercial and business traffic during the peak periods. The calculation of the cost of these delays is based on the decrease in average speeds during the peak period and an opportunity cost of twice the average wage of the driver. For commercial vehicles, the distance travelled during the A.M. peak period was estimated to be 24.8 million kilometres. Business-related travel by automobile was estimated to be 10% of total travel during this period, i.e. 108.4 million kilometres.

The total cost of commercial delays was estimated to be $95 million for both the A.M. and the P.M. peak periods. These costs were assigned to the individual modes based on vehicle kilometres and the road space index.

Urban Sprawl

The costs of urban sprawl manifest themselves in a number of ways, including:

- Through increased infrastructure costs (roads, sewers, utilities, school transportation, etc.).
- Through the loss of wildlife habitat and other indirect environmental impacts.
- Through the imposition of higher transportation costs on future generations.

These costs were not examined in detail in this study. Instead, the study relies on the findings of a report entitled "Transportation Cost Survey" by Mr. Todd Litman. This report estimates the costs to be as follows:

Infrastructure Costs	- $0.006 per vehicle kilometre
Loss of Open Space	- $0.017 per vehicle kilometre
Future Transport Costs	- $0.005 per vehicle kilometre

Environmental and Social Impacts

The environmental and social impact include unaccounted accident costs and air,water and noise pollution.

Unaccounted Accident Costs - Unaccounted accident costs are defined as the costs to society which are not accounted for in insurance claims. The calculation of these costs involved a detailed assessment of the number and types (fatal, bodily injury and property damage) of accidents in 1991. The frequency of involvement by the various modes was also identified. Blame was assigned on a 50:50 basis to the participants in the accidents as more detailed information was not available.

The social costs of an accident were develop based on a study entitled "The Costs of Highway Crashes" by Ted Miller for the Federal Highway Administration. This study identified the per accident costs as being:

Accident involving a fatality	- $3.620 million
Accident involving an injury	- $0.088 million
Accident involving property damage	- $0.006 million

The total costs were estimated to be about $1.5 billion after the payment of insurance benefits. These costs were allocated by mode based on vehicle kilometres travelled and an unaccounted accident cost index that reflects the relative incidence of accident costs not covered by insurance. This index ranges from 0.53 for buses to 5.8 for pedestrians.

Air Pollution - The costs of air pollution were measured for the most common pollutants: carbon dioxide, methane, carbon monoxide, nitrogen oxides, sulphur dioxide, volatile organic compounds, particulate matter and chlorofluorocarbons (CFCs). A detailed analysis of emission levels and sources was undertaken based on data provided by the Greater Vancouver Regional District.

The per unit environmental costs were obtained from a report entitled "Evaluation of External Costs Associated With Natural Gas Use" by G.E. Bridges for B.C. Gas. The costs per tonne ranged from $5.45 for carbon dioxide to $29,430 for CFCs.

The total cost was estimated to be $432 million, of which $422 million was assigned to private vehicles, while the remaining $10 million was assigned to transit vehicles. The costs within each mode were assigned by vehicle kilometres and relative fuel efficiency.

Water Pollution - The cost of water pollution was examined in detail. Instead, the study relied on the findings of the report entitled "Transportation Cost Survey" by Todd Litman. This report estimates the cost of water pollution to be $0.002 per vehicle kilometre. This cost is adjusted by relative fuel efficiency of the various modes.

Noise Pollution - The cost of noise pollution relates to the decrease in property values because of the noise generated by high volumes of vehicle traffic. The study used a methodology employed by the B.C. Ministry of Transportation and Highways which indicates that property values decrease by 0.6% for each decibel of noise above 50 decibels (average).

The investigation of this matter indicates that about 790 kilometres of road have average noise levels above 50 dB(A), and that with current traffic volumes, the average noise level is 64 dB(A). The affected lands are estimated to have an assessed value of about $7.2 billion. The reduction in land value is thus about $600 million, which on an annualized based equates to about $60 million. This cost is assigned to the modes on the basis of vehicle kilometres and a noise index which ranges from 1.0 for automobile to 2.0 for diesel buses and 3.0 for motorcycles.

FINDINGS

The principal findings of the study are shown in Exhibit 5. This exhibit indicates the unit costs (per passenger kilometre) for the twelve modes.

Exhibit 5
Summary of Unit Costs ($ per passenger kilometre)

Mode	Urban A.M. Peak	Urban Off-Peak	Suburban	Average
Average Car	$0.99	$0.69	$0.61	$0.68
Fuel Efficient Car	0.94	0.64	0.57	0.64
Car Pool	0.65	0.42	0.36	0.41
Van Pool	0.52	0.31	0.26	0.31
Motorcycle	1.33	1.03	0.95	1.01
Diesel Bus	0.78	0.61	0.50	0.6
Trolley Bus	0.80	0.67	N.A.[2]	0.7
Skytrain	0.48	0.79	N.A.[2]	0.74
Seabus	0.71	0.96	N.A.[2]	0.90
Bicycle[1]	1.03	0.80	0.77	0.82
Pedestrian[1]	3.77	2.68	2.42	2.67
Telecommute[1]	0.19	0.19	0.20	0.19

[1] *Caution should be exercised in using the numbers shown for these modes due to the lack of good data.*
[2] *N.A. - Not applicable.*

The principal conclusions which can be reached from the results shown in Exhibit 5 are as follows:

- Car pools and van pools are among the least cost options for the movement of people during peak periods. The reason for the low cost is the relatively inexpensive vehicles involved and the use of volunteer drivers. While results are also shown for car and van pools during the urban off-peak period and in suburban areas, very little usage of such services would typically occur.

- Skytrain is the lowest cost option for moving people during peak periods and amongst the highest during the off-peak periods. This is a direct result of the relatively high fixed costs of the system. These results indicate that any initiatives to increase ridership could have a substantial impact on average costs.

- The cost advantage flips between transit and private vehicles in the peak versus the off-peak periods, as shown below.

	Peak	Off-Peak
Combined Transit	$0.72	$0.68
Private Vehicles	$0.94	$0.67

- The bicycle and pedestrian modes have significantly higher costs than most of the other modes. This is due to the combined effect of the value of time and average speed, and the relatively high accident costs attached to each of these modes due to the assumption that blame is assigned on a 50:50 basis to the two parties involved in each accident.

Exhibit 6 provides a summary of the total costs for private vehicles and public transit.

Exhibit 6
Summary of Total Costs ($ x billion)

Cost Category	Private Vehicles	Public Transit	Non-Motorized
Direct Operating	$3.85	$0.45	$0.04
Indirect Parking	0.61	-	-
Transport Infrastructure	1.21	0.03	-
Time	3.90	0.48	0.61
Urban Sprawl	0.34	-	-
Environmental & Social	1.84	0.01	0.21
Total	$11.75	$0.98	$0.87

As indicated in Exhibit 6, private vehicles account for $11.75 billion or 86% of the total economic costs of people movement in the Greater Vancouver region. Private vehicles are responsible for 97% of transportation infrastructure costs, and virtually all of the indirect parking and urban sprawl costs.Time is less of a factor with private vehicles than it is with transit and non-motorized transportation.

Exhibit 7 provides a summary of who pays the costs attributed both private vehicles and and public transit. As indicated in this exhibit, users pay 77% of the total economic costs of private vehicles and 63% of the total economic costs of public transit. Provincial taxpayers contribute much more to the costs of public transit than the costs of private vehicles, 23% for public transit through direct financial subsidies versus 2% for private vehicles. On the other hand, society pays much more of the costs of private vehicles, due to the large component of environmental and social costs.

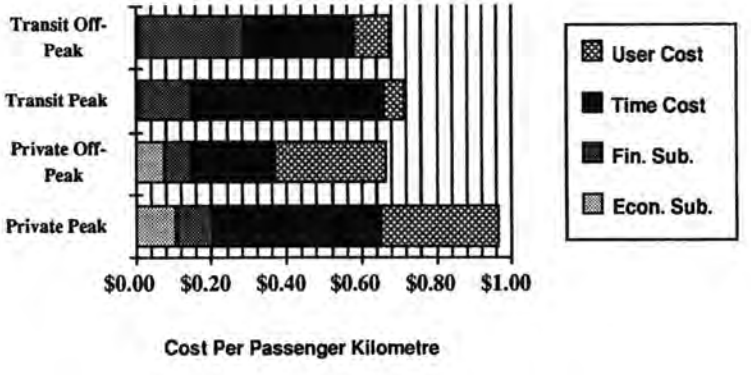
Exhibit 7
Payment of Costs by Stakeholders (% of total costs)

Stakeholder	Private Vehicles	Public Transit
Users	77%	63%
Automobile Drivers	0%	5%
Households	0%	1%
Business	3%	3%
Municipal Taxpayers	5%	3%
Provincial Taxpayers	2%	23%
Society	13%	2%

The total financial and economic subsidy to private vehicles amounts to 23% of total costs or about $2.7 billion. The principal components of this subsidy are road construction and maintenance ($600 million), roadway land value ($601 million), air, water and noise pollution ($512 million), urban sprawl ($282 million) and unaccounted accident costs ($397 million).

The total financial and economic subsidy to public transit amounts to 37% of total costs or about $360 million. The principal components of the subsidy are provincial government contributions of about $224 million and the transit tax on gasoline paid by automobile drivers of about $51 million.

Exhibit 8
Composition of Costs - Peak Versus Off-Peak



As indicated in Exhibit 8, the level of subsidy to transit is significantly reduced during the peak periods. Accordingly, initiatives that stimulate ridership throughout the day would significantly reduce the per passenger kilometre cost of transit. On the other

hand, initiatives that result in private vehicle operators bearing more of the full costs could make transit a more attractive option on the basis of user costs.

CONCLUSIONS

The identification of the full economic costs of transporting people is an exercise that is problematic in several respects:

- The methodologies used to identify and quantify the costs, in many cases, have not been developed or have not become commonly accepted.
- The data required to undertake many of the analyses of specific cost elements is not available or is not in the most suitable format.
- Diverse opinions exist amongst the stakeholders regarding the appropriateness and level of costs.
- Realization has to occur that the cost model is not intended to provide detailed information about matters such as ridership on a particular bus, or the benefits attributable to having a company salesperson drive from customer to customer.

Despite these and other problems, the study commissioned by TRANSPORT 2021 provides a reasonable insight into the nature of costs and their likely magnitude. The composition of costs provides signals to the types of initiatives that might increase transit ridership or reduce traffic congestion for example. The magnitude of costs indicates how significant some of the barriers and problems are.

Cost Benefit Basis of Highway Investment Appraisal and Road Pricing

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Introduction

This paper discusses applications of the social cost benefit analysis (SCBA) to highway investment appraisal, road pricing, and road cost allocation. SCBA was embraced by the British Columbia Ministry of Transportation and Highways (MoTH) in 1990 in response to the need to ration the ever shrinking Ministry budgets for investments posed by the ever growing demand. The same SCBA framework could be used as a pragmatic base for full road-price determination and cost allocation to road users.

By 1992, MoTH developed and implemented standardized procedures for SCBA appraisals of projects other than urban transportation (Bein and Harris, 1992). The tools include state-of-the-art road-user unit costs (Bein et al. 1994). Environmental and social costing is under development for SCBA at MoTH.

Perspective

Historically, MoTH lacked economic criteria for allocating funds to programs and projects and too little weight was given to road user societal and environmental costs. Economic analysis tools, such as Social Cost Benefit Analysis (SCBA), Cost Effectiveness Analysis, and Economic Impact Assessment, were examined for possible support of highway investment decisions by MoTH (MoTH, 1992b). Only SCBA can address the goals proclaimed in the Ministry's Mission Statement, using rudimentary methods. For its universality and rigour, SCBA was adopted by MoTH and preliminary tools were developed and implemented on a trial basis by 1992. Guidelines (MoTH, 1992), standardized input data, and User Benefit Cost Spreadsheets (UBCS) software (MoTH, 1992a) were developed to assure comparability and uniformity of rural highway investment appraisals. MoTH staff and contractors were trained in the use of these aids on evaluations of rural road projects.

Our initial work in SCBA focused on planning of highways outside the metropolitan network. A synopsis of applications to date can be found in (Bein 1993). Following the experience from the preliminary applications, the appraisal tools are being refined for the needs of multi-modal transportation planning, urban project appraisal, rehabilitation programs, design standards and the overall MoTH investment program planning.

Well into implementation of our tools, other Canadian authorities confirmed that we have been moving in the right direction. The Royal Commission on National Passenger Transportation (Royal Commission, 1992) recommended that

investment in transportation, and road user charges, be based on the economic efficiency principles. In British Columbia, the government issued general project evaluation guidelines which oblige the decision makers to consider the multiple accounts of agency cost, service user benefits, and social and environmental impacts (CCS, 1993). At the federal level, HUBAM appraisal model of Transport Canada is slated for upgrading, and UBCS could become its potential replacement, or source of up-dated road user cost data. In the U.S., MicroBENCOST is under development, but it contains dated user costs.

Canadian Transportation Inefficiency

In the industrialized world, Canada's transportation is among the least efficient because it is dominated by the road mode and by the private automobile, at the expense of the other modes. In 1989, 16 percent of our GDP was consumed by all transportation. By comparison, transport activities account for 4 to 8 percent of GDP in other industrialized countries (ECMT, 1990). Canadian health care shared 9 percent of GDP. "Vast distances" and "cold climate" can no longer excuse our road transportation inefficiency, because most of this activity takes place in the urban traveller movements.

People and goods movements by road are subsidized by the general taxpayer. As a consequence, multi-modal competition is impossible. Public transit cannot attract sufficient ridership to free itself of subsidies (also by the general taxpayer) and railways are put in a disadvantage.

Any underpriced good is bound to be used inefficiently and wastefully, and road transportation is no exception. Canadian cities sprawl in tact with road improvements and there seems no end to it. The rate at which Canadian cities sprawl is second only to the U.S., swallowing ever larger tracts of land (often agricultural) and causing congestion on commuter arterials and in the urban centers. Loss of open space, traffic noise, particulates, ground-level ozone, and global atmospheric change are among the most serious environmental impacts. The rivers of car traffic from the monotone suburbs eradicate livable, older neighbourhoods, pose a barrier and safety hazard to non-motorized travellers, and impede a freer movement of public transit and commercial vehicles. Some 4000 Canadians are killed each year in traffic accidents, most of them in urban areas. As the Canadian population ages, and the average income continues to fall, the growing ranks of the poor and the disadvantaged will be denied a better transit service and accessibility to the interactions they require. Their work, education, leisure and social opportunities are bound to become ever scarcer if automobile dependency is allowed to continue.

Huge quantities of fuel, materials, labour and capital, that the Canadian economy could put to a more productive and efficient use are wasted in vehicle manufacture, road and parking construction, and vehicle operation. North American road vehicles burn over half of the world's fuel production. The price is not only paid during Gulf Wars; global inequity, depletion of non-renewable resources, and huge contribution to global warming, with which our children and future generations will have to deal with, are much higher yet intangible costs.

Building more road capacity will not solve the problem of inefficiency. On the contrary, population growth will cause any additional road capacity to fill. Unless transportation is integrated into land use planning, road supply is

rationed, and travellers pay their way at a price better reflecting infrastructure, social, and environmental costs they impose on others, the vicious circle will not be broken. Qualitative changes are needed, rather than more blacktop and parking.

Aschauer (1988) found that the strongest growth in productivity is achieved by those nations who invest more per capita in infrastructure which includes roads as well as education, health care, utilities and so on. Because they have invested more per capita in infrastructure Japan and Western Europe are far ahead of North America in productivity growth. One example of sub-optimum infrastructure, Canada and US. have too much single-occupant travel by car, pickup and van, and not enough by public transit and other modes.

What is SCBA?

Social Cost Benefit Analysis (SCBA) is the estimation and evaluation of net benefits associated with alternatives for achieving defined societal objectives. It requires the measurement of the economic costs and benefits from changes in resource allocation in the economy due to each road investment alternative. SCBA is often synonymous with economic analysis in applied transportation economics. Economic analysis compares a road project's net worth to society, relative to objectives which seek to maximize the collective well being, also termed economic efficiency, of the members of society. Standard Cost Benefit Analysis (CBA) is a partial technique of SCBA evaluating the agency costs and three direct road user costs: travel time, vehicle operation and accidents.

SCBA presumes that the economic efficiency goal includes maximizing real economic gains to consumers and producers (or real gains to both firms and individuals) as well as gains in the quality of life and protection of the environment. Rules and a framework for SCBA are provided by applied welfare economists. The challenge in applying SCBA is to value the real gains to consumers and producers, and to evaluate the other effects within the same framework. If employed correctly, SCBA is the evaluation tool of choice to enhance long term economic development, economic growth and quality of life, including the environment.

There are equity goals which are as valid as the economic efficiency, but which are not technically "economic," for example, redistribution of income between income classes, or between regions of different wealth. Equity goals are seldom addressed in technical evaluations of transportation investments.

Some highway investments serve the strategic goals of economic development and community support, for example, land use changes and development; short term job creation; attraction of new industries and firms; and, ensuring that mobility needs are met regardless of geographical location. Strategic goals have traditionally been evaluated in Economic Impact Analysis (EIA). EIA ranks project alternatives on the basis of objectives which do not necessarily promote economic efficiency and cannot all be measured in monetary terms. The approach is not rigorous and can be abused in order to justify investments in roads. The Royal Commission (1992) did not agree that strategic goals should continue to drive Canadian transportation policy because:

- projects that contribute to regional developmentals pass the benefit-cost test under the efficiency objective;

- short-term local economic gains from construction activity are limited, because equipment and materials are purchased from other regions; and
- transportation projects are not designed to carry out regional development objectives, and should not be singled out for subsidies, which can place a long-time drain on financial resources that could otherwise be used positively.

Multi-Goal Decision-Making Environment

MoTH's implementation of SCBA recognizes that it does not supplant other decision criteria. The Government of British Columbia aims at a mixture of economic efficiency, strategic and equity goals. Economic analysis alone does not provide sufficient background for the decision makers to appropriate the highway budget to different program categories, to justify programs and projects, and to prioritize them within budget constraints. The other criteria that must be considered in addition to the economic indicators to achieve value for highway investment dollar are local community concerns, environmental and social effects not quantified by the economic analysis, technical viability factors, project and program commitments, and projected capital funding.

MoTH Mission Statement professes the most general economic efficiency goal of social welfare: "To provide and maintain *safe* and *efficient* movement of people and resources on a provincial transportation system in conjunction with the *economic development* of the Province in a *socially and environmentally acceptable* manner." The Mission Statement refers to all modes. Safe and efficient transportation of people and goods covers the income objectives of travel time and vehicle operating cost savings, comfort, accident reduction benefits, and net economic development.

The mission of supporting economic development in a socially acceptable manner affirms the efficiency goal as well as the strategic and equity goals. The environmental acceptability emphasizes a specific objective of high priority to our generation. The social acceptability stipulation includes provision of access to markets and personal mobility to all citizens. Preservation of existing transportation infrastructure is not explicit in the statement, but it ties in with the efficient transportation, economic development and social acceptability objectives .

Role of SCBA in Road Investment Decision Making

Efficiency, Equity and Financial Soundness

SCBA provides a structure for evaluation of investments, policies and regulations aimed at an efficient, equitable and financially sound highway transportation system. Well defined principles of valuation provide a basis for measuring the net social benefits of road developments, including the benefits external to the project objectives.

When managed using decision-support methods which endeavor to maximize public welfare, the highway system will be efficient, that is it will produce the desired user, societal and economic development effects. Equity can be addressed because SCBA distinguishes the economic efficiency effects from the

income distribution and local effects of a proposal. Financial soundness is realized when SCBA is used to optimize pricing and funding alternatives.

Funds Allocation and Project Ranking

In a study of nine ranking methods applied to 2000 added highway capacity projects, CBA was found to be the superior evaluation tool (McFarland and Memmott, 1985). SCBA provides a base for deciding how much should be spent on roads and how the funds should be allocated. It offers the decision maker two answers which are key for socially optimal decisions:

- Which set of programs and projects should be chosen from a large group.
- Which alternative should be chosen for a given project, in terms of location, design, scale and phasing.

Secondary Effects

The secondary effects of road investments are difficult to identify and cannot be evaluated for lack of suitable methods. They are normally ignored in SCBA and CBA evaluations. The largest of the excluded effects are related to business efficiency of commercial transport. Business efficiency improves through productivity gains in terms of stock inventory levels of just-in-time transport, vehicle fleet reductions and economies of scale of the same output from fewer depots. However, for most rural highway evaluations CBA and in some cases SCBA (incorporating user effects, noise, air pollution, wilderness preservation and recreation opportunities) will reasonably approximate total benefits and costs. For capacity improvements and rehabilitation of the U.S. Interstate System, CBA gave similar answers to SCBA on project priorities and investment strategies (Gomez-Ibanez and O'Keefe, 1985).

SCBA assumes that the world around the analysis is static, and only those variables change which are directly associated with the project. The analysis ignores possible dynamic linkages between transportation and the economy, and it could possibly recommend a suboptimal solution. However, Swedish research (Hussain and Jansson, 1990) shows that for rural main roads, the economic effects on road users alone provide a good approximation of the total net welfare gains due to a road investment in an economy with perfect markets.

Investment Effects on Growth and Productivity

Transportation provides service to other industrial sectors, which improves productivity, permits more efficient allocation of productive resources, and enhances consumer choice. This is how highway investments contribute to economic growth (Hansen, 1973; Stephanedes, 1989). Empirical evidence is lacking on the 'before' situation and the 'after' effects of new roads (Whitelegg, 1985), but higher expenditures on public infrastructure in the industrialized countries correlate with higher growth in productivity (Aschauer, 1988).

The regional highway network develops in three phases. The preliminary phase promotes regional development. Then additional investments in the regional highway system produces little or no regional development. In a final phase, additional investment increase local business efficiency and reduce user costs, but little economic development is achieved.

Economic Impact Assessment

Although EIA can provide information to local support groups, politicians and planners on the likely impacts of highway improvements, economic impact measurement tools alone are not sufficient to evaluate the economic development effects. The general economic benefit is measured by the *net increase* in economic activity from a national perspective. Mere transfers of activity from other areas to the project area do not contribute to the economic efficiency goal of transportation infrastructure investment.

Local interest groups tend to emphasize the *gross* economic impacts and point to them as justification for the investment. The general public, media, and the majority of government officials will not distinguish between net and gross economic effects. However, EIA can be a valid ranking method for projects which have been justified by SCBA within a program earmarked for local development roads.

Pitfalls

Like any sophisticated tool, SCBA has a potential for being misused willfully or unknowingly. To guard against the possibility, MoTH procedures and data used in SCBA are standardized and can be used only by licensed practitioners, either in-house staff or consultants. Dedicated resources to check compliance with the standards are being developed at MoTH.

In Sweden, Nilsson (1991) found the corrupting factors in both the investment evaluation procedures and in the decision making processes:

- earmarking of road investment funds based on traditions of historical and geographical fairness, which do not necessarily conform with economic efficiency criteria,
- local community preferences overriding societal preferences,
- more weight assigned to technical factors with which decision makers are more familiar,
- regions manipulate results in order to increase their share of the budget, and
- regions use different CBA principles to appraise projects submitted for program planning at a higher level.

In British Columbia, we have encountered all of the above problems. The most serious problem, however, is that regions promote projects which have not gone through a rational and systematic process of generating and evaluating alternatives. It is not always clear if and how other alternatives were considered, if SCBA was used, and how they rated relative to the preferred option. On the procedures side, we don't yet have a comprehensive suite of tools to support all SCBA evaluation requirements. This disadvantages urban project appraisal relative to rural projects, and rehabilitation and minor geometric improvements – relative to capital-intensive projects.

Our preliminary tools are strong in user costing but decision-making processes are not necessarily compensating for the social and environmental criteria which are not quantified yet. Consequently, the evaluations are in effect supporting highway development to the projected traffic growth at the expense of considerations such as local air quality, climate change, urban sprawl and social

inequities of transportation schemes. Improved roads attract more traffic, which requires more improvement – the vicious circle never ends. Changes are required in people's travel behaviour, land use and pricing of roads in order to bring about a more efficient transportation. Decision-makers and analysts will not be able to evaluate the needed policies and to plan for the most efficient modes using SCBA, unless the social and environmental impacts are costed as well as user costs. In the U.K. for example, £10 billion were missed in extra cost to pedestrians and bicyclists when the motorway expansion program was evaluated (ref.)

Two-thirds of a recently considered British 15-year road expansion program of 243 projects were either highly controversial on environmental grounds or damaging to beauty spots (Crawford, 1993). The method of assessing costs of these projects is the culprit. It does not penalize for the use of undeveloped land, which is cheaper to purchase than residential or industrial areas, but often remote and environmentally sensitive.

Even if tools were available for costing the social and environmental impacts, the economic indicators produced in SCBA framework for project appraisal do not convey the most significant non-user costs. These costs are similar in both the base case and proposed case. SCBA of a project will show the noise costs, for example, as an increment from the base to the proposed case. The more fundamental problem of noise impact at the base traffic volume level will not be addressed if SCBA is so constructed for project appraisal.

Davis (1993) shows how road safety has become a political tool wielded in favour of the hegemony of the car and against the rights of those who cannot, choose not, or would prefer not to be motorists. Whitelegg (1993), Johnson (1993) and many others point out that expansion of the road network and the increase in traffic does not give people more free time. On the contrary, they use whatever time savings they do gain, to travel further. Suburbs and travel proliferate, but quality of individual, family, community and civic life don't improve. Obviously, such considerations are largely absent from road and transportation decision-making.

Road Underpricing

Tragedy of the Commons

"Tragedy of the Commons" principle asserts that any public good or environmental amenity that is available at little charge will eventually be used inefficiently, or will be wasted (Hardin, 1968). There is no doubt anymore that road transportation is underpriced, therefore overutilized and a burden on society's resources.

The Transport 2021 study (KMPG, 1993), for example, found that passenger car transportation in Greater Vancouver Regional District (GVRD) is 20% underpriced. It means that the average car user, including passengers, have about 20% of their total transportation cost covered by the property owners, general taxpayer and the general society (including future generations) who do not necessarily use that car. Re-calculation by the author (Bein, 1993) shown in Table 1, indicates that the imbalance is far worse. The costs of urban sprawl, unknown at present, are missing in Table 1, and infrastructure and parking costs

are likely understated. With appropriate corrections, the conclusion is that light vehicles pay only half of their way, or maybe less.

Table 1: Light vehicle transportation costs in Greater Vancouver, $Billion (1991)

Light Vehicle Cost Category	Author's analysis (a)	KPMG (1993)
Vehicle Operation	2.6	3.8
Infrastructure + parking	1.8	1.8
Travel Time	3.8	3.8
Accidents	2.5	1.3
Local Air Pollution	0.8 }	0.4
Global Warming	2.9 }	
Noise	0.7	0.06
Barrier Effects	0.5	Nil
Light Vehicle Total Price	15.6	11.2
User Pay	9.0	9.0
User/Total Cost	0.58	0.80

(a) Source: Bein (1993)

Socioeconomic Costs of Underpricing

Underpriced automobile travel causes demand to grow thus creating pressure to build more road capacity, mainly to alleviate the peak volumes during congestion periods. In North America, vehicle travel distance increased much faster than the population grew, and faster than the number of vehicles during the last forty years. One factor is that more people with higher incomes and separate households require and can afford more vehicles. Demographic changes, such as the increase in the number of single-parents, and single-person households, rise in female labour force, and more than doubling of per capita disposable income also contribute (Johnson, 1993).

But the most crucial fact is that we drive longer distances to reach the same number of destinations as forty years ago, because of urban sprawl. In spite of apparently better mobility a present-day automobile user has access to fewer destinations and interactions required by our daily lives. We just drive longer distances faster and in the process lose touch with the places we drive through (Stanley and Spivak, 1993; Kunstler, 1993; Engwicht, 1993; Johnson, 1993). The longer distances result from auto-induced, low-density patterns of land use. In making residence selection decisions, people trade off low cost of real estate in suburbia with the increase in travel time. Historically, the process of sprawl has been linked with the highway development and with the political process.

If the full social costs of driving (not just travel time and vehicle expenses) were internalized, many people would consider housing in more dense areas, perhaps served by mass transit, and in any case closer to the places they most frequently go to. Likewise, decisions regarding travel to shopping at super-stores are

conditioned by the gains of purchase price savings and convenience, relative to the low cost of getting there and parking. As people began to pay their way fully, they would make more conscientious decisions before they started a trip and single-occupant driving would decrease. Efficient pricing through road user charges which discourage people from using the infrastructure more than they need to – but not less, since this wastes an opportunity – has a great long-term travel demand reduction potential. With reduced demand for automobile travel, increased usage of mass transit, and more efficient land use regarding transportation needs the following socioeconomic costs could be greatly reduced or eliminated:

- traffic-related accidents, emissions, noise and community severance and degradation;
- demand for automotive fuels, and with it our reliance on imported oil,
- time waste, stress, pollution and business inefficiency due to congestion,
- land take of urban sprawl,
- road expansion, and
- subsidies to mass transit operations.

More fair pricing of the road transportation good would also shift the tax burden from the property owner and general taxpayer to the road user, thus restoring the power of market forces in the economy, eventually leading to better productivity and competitiveness of Canadians.

Can Technology Help?

Technology improvements alone do not offer comparable long-term potential. They can only be regarded as short-term fixes which may induce more inefficiency (Stanley and Spivak, 1993). On-board computer systems for enhanced driver guidance through congested road networks, collision avoidance gadgets, alternative fuels and propulsion systems, small urban vehicles, and freeway access and flow optimization will do little to eliminate emissions, noise, and urban fabric deterioration. They will, however, momentarily open more road capacity which will be lost to latent demand in no time – unless efficient road pricing is implemented at the same time.

Road Pricing Philosophies

Hansson and Leksell (1990) lay out the following socioeconomic principles for road pricing:

(a) Taxes and fees charged to road users should be based on well-defined cost responsibility.

(b) Road use charges should include the total socioeconomic costs caused by road usage.

(c) Cost responsibilities should be established in the form of fixed and variable roaduser charges.

(d) Variable road user charges should reflect the short-term marginal socioeconomic costs. Fixed charges should in principle reflect the

difference between the marginal costs and the total socioeconomic costs caused by traffic.

Royal Commission (1992) compiled the following set of principles:

(a) Travellers must pay for all of the costs incurred in producing transportation services.

(b) Road user charges must be set above the marginal cost (the additional cost that results from a small increase in the amount of transportation service provided).

(c) Road user charges should not be so high that they will discourage the use of the service by some people, which would result in a loss to the economy.

(d) Users should pay individual prices based on the costs and demands associated with each link or terminal on their trip.

(e) If a transportation mode is to pay its costs fully but not more than its costs, there should be no special charges that are above those required to meet infrastructure, environmental, safety and accident costs.

(f) Different prices should be imposed on various groups of users depending on the costs they impose and the benefits that each group derives from the infrastructure.

Collectively the two philosophies exhaust the theoretical principles of "pure" road pricing, as follows:

(1) Rational – cost responsibility should be well-defined for each road user group.

(2) Comprehensive – total socioeconomic costs due road provision and usage should be included.

(3) Two-part – a per-use fee should be set at, or moderately above, marginal cost, and an annual fee can be used to cover the complement to the total cost.

(4) Efficient – to guard against a loss to the economy at the other extreme, user charges should be kept below a level which would discourage the use of the service.

(5) Stand-alone – charges should be differentiated by the costs and demands of individual links and parking terminals.

(6) Fair – various groups of users should pay different charges according to the costs they impose and the benefits they derive.

(7) Equitable – no extra charges must be imposed over and above those required to meet the total costs.

(8) Universal – all road users pay, regardless of which part of the network and which parking terminals they use.

Operational Limitations

In reality, pragmatic and political factors are likely to skew the principles. As an example, Small et al. (1990) proposed congestion pricing of light vehicles (marginal charges) to subsidize pavement strengthening programs catered to

heavy vehicles. The principles of fairness and standing-alone were presumably traded-off for efficiency. But, paradoxically, economic efficiency would not be encouraged in such a scheme; to keep it efficient, the heavy vehicles should be responsible for all the costs they impose, including thicker pavements. In a healthy market economy, this charge should be passed on to the consumers of goods and services delivered by those heavy trucks and buses.

The other principles are not easy to implement, either. Marginal costs are often too complex to measure, and they vary with circumstances. Pavement damage, for instance, depends on axle loads as well as climatic factors, age of the structure, and construction quality, neither of which are understood perfectly and the interactions between the factors are still more complex. Even if perfect knowledge was at hand, variables such as weather and climate would need to be monitored closely site-by-site, and the effect would have to be factored into the damage responsibility equation in real time and with reference to a particular vehicle. Axle load measuring inaccuracy of 5 percent (a standard in static wheel load measurement) introduces a 20 percent error in the damage responsibility index. Dynamic wheel loads vary much more depending on ambient temperature, inflation pressure of tire, and road surface uneveness. The provider of roads would find it difficult to set the marginal part of prices accurately.

Absolute fairness is also impractical because we are not able yet to measure the costs and benefits of different user groups accurately. For example, the debate goes on regarding value of human life, unit damage costs of vehicle noise and emissions, and emission rates for different types of vehicles, engines, and operating conditions. The notion of benefits is not too well defined either. The construction quality factor in the pavement damage example often remains covered for years. Once it surfaces, the contractor is off the scene already. Why should the motorist pay for the contractor's mistakes, and for inadequate inspection by the facility owner?

A road pricing scheme cannot possibly be efficient and comprehensive at the same time. Charging the full cost would turn away too many people from using the transportation system. If motorists in Greater Vancouver were to be comprehensively charged for the global warming damage costs they impose, it would mean an additional charge of about $0.2 per each km driven, or $2 per each litre of gasoline consumed, or $3600 per year for an average car usage of 16000 km. If all the costs were included, the charge would be about $0.7 per km. Most people would have to leave the car in the garage, but there is no alternative transportation to substitute with in the short term.

Stand-aloneness cannot be achieved without sophisticated electronic pricing and charge collection systems, which create their own problems and still remain to be proven in real conditions (Harrop, 1993). Charges may be difficult to accept by, and to collect from users. The collection effort, systems and equipment add another cost item to the total cost, which already is difficult to recover.

A host of practical questions arise from a proposition of rational road pricing. Why, for example, should users of low-volume roads pay inevitably high charges? They do use an expensive facility (on a per-use basis), but they are also essential to the local economy, (perhaps resource based), and they do not contribute to urban congestion and job requirements. Which jurisdiction should initiate road pricing, or should all levels of government and infrastructure owners

act in concert? In the latter case, do we have traditions and processes in place to ensure that such integrated policies could be successful?

How will a government or private owner of infrastructure guard against a breach of the equity principle? It is quite luring to use road charging as a general revenue generator rather than an instrument of achieving greater efficiency of transportation and land use.

Proposed Road Pricing Scheme

A road pricing and cost allocation scheme that would have a reasonable chance of success should:

(1) Be simple, implementable, transparent and accepted by all stakeholders, including those who may lose.

(2) Transfer existing tax burden from the property owner and general taxpayer to the road infrastructure and parking facility user, but be revenue-neutral.

(3) Account for all well-defined costs, such as infrastructure, accidents, noise, emissions and barrier effects.

(4) Be integrated with land-use planning for decreased trip demand.

(5) Be implemented gradually to ease the effect on the lifestyle and disposable income of people, and on the economy in general. This may require subsidy to commercial vehicles, to public transit and to changes in the urban form in the initial stages.

(6) Be fair to a certain degree since absolute fairness is expensive to implement. But in any case be universal, i.e. all users should pay, whether they are urban commuters or motorists on low-volume roads. Presently proposed congestion toll collection schemes will discriminate against: (a) urban vs. rural road user, and (b) those urban commuters who have to pass through a toll site vs. those who do not. Low tech, non-electronic, area-wide charges (such as a pre-paid sticker), would be a preferred solution (Hassop, 1993).

(7) Rely on simple mechanisms of price determination and cost allocation. Classing of road users into groups such as light vehicles (cars, vans, pickups), light trucks, and so on, would be preferred. Charging would be on per-km basis for infrastructure, noise, dust, accidents, barrier effects and other costs which are not easily attributable to a particular user group. Vehicle-specific costs (CO_2, particulates, ground-level ozone) could be recovered by a combination of fuel taxes and emission taxes depending on engine and fuel type, and emission control technology in an individual vehicle.

(8) Compensate those who have to use a car (infirm, handicapped, inhabitants of sparsely populated areas.)

(9) Place accountability and fiscal responsibility on all stakeholders.

For the government this would involve setting appropriate policies, monitoring their implementation, and intervening where market forces are unable to assure achievement of socioeconomic goals.

For infrastructure owners – providing only what is required, and of reasonable quality. Pavement structures should be designed for the heavy trucks to serve the axle loads adequately without premature structural and surface damage. Capacity should not be added in advance of confirming the users' willingness to pay for the full socioeconomic costs. Construction quality should be inspected thoroughly and liability placed on the contractor for any errors and omissions.

For the travelling public – making everyday decisions that would lead to changes in travel behaviour and eventual reduction of demand for inefficient travel by each individual.

Conclusions

Pilot applications of UBCS and associated data showed that SCBA is a useful tool in:

- justifying projects submitted to Treasury Board approval;
- supporting high-level (reconnaissance and corridor) at MoTH headquarters and regional offices;
- program planning for limited budget;
- evaluation of pavement management strategies;
- assessment of new road technologies, such as toll collection; and
- urban transportation project evaluation and policy setting.

Social cost benefit analysis (SCBA) provides a practical tool for evaluating and priority setting of highway investments. To avoid socially undesirable decisions, SCBA should incorporate social and environmental criteria in monetary terms compatible with the economic agency costs and the user benefits which are monetized in cost benefit analysis reliably. Those criteria which cannot be monetized must be accurately defined and weighed in a process of genuine public involvement.

Using SCBA in conjunction with such processes, highway and transportation decisions should be, and they can be made, taking the full costs of various impacts into account. To this end, highways should be planned within a framework integrating all transportation modes and land use planning. This would assure that the multi-modal and the most efficient alternatives are considered.

Road pricing and cost allocation is not amenable to SCBA applications directly, because of strong political sensitivity of charging full costs, and analytical complexity of determining and allocating costs fairly to all users.

The full-cost accounting of SCBA is less useful for road pricing, because we cannot afford to pay the full socioeconomic damage costs through user charges without severely upsetting the economy and the lives of people. SCBA does, however, offer a structure for:

- defining the total and the component costs of transportation,
- assessing relative benefits of different road user groups, and,
- determining allocation of the total or component costs to road users.

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Abbreviations:

MoTH = British Columbia Ministry of Transportation and Highways

CCS = British Columbia Crown Corporations Secretariat

ECMT = European Conference of Ministers of Transport

TAC = Transportation Association of Canada

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An Approach to Railroad Capacity and Train Income Management

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Introduction

One of the most vigorous changes that can occur within the competitive framework of an industry is its transition from a regulated to a deregulated business environment. During the early 1980's in the United States, the Staggers Act forever altered the manner in which surface transportation companies view their product offerings, their customer base and their competitors. In the not too distant future, NAFTA will also significantly change the continental transportation playing field. Long term survival of transportation entities will require the ability to quickly and profitably develop market opportunities and adapt to an ever changing and increasingly competitive marketplace.

With regard to service offerings and rates, railroads must begin to focus on three fundamental and distinct issues:

* unit of production definition and consistent operation
* network capacity utilization measures
* train income management

From these fundamental building blocks, a framework is created for understanding and managing the more complex aspects of the business. This paper presents a process which develops the fundamental building blocks as well as a methodology that can be used to value a portfolio of network service offerings.

The Playing Field

Essential to the success of every transportation entity is the ability to provide consistent, on-time, and damage-free service. The development of service products and a clear definition of markets served is crucial.

As cooperation among rail carriers spawn more run-through agreements and seamless, door-to-door intermodal services, it becomes critical that all network service offerings become accurately scheduled. Internal network scheduling, such as local feeder train service, is also important in the development of known service offerings. A master schedule, which is an electronic collection of all known and commercially viable service offerings, is then assembled and held constant for some short-term time period.

Service product offerings and their associated train services are then aligned and managed in terms of the types of assets employed, rather than the traditional geographic operational viewpoint. This becomes crucial later in the discussion when trade-lane capacity measures and network value analysis are presented. Finally, true origin to true destination service performance must consistently meet the expected on-time requirements.

Unit of Production

From a micro-economic perspective, each railroad assembles inputs of production, combines the inputs in a production process to create output, and sells the resulting output. The railroad also organizes its production and sales activities so as to achieve certain objectives, such as profit and output maximization.

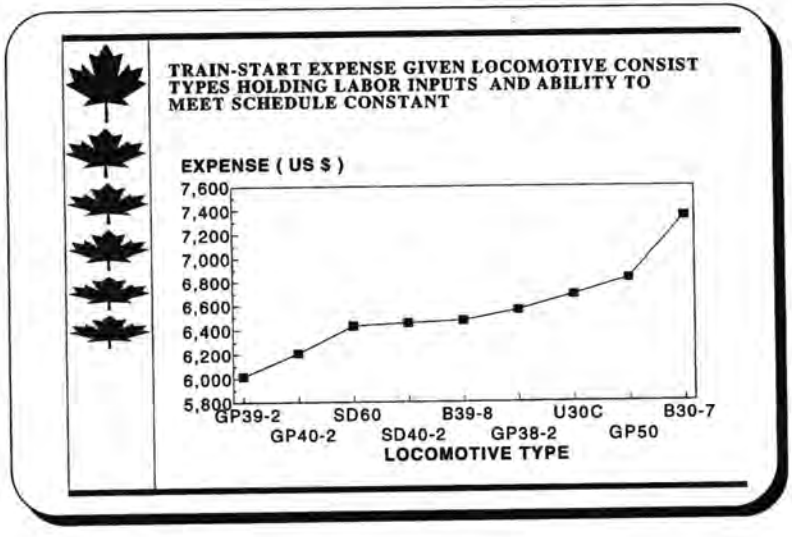
Naturally, the railroad faces constraints in its production decisions. These include bureaucratic constraints (i.e.. antitrust and other government regulation, rate-of-return regulation, and taxation) and market constraints (i.e.. the price of labor, capital, locomotives and other inputs, demand for the service products produced, and the degree of marketplace competition). Our focus in this discussion, however, is on another constraint: One that is in essence a technological constraint pertaining to the manner in which labor, capital, locomotives, cars, and other inputs can be combined to produce viable service offerings.

The process through which train service is assembled to produce viable service offerings requires thorough analysis. The individual train-start is solidly at the core of the production process. The inputs required to build a train-start can generally be separated into the long-term variable cost components of :

* Actual crew wages
* Consist specific locomotive annuities
* The fuel that only the locomotive consist consumes
* Consist specific locomotive maintenance

It is important to note that once the network schedule is committed to for a period of time, a specific amount of labor and capital assets essentially become committed to the production process. Hopefully the amount of inputs to consistently achieve high service levels also represents a minimum of assets employed to produce the service.

Transitioning from the economic view to the actual implementation plan on a network level involves scheduling, locomotive management, and marketing input. Below is a curve showing the production function for an actual train-start on the BN network. Each consist that makes up the curve has an equal probability of consistently meeting the schedule requirements, although labor and locomotive assets employed create different production cost functions.



One important issue that is clearly shown in the above graph is that train-start economics and the inputs used to generate them must be thoroughly understood and efficiently matched to specific market requirements. In very competitive, short-haul intermodal markets, train-start management can be the difference between positive or negative returns. Clearly, the train-start forms the foundation for operations, financial and asset management.

Having defined our unit of production as the unique train-start, the question then becomes, " how can a railroad network ensure that it is achieving maximum productivity from each train-start?"

Production Capacity Planning and Measurement

The ability to operate the right service capacity in the right market with the right cost and rate structure is difficult to attain for any production process. Traditionally in the railroad industry, inherited franchises defined what markets to serve, the tariff or contract spelled out the rate levels to customers on the franchise, and the largest train that could physically fit on the line between two terminals was thought to be the most profitable way to operate the network. Under certain conditions all of these old rules of thumb have some merit; just not necessarily in economics.

Traditional railroad approaches to train-start capacity planning and measurement generally evolved around bridge and track engineering maximum limitations. Issues such as minimum siding lengths on track segments, bridge tonnage limits, and tons per operative brake formed the basis for "acceptable" train size operation. While defining the outer edge of safe operation, these "acceptable" train size parameters have little economic basis.

HPCAP

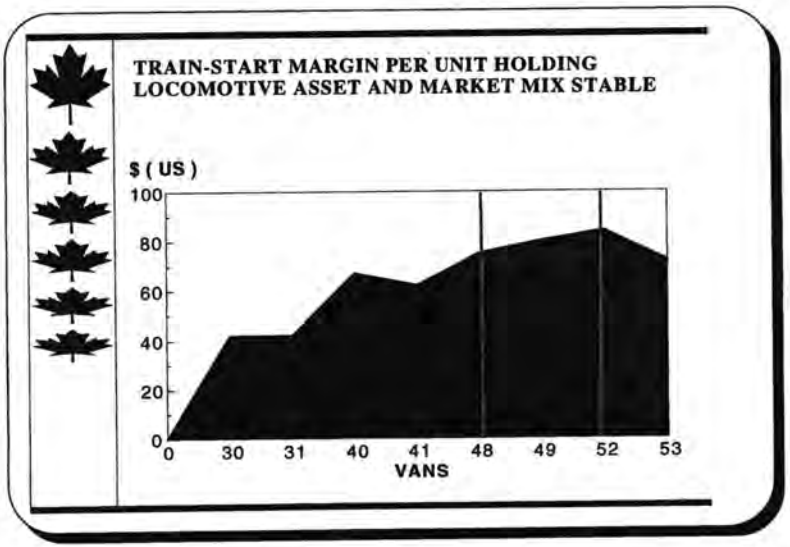
Economic reality rears its ugly head when tonnage supplied to a market or set of markets is out of a balance with tonnage demanded. This is the point at which effective train-start management and its tonnage generation plan come together with marketplace demand. One approach which has proven itself in terms of schedule achievement and improved profitability is horsepower capping (HPCAP).

HPCAP is a process which takes into account expected market tonnage demand, the efficiency factors required to successfully meet the schedule (generally in the form of link and train-type specific horsepower per trailing ton or tractive effort per trailing ton ratios), and the builder class of locomotive best suited for the terrain characteristics the service will traverse.

Generated tonnage for each train-start can be developed utilizing the network schedule, the efficiency factors required to meet the schedule, and the choice of builder class that best fits expected market demand. As the system pool of linehaul locomotives is drawn down and assembled into specific train-starts, the capabilities of the network become better defined. In some instances, major

network constraints such as arrival / departure windows at terminals, the number of available linehaul locomotives, and the amount and type of rolling stock will force either adjustments of operational capabilities, improvement in the target marketing of products or an integration of both approaches.

A conscious business decision must be made during the initial construction of the network train-start portfolio as to what level of market demand will be met. The first step should be to ensure a sound service, operational, and financial foundation by focusing on the existing locomotive fleet. It is usually wise to meet a high percentage of daily expected demand in order to operate in the efficient zone of the production function. Because this approach has essentially fixed the capital stock of the network and the assets that will be employed on the individual train-start, we can begin to understand the various zones of the production function. Below is an illustration of an HPCAP train-start curve for a specific BN market served. Note the inefficient and efficient zones for accepting or rejecting levels of market demand given assets employed.



Since the amount of output tonnage that a train-start can produce is dependent upon the amount of capital asset employed, each addition of capital gives rise to a unique set of economic relationships. The driving force for profit-maximizing train-starts and railroads is clear: Understand the market demand levels to insure that the capital assets employed in the production process generate results in the efficient production and margin zone.

As can be seen, there are network requirements and benefits from the implementation of an HPCAP approach. Basic requirements include schedule consistency for asset rotations and network velocity, disciplined locomotive management and terminal operations, and the integration of effective marketing and operations organizations. The benefits include a more accurate financial assessment of asset requirements, productivity, and return. An understanding of systematic spot and high return market opportunities can also be developed in addition to stabilizing marketing decision support tools which utilize a long-term variable cost methodology. This stabilization process begins to form the basis for understanding the market mix and price management components of the production process.

Train Income Management System

Having gained an understanding of how to meet a projected level of network demand given a viable service schedule and an initial set of crew and locomotive capital constraints, the discussion then focuses on how to manage the business mix which gets placed behind each train-start. One approach that has met with success in the operational, marketing, and financial arenas focuses primarily on the tactical separation of train-start expense from business mix expense. A commitment to operate the network service schedule for a short-term period and apply train-start assets to meet the expected demand arising from this plan essentially removes the variability of these expenses since the train-start cost dollars are committed. The market mix that was previously estimated in tons or platforms now becomes estimated in terms of origin-destination pairs, number of car and/or van/container type, and specific customer cashflow streams. This is where the fun really begins for those of you not having fun yet!

Market mix for an individual train-start is essentially all traffic which has the ability to be conveyed locally by the train or relayed to or from other trains based upon the network schedule. The view of the traffic is always based on the shipment view, or the view that considers all the activities that occur from the movement of the traffic from true origin to true destination. The shipment view allows an estimate of the traffic's contribution margin (CM): (CM = Settled Revenue - Direct or Variable Expenses excluding all train-start expenses), to be developed for all traffic on the network as specifically as is meaningful for each type of train-start and railroad.

Employing an existing variable costing system with a few modifications and some off-the-shelf statistical software, and train income management is ready to begin. A few elements that have shown to support the train income management process include historical traffic origin-destination demand by day-of-the-week for all service that will operate within a scheduled time horizon, associated unit

tonnage, settled revenue, direct expense for each unit, CM, and destination dwell-times. Significant variability of demand should be investigated, since most historic demand patterns should be fairly consistent at the origin-destination, day-of-the-week level of analysis. The next step leading toward implementation is the development of an easily communicated set of train operating plans. These plans include activities such as:

* Expected tonnage picked-up or set-out at each terminal for each train
* Tonnage allocations/allotments for future train-to-train block swapping
* Customer specific platform allocations for intermodal hub operations

Each revision of the network schedule where routings change to involve different service parameters, train service employed in the shipment routing, or markets conveyed will require the network train income management plan to also change. Integrated marketing strategies which constantly work to improve the traffic mix through new opportunities or redeployment can also be tested under simulation prior to any commercial actions. Most importantly, train income management creates the basis for decision support information that is common for operations, marketing and finance.

Network Valuation Analysis

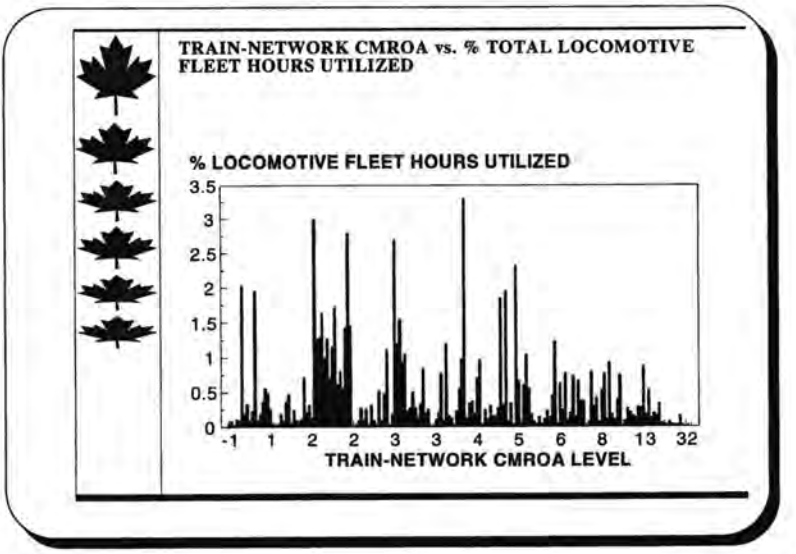
From a strategic standpoint, having constructed a portfolio of scheduled, capacity controlled train-starts on which the income is managed, there now exists the opportunity to manage the network in terms of maximizing shareholder value. Steps required to begin the improvement of shareholder value include: segmentation of all service offerings into independent train-networks, a calculation and ranking of each train-network in terms of contribution margin return on assets employed (CMROA), and a management process to develop "asset-sender" and "asset-receiver" train-networks.

The segmentation process has its roots within network scheduling and HPCAP. Each line-haul, revenue service train-start is assembled into a discreet train-network. A train-network is a group of two or more trains which exist as a stand alone service operation. An example would be a loaded and empty coal train having the same mine and utility pairing, or a pair of general merchandise trains that serve opposing origin-destination cities. Train-network segmentation should be firmly aligned with the commercial products offered by the network, not the particular geography.

Useful data elements for each train comprising the specific train-network include the number and percent of total locomotive fleet hours consumed, loaded and empty unit counts (to check for unusual events that could bias the results),

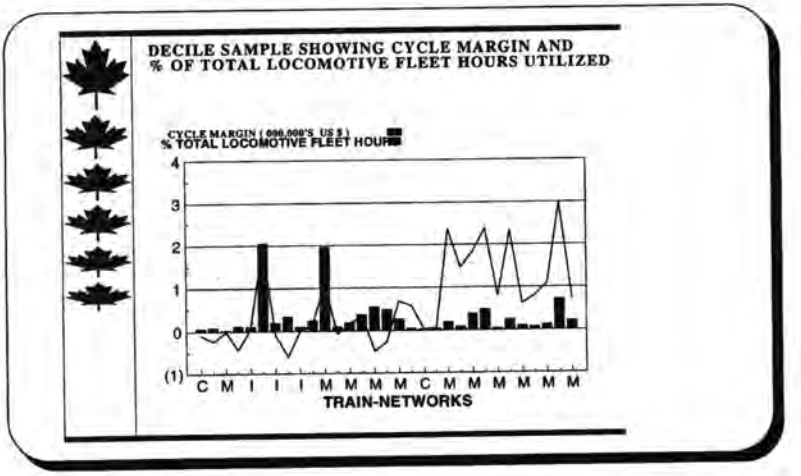
revenue, expense, and margin. Summary data elements for the train-network as an entity include an accumulation of revenue, cost, margin, train-start expense and contribution margin.

Viewing the railroad as a portfolio of train-networks inevitably forces the question of, "where are assets deployed and how much return are they generating?" The number of trains that comprise each train-network should differ, given the various type of service products and the level of segmentation chosen. In order to balance train-network summary statistics, which are proportional to the number of trains aggregated into a train-network, a CMROA methodology is useful. CMROA levels the playing field for all train-networks, regardless of product type or number of trains in each train-network. There exists a relationship between assets employed and return generated such that four natural zones can be distinguished and analyzed. The following graph is an illustration of how various train-network CMROA's can be compared to the percentage of locomotive fleet hours required to produce the return.



These zones are broadly classified in relatives terms of assets employed versus quality of return. The zones are: high asset employed / low return, high asset employed / high return, low asset employed / low return, and my personal favorite, low asset employed / high return. Analysis should begin with the high asset / low return and the high asset / high return. Both zones should be carefully

studied for opportunities to reduce assets employed. Assets can then be identified for higher return redeployment or eliminated from the asset base. When faced with a large number of train-networks, it is helpful to further segment the four zones into a set of decile plots. Below is an example of one decile showing percent of total fleet hours utilized, cycle margin for the train-networks, and type of service product.

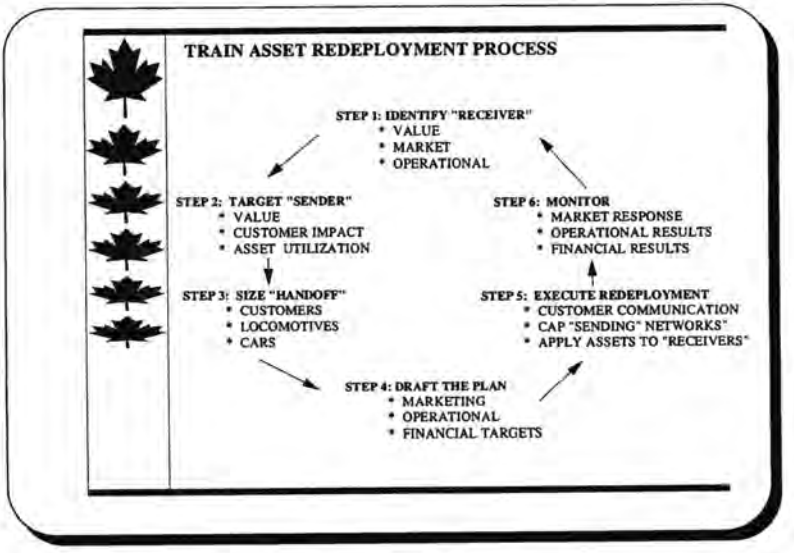


In the above example, train-networks are identified as product types serving the coal (C), merchandise (M), or intermodal (I) markets. A management decision should be made as to what relationship between total fleet hours consumed and cycle margin generated is acceptable, given the next best opportunity for the asset.

Use of this framework quickly identifies the strength and weakness of each train-network. The management temptation is to immediately target for redeployment the assets utilized within the weak train-networks. Discipline must be maintained such that the redeployment process initially targets higher return opportunities. Marketing needs to estimate the new opportunity demand and service requirements, while field operations needs to give input on the feasibility of operating a different network schedule.

If these efforts by marketing and operations show promise, then an estimation of the asset requirements for the higher return "asset receiver" and the selection of an "asset sender" train-network puts the redeployment process into action. The process is a continuous one, as new market opportunities are developed and

return improvements are made for financially weaker train-networks. The timely communication of financial results and new business opportunities will continually guide the redeployment process. Integration between marketing, operations, and finance is vital to a successful and sustainable redeployment process. A view of the operational elements of the train asset redeployment process is shown below.



When drafting and executing the redeployment plan, it is important to consider existing value generated, customer impact from a decline in service levels, and the degree to which assets are being utilized within the "asset sender" train-network. This allows a more precise handoff of assets, while maintaining "sender" cashflow and minimizing or capping the amount of assets that may continue to operate within the "sender" train-network. The train asset redeployment process requires the expansion of existing business opportunities and the development of new service products that create greater customer value.

SUMMARY

One of the most dramatic changes that can occur within an industry is its transition from a regulated to a deregulated competitive business environment. In the United States, the Staggers Act forever altered the manner in which surface transportation companies view their product offerings, their customer base, their

competitors and themselves. In the not too distant future, NAFTA will also significantly change the continental transportation playing field. Given an increasingly competitive marketplace in terms of service offerings and rate, railroads must begin to focus on three fundamental and distinct aspects of importance; unit of production definition and consistent operation, network capacity utilization definition and measurement, and network train income management.

An approach for railroad capacity and train income management has been presented based upon the fundamental unit of rail production, the specific train-start. From this building block, a framework has been created to understand and manage the more complex aspects of the business. Horsepower capping (HPCAP) will allow train and network capacity management that considers train schedule compliance, train efficiency factors, and train-start economics. It enables the monitoring of tonnage generated through train-starts versus tonnage demanded by the marketplace, thereby incorporating economic efficiency.

Train income management provides both a micro and macro viewpoint. The micro view presents a framework for decision support by marketing, operations and finance to understand assets employed, market mix, and price mix. The macro view allows the construction of train-networks that represent the collection of assets required to produce a return. Network value analysis considers each train-network as a financial entity consuming assets and generating returns in the railroad's portfolio of service products. By maximizing the return generated by these train-networks, or through the creation of new train-networks, shareholder value improves dramatically since a higher return is generated within an existing asset base.

Long term survival of any surface transportation firm is not guaranteed. For the railroad industry to survive in an extremely competitive environment, it must embrace and implement new perspectives on the business. Capacity and train income management provide the ability to quickly and profitably create increasing customer value, while also consistently growing shareholder value.

CHANGING TRACKS
A Challenge To Increase Railway Productivity And Competition With Common User Plant

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INTRODUCTION

The purpose of this paper is to challenge the conventional conception of railway re-structuring requirements in Canada. This paper advocates Common User Rail Plant as a private sector alternative to both maximize rail plant productivity and rail carrier competition.

In its simplest sense the Common User Concept is to provide multiple carrier operations on one railway line. Joint track usage and running rights provisions of the current National Transportation Act (NTA) encourage common use of rail plant.

The ability to both offer and use railway running rights facilitates system rationalization and productivity improvement by providing existing infrastructure owners with the ability to match plant more closely to needs. The recently authorized joint use of track separately owned by a partnership in the Ottawa Valley is a form of common user rail plant, but limited exclusively to CN Rail and CP Rail.

Potentially, imposition of joint track usage or shared railway running rights could go substantially further by making it easier for third parties to physically access railway infrastructure at controlled rates, thereby facilitating a market for new railway carriers who would not own infrastructure, but would use infrastructure owned by others. This is an attractive short term step to increase competitive options for all shippers, reduce potential for price discrimination against captive shippers and motivate much needed productivity gains.

In its most productive application, the common user rail plant concept should seek to separate the ownership of the tracks by a single entity from the common use of those tracks by many train operators. For example, extending the infrastructure partnership which CN and CP have proposed in the Ottawa Valley to embrace a "right sized" transcontinental track system would optimize plant productivity; and expanding their joint-use proposal to allow common-user track access for any rail carrier would open the current duopoly into a more competitive marketplace keeping carrier rates consistent with that productivity improvement.

CHANGING THE RAIL CARRIER COST STRUCTURE

Railways have high fixed infrastructure costs which result in average unit costs declining as rail traffic increases. Railway incremental costs remain below declining average total costs per unit given the pervasive tendency toward long run excess capacity versus demand for rail plant.[1]

These are "natural monopoly" characteristics to the extent that a railway would most efficiently supply at lowest total cost, the full market potential for train service, if it became the only supplier. A resulting price discrimination range is justified to elicit, with each echelon of additional traffic, increasingly lower unit costs for all traffic.

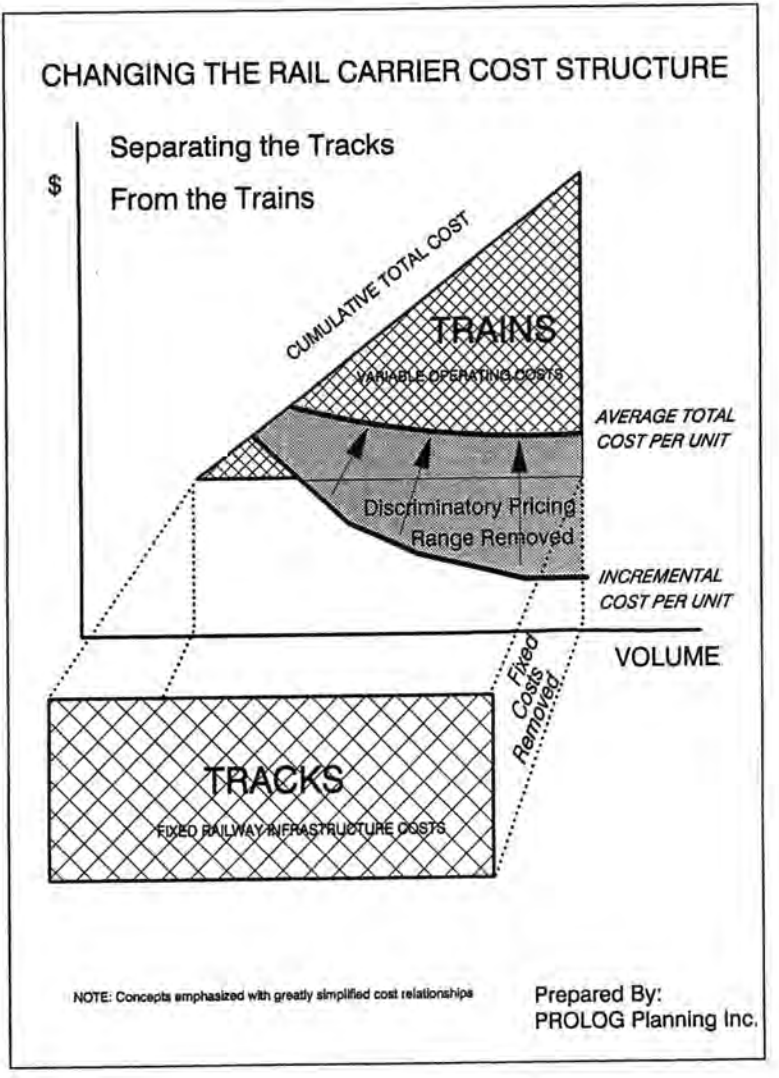
Discriminatory pricing is accomplished where markets can be differentiated and where volume priced down to incremental (variable) cost adds more to total revenue than to total cost. As long as additional traffic covers incremental cost and contributes something to fixed costs, the burden absorbed by other shippers is reduced. Everyone is better off.

Of course those shippers discriminated against may not perceive that they are better off. In the past, railway rate discrimination favoured low value bulk commodities having highly elastic demand for transportation, but many of those commodities are now considered to be relatively inelastic markets with no practical transportation alternatives. Consequently the captive shipper of low value resources is no longer a beneficiary of discriminatory pricing.

For such captive commodities, the railways' incentive now is to practice legitimate price discrimination to the maximum value of transportation, to the equally legitimate distress of shippers with no competitive alternatives. The challenge is to change the rail carrier cost structure to eliminate the incentive for price discrimination against captive shippers.

Railway infrastructure (right-of-way, track, tunnels, bridges, yards, etc.), associated maintenance, related property taxes, and required return on investment are largely responsible for the high fixed threshold in the railway cost structure. Removal of this fixed cost, subject to reimbursement through infrastructure user charges, would drastically alter the railway cost structure.

The effect would be to tremendously reduce the proportion of total costs that are fixed and to correspondingly raise the proportion of variable costs, primarily operating expenses which vary with traffic volume. This would largely replace the phenomenon of decreasing railway unit costs with a constant unit cost phenomenon much more similar to motor carriers. The following figure conceptualizes the change in railway cost structure that would result.[2]


CHANGING THE RAIL CARRIER COST STRUCTURE
Separating the Tracks
From the Trains
$
CUMULATIVE TOTAL COST
TRAINS
VARIABLE OPERATING COSTS
AVERAGE TOTAL COST PER UNIT
Discriminatory Pricing Range Removed
INCREMENTAL COST PER UNIT
VOLUME
Fixed Costs Removed
TRACKS
FIXED RAILWAY INFRASTRUCTURE COSTS
NOTE: Concepts emphasized with greatly simplified cost relationships
Prepared By:
PROLOG Planning Inc.

ADJUSTING THE SHIPPERS' RATE REGIME

At present, railway rate making reflects the fact that carriers must cover private sector investment, replacement and maintenance for infrastructure - especially with regard to the ongoing overhead cost of any unused capacity. For most other modes infrastructure remains in the public sector, and carriers need only recover the pay-as-you-go costs incurred through user charges (taxes and tolls).

Without traffic contestability to influence pricing toward the lowest levels consistent with return of costs and reasonable profits, railway pressure to set rates as high as possible will increase the likelihood that rates may actually exceed what the traffic can bear - especially where it is difficult to differentiate shippers' true value of transportation service. As a result the traffic may not move, or will be moved in the short term at rates which make it unattractive for the shipper to expand, re-invest in, or even continue, current production capacity.

Changing the railway cost structure could change railway ratemaking. If incremental (variable) cost is made nearly equivalent to average total cost, then a rate regime to shippers based upon average cost of service would be in order, replacing the current discriminatory price structure.

The regulatory implications are equally significant. Regulatory interference on behalf of captive shippers is generally justified on the basis of "natural monopoly" characteristics due to high fixed costs. Elimination of those characteristics would also eliminate the need for any regulatory recourse by captive shippers.

Ideally, railway tracks would be made available on the same basis as toll roads to truckers. By eliminating high fixed threshold costs from carrier cost structures, entry barriers to rail carrier operation would be lowered, and competition for the shipper's business expanded. If existing competition was not adequate to achieve reasonable rates, a captive shipper could raise the prospect of becoming his own carrier.

ADAPTING TO RAIL PLANT USER CHARGES

If fixed infrastructure costs are removed from the carrier cost structure, they must be replaced by some form of rail plant user charge. To the extent that rail carriers are uniformly charged for fully allocated costs of rail plant usage, equalized across all types of train service, higher transportation rates may be passed through to some shippers. However, the potential economic dislocation which this could entail should be more than offset by the innovative impact of open access to tracks, which would reduce costs and widen the range of cost-effective options for all shippers.[3]

The economic phenomenon of declining unit costs would not simply disappear by separating railway carrier operations from railway infrastructure ownership. Rather it would be transferred to the new owner of railway infrastructure - whether public or private.

Under this infrastructure regime though, it would become more difficult for the track owner to differentiate markets in the traditional way. Price discrimination to maximize volume economies of scale would still be desirable, but should more likely be based on the characteristics of trains, taking into account their different requirements for track capacity.

Market differentiation for pricing to carriers might become the priority of the train, rather than the value of a commodity or its susceptibility to competitive alternatives. The railway infrastructure owner could also place greater emphasis on cost-based, "peak responsibility" pricing, charging higher capacity costs to trains operating in peak seasons on congested lines and lower costs to trains using off-peak, or alternate route, excess capacity.

Such pricing would encourage efficient use of rail plant and, through the resulting pattern of demand for capacity, provide guidance for infrastructure investment - or disinvestment.

RIGHT SIZING CANADIAN RAIL PLANT

Elimination of competing infrastructures could improve productivity (maximize throughput over minimized plant) from two perspectives. First, where there is low traffic density and correspondingly redundant track capacity (e.g., north of the Great Lakes) and second, to optimize use of existing capacity where there is high traffic density (e.g., through the Fraser River Canyon).

It is the first perspective (low density) which always receives the most attention in terms of both branch line abandonments and main line consolidations because it occurs where traffic decline is eliminating economic viability. From the second perspective (high density), sufficient economic viability and potential traffic growth can cause optimization opportunities to be overlooked.

The conventional wisdom is that while low density operations may be merged onto common plant in the east, that with higher density in the west, CP and CN will maintain competing infrastructures. This in turn must lead to less than optimum total plant operations, because both railways will invest in and maintain track that matches their individual operating constraints against their individual traffic assumptions - which may assume more traffic and correspondingly more capacity requirements than would result from consolidated traffic demands allocated to the most efficient plant use.

While two competing infrastructures in Canada may improve their rail plant productivity, they can never optimize it. Traffic diverted to one carrier will always increase the surplus capacity (and plant inefficiency) of the other.

The productivity problems of competing infrastructures can be reconciled with joint plant usage. However, the evidence to date is that CN and CP cooperate only as a last resort - where they are no longer capable of separate economic survival, as in the east.

In the west, where the question of economic survival is not quite so critical they can afford to continue wasting resources! Ironically, compared to marginal eastern traffic susceptible to multi-modal competition, the high volume, relatively profitable and largely captive western rail traffic is actually precluding optimum plant productivity.

The rationale for right sizing Canadian rail plant does not stop in the east. Ultimate implementation of a trans-continental common user rail system would allow the full benefits of plant consolidation to be realized right across the country. The National Transportation Act Review Commission has proposed a hierarchy of flexible outcomes for transcontinental railway rationalization which, as reinterpreted below, could well foster a commercially viable common user track system in Canada.[4]

RAILWAY RATIONALIZATION HIERARCHY

I

NATIONAL COMMON USER RAIL SYSTEM - A single trans-continental track system of the minimum infrastructure required to match the maximum train service demand.

II

REGIONAL FEEDER RAILWAYS - Shortline railways conveyed from surplus transcontinental rail system trackage and dedicated to/supported by single, or several, shippers.

III

RESIDUAL PUBLIC INTEREST RAIL LINES - Uneconomic branch or main line railways found to be in the public interest and retained at public expense in lieu of abandonment.

SEPARATING THE TRACKS AND THE TRAINS

Traditional concepts of rail plant versus train operations are changing in Canada. Approval of a separate partnership to own rail plant in the Ottawa Valley that will be jointly used by CN and CP train operations, is a startling indication of the new willingness to look at unconventional solutions for problems of productivity and competition.

The National Transportation Act Review Commission has recommended that separation of tracks and trains be taken even further with a pilot project to test the common user concept.

> "If the rail plant were separated from railway operations and administered as a separate entity, operating companies could compete on the publicly owned rail plant. This would be comparable to the position of motor carriers, who compete on publicly owned highways. . . . we are impressed with the prospect of competition on a single rail track which this type of arrangement could bring to pass, and the resolution of the problem of securing effective intramodal competition in railway transport"
>
> - NATIONAL TRANSPORTATION ACT REVIEW COMMISSION

Similarly, The Royal Commission on National Passenger Transportation has focused on third party track access to foster multiple carrier competition; and raised a critical concern that fair treatment of competing traffic could be jeopardized without neutral track ownership separate from carrier operations.

> "In Canada, separating ownership of rail track and carrier operations is more important as a freight issue . . . Nevertheless, we view effective open access and equal treatment of traffic as vital. Should the application of Recommendation 6.7 - that legislation on track access be strengthened and apply to passenger rail as well as freight - not prove satisfactory, then we would recommend that the federal government separate ownership of track and dispatch from carrier operations."
>
> - ROYAL COMMISSION ON NATIONAL PASSENGER TRANSPORTATION

This separation is already underway in Europe where most railway systems are publicly owned. The European Union has proposed open entry onto each national railway system, for third party train operators as well as all national railways. Sweden and France have already begun in this direction.

In Canada, highway, air and marine infrastructure is already separated from carrier operations. A similar policy toward railway infrastructure would promote a more competitive market in train operations; and more clear, demand-related signals for "right sizing" of separately owned track.

Compared to the United States, the mix of privately owned versus crown owned infrastructure in Canada presents a unique opportunity to promote Canadian rail carrier competition - whether a separated track system becomes wholly public or wholly private or remains a combination of the two.

CN infrastructure, for example, is already in the public sector and could provide the common user rail plant for a public track agency. Strategic CP routes could be consolidated with CN routes as funding became available. Such consolidations with current CN infrastructure might actually be self-financed through the sale of CN train operations, which would then use the optimized track system in common, and in competition, with all other rail carriers.

"Both CN and CP would be primarily freight carriers with neither one owning railway track. At that point, CN should be privatized to create fair competition for CP, and the proceeds of the sale would help pay for the purchase of the CP infrastructure."

- ROYAL COMMISSION ON NATIONAL PASSENGER TRANSPORTATION

CP infrastructure, as the opposite example, is already in the private sector and could provide the kind of commercially viable private track system advocated in this paper. In return for a franchise to provide the minimum rail system required to meet total demand for track access, CP could be allowed to collect a utility rate base type of return from multiple users of its railway; or CP could competitively sell its train operations in an open market on tracks owned by someone else - but, without an "arms length" relationship, not both.

To maximize neutral operation of market forces and corresponding productivity incentives, CN and/or CP would probably have to choose whether to provide tracks or run trains.

From a separate rail plant perspective, it should not be impossible to make investment and maintenance attractive to the private sector for commercially viable infrastructure; and from a separate carrier operations perspective, running competing train services in common on a single rail system should not be a technical problem.

Train dispatching, priority and control of movements, can be accommodated as effectively as air traffic controllers manage multiple aircraft movements across the country. Strict enforcement of rolling stock safety standards and, as with airline pilots and truck drivers, properly licensed train and engine crews, should curtail any concern about unsafe operations. Otherwise, the only entry requirement would be a locomotive, cars and crew.

INCREASING THE CONTESTABILITY OF RAILWAY TRAFFIC

The practical necessity of increasing infrastructure productivity through much needed rail plant rationalization is poised to drive Canadian transportation policy by default. The countervailing requirement is to offset the threat of consolidating market control with a practical approach to increased rail traffic contestability.

In practical terms the infrastructure problem is too few trains chasing too much track. In practical terms the infrastructure solution is to match track supply with train demand by "right sizing" the consolidated plant of competing carriers.

The practical result should be increased railway productivity with combined traffic on reduced plant - which lowers unit costs and increases railway competitiveness. That is, lower costs mean lower rates and/or increased profitability.

How, then, does increased railway competitiveness translate into increased shipper competitiveness? Without carrier competition to promote productivity sharing with shippers, it may not.

Certainly getting rid of competing infrastructure by itself does nothing to increase competition; and, the duopoly of Canadian transcontinental carriers will only further concentrate market control to the extent that operations, as well as infrastructure, are merged.

As a practical matter, INCREASED RAILWAY COMPETITIVENESS should not be confused with INCREASED CARRIER COMPETITION. From a Canadian railway perspective, if you can eliminate competitors you increase your own competitiveness - but you potentially put the competitiveness of your Canadian shippers at risk.

So where is the competitive balance? Moving from a railway duopoly to a monopoly market does nothing for the much vaunted role of market forces in replacing the legitimate requirement for some sort of regulatory recourse for captive rail shippers. Especially if operations as well as infrastructure begin to be merged, Canada is moving backward toward the requirement for economic regulation to avoid increased potential for "natural monopoly" abuse.

Re-regulation is a not an attractive option, but the veil of competition in which the Canadian railway industry wraps itself is really quite thin.

CANADIAN RAILWAY COMPETITION UNVEILED

POINT	and	COUNTERPOINT
o THE RAILWAYS COMPETE FOR TRAFFIC WITH CONFIDENTIAL CONTRACTS.		o BUT IF YOU ARE A SHIPPER THE CARRIER KNOWS YOUR COMPETITORS' RATES AND YOU DON'T.
o THE RAILWAYS HAVE PLENTY OF COMPETITION FROM OTHER MODES.		o BUT BULK SHIPMENTS LIKE WESTERN GRAIN, SULPHUR, POTASH AND COAL ARE NOT CONDUCIVE TO TRUCKING HIGH VOLUMES OVER LONG DISTANCES AND BARGING IS NOT AVAILABLE.
o THE BULK SHIPPER CAPTIVE TO A SINGLE RAILWAY CAN ALWAYS USE TRUCK RELOAD OPTIONS TO ACCESS ANOTHER RAILWAY.		o BUT THE ADDITIONAL TRUCKING AND REHANDLING COST WILL BE A HIGH PRICE TO PAY FOR COMPETITIVE ACCESS
o THE RAIL CAPTIVE SHIPPER CAN ALWAYS USE COMPETITIVE ACCESS PROVISIONS OF THE NTA (1987) FOR NEGOTIATING LEVERAGE.		o BUT IF THE RAILWAY CALLS YOUR BLUFF REMEMBER THAT ONLY ONE SHIPPER HAS SUCCEEDED WITH THE LEGAL CHALLENGES AND ADMINISTRATIVE PROCEDURES TO ACTUALLY PUT IN PLACE A COMPETITIVE LINE RATE.

Common Use of a single consolidated rail system by many competing carriers could bring the market balance to competitiveness that benefits all stakeholders.

THE COMPETITIVE BALANCE

Rail plant productivity improvement from elimination of competing infrastructure and consequent increase in Canadian railway competitiveness;

- Balanced By -

Countervailing market forces brought to bear, especially for captive shippers, with physical competitive access to other carriers' trains - not just to administrative procedures under the NTA (1987).

While the Ottawa Valley Partnership proposal for joint track usage at least maintains current levels of competition, without open access to other carriers it can never really provide long term traffic contestability. To the extent that deregulation seeks to maximize market forces and to minimize regulatory intervention, that result can only be realized with the prospect of other carriers contesting the CN/CP duopoly.

Competitive access provisions of the NTA (1987), are only token remedies to overcome a non-competitive situation which could be largely reconciled with open access to common user rail plant. Third party access must be available to other rail carriers - initially to provincially and/or federally chartered railways; perhaps even to U.S. railways and ultimately to any "fit, willing and able" train operator.

This is the level of railway traffic contestability required to guarantee the benefits of a fully competitive market; not just token competition between the two transcontinental carriers, or obscure recourse to regulatory procedures that seek to emulate physical competitive access.

KEEPING THE TRACKS IN THE PRIVATE SECTOR

The idea of third party access to common user railway tracks generally conjures up the negative vision of a public track agency - which in light of current fiscal constraints on government involvement, is probably a non-starter. Even if a public track agency could be funded, a residual problem is the tendency of anything public to become subject to politics, more than economics, which inevitably entails "public interest" rather then market driven demands.

Why not structure a private sector track system separate from train operations? Under proper conditions, providing common user plant could become at least as financially attractive as running trains on it. Paramount among these conditions is the unfettered ability to optimize plant productivity.

OPTIMIZATION OF COMMON USER RAIL PLANT

- Not only -

By consolidating traffic from low density operations onto rationalized infrastructure;

- But also -

By allocating high density traffic to best use available capacity without duplicating investment and maintenance.

However, without the neutrality of publicly provided infrastructure available to other modes, what would protect rail carriers from monopoly abuse by a single private sector track provider? No matter how many competing carriers bring the positive influence of market forces to bear on productivity and rates, the common user plant would still be a monopoly.

There is undoubtedly a trade-off between the attraction of a private sector track provider and the risk of monopoly abuse by that track provider. However, the impact of potential monopoly abuse by a single track provider, separated from many competing carriers, is considered to be far less than the concentration of market power with control of both tracks and trains under just one or two railway companies.

The most practical solution may be to facilitate the "natural monopoly" benefits of least cost track access for rail carriers through a conventional rate base utility approach with common user tolls published and subjected to "just and reasonable" review by a regulatory body.

Unfortunately this does nothing for the negative incentive toward public utility "cost of service creep" which competing infrastructures presumably minimize; and is admittedly inconsistent with the desire to eliminate regulatory interference rather than to increase reliance on it. However, if as Canadian railways argue, there already is infrastructure competition from American railways, the prospect for monopoly abuse of rail carriers may not be that great.

The cost of an acceptable trade-off to keep both rail track and train operations in the private sector might be made more acceptable by borrowing from recent regulatory restructuring experience in the North American gas transmission industry. Although not perfectly analogous, in that restructuring, pipeline companies traditionally moving only their own gas were required to provide open access for any gas movements. At the same time ownership of gas production and transmission facilities was required to be separated to avoid the conflict of interest in owning pipelines and distributing natural gas.

The result has been dramatically increased competition and reduced consumer costs. Economically justified discriminatory pricing (subject to regulatory review) differentiates the market with fully allocated tolls for contracted capacity and marginal cost tolls for spot gas.

"Arms length" operation of trains separate from ownership of track might accomplish a similar result with little or no regulation. One implementation model could be an extended version of the Ottawa Valley Rail Plant Partnership, subject to allowing third party access by any train operators and perhaps their becoming a member of an "arms length" track partnership, say in proportion to the number of trains each operated. Alternatively, If CP or CN were franchised to provide a single transcontinental common user rail plant, allowing continued train operations, sufficiently at "arms length" to maintain neutrality, might help cap user charges.

The common user concept need not be rigid and can be worked out to meet any number of perceived problems. American railways could initially be excluded as operators. More amenable might be the option for single shipper short lines to operate trains over common user rail plant rather than to interchange with CN or CP. Most likely, though, CN and CP would continue to operate most trains most effectively.

CONCLUSIONS

Railway competitiveness cannot be legislated. It derives from productivity improvement best driven by full exposure to market forces. Deregulation encourages market competition both to increase productivity and for fairness in pricing.

By definition competition cannot work in captive markets. Therefore the railway cost structure which still fosters discriminatory rates and/or the infrastructure ownership system which can leave rail shippers captive to a single carrier are due for change.

Separating the trains from the tracks would create a new market dynamic putting railway carriers on close to the same competitive footing as highway carriers. With the opportunity for many carriers to access all shippers, market forces would operate more freely and allow the current benefits of more perfect competition among highway carriers to reach railway shippers as well.

The important point is that demand responsive optimization of common user rail plant is an achievable outcome with some creative re-structuring. If conventional railway conceptions can be overcome, there is a real opportunity to establish a unique, albeit different from the U.S., structure for maximum operation of market forces to the benefit of true railway competitiveness and carrier competition in Canada.

ENDNOTES

1. To further simplify this discussion, fixed costs are assumed to be railway infrastructure only (right-of-way, track, tunnels, bridges, yards, etc.), and incremental costs are assumed to be the variable costs of operations (equipment, fuel, labour, etc.). However, a more complete economic treatment would recognize that many "fixed" costs are variable in the long term (since the amount of infrastructure can be decreased or increased to reflect traffic requirements), hence that long run variable costs include some costs of a "fixed" nature; that some "variable" costs are relatively fixed or "constant" in the short run and that variable, incremental or marginal costs are not the same.

2. For a more complete discussion of railway regulatory economics and the challenge of bringing market forces to bear on behalf of captive Canadian shippers please see:

PROLOG Planning Inc., Comprehensive Review of the 1987 National Transportation Act and Other Legislation: Working Paper No. 1 - An Overview Study (Sections III and IV), for Alberta Transportation and Utilities, June, 1992.

3. For another view on the potential pricing impact of changing the railway cost structure please see:

TRAVACON Research Corporation, Comprehensive Review of the 1987 National Transportation Act and Other Legislation: Working Paper No. 2 - Rail Provisions Study (Chapter 6), for Alberta Transportation and Utilities, June, 1992.

4. For a full review of the plant rationalization approach as proposed in Recommendation No. 8 please see:

National Transportation Act Review Commission, COMPETITION IN TRANSPORTATION - Policy and Legislation in Review, January 1993, Vol. I, pp. 88-94.

SEPARATING TRACK FROM OPERATIONS: A LOOK AT INTERNATIONAL EXPERIENCES

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Background

Recent years have witnessed a significant shifts in transport policy (Button and Keeler 1993). There has been, as part of what has been called a 'general withdrawal of the state', an almost universal move towards market liberalisation and the transference of significant parts of transport supply from the public to the private sector. Of particular interest has been the contemplation, and sometimes, implementation of the standard model in road transport for use in the rail sector – namely a separation of track and fixed infrastructure from operations. This would reverse the existing structure whereby, in most countries, these functions have been vertically integrated. In some European countries, in particular, this interest in severing the link between infrastructure and operations has often been connected with privatisation since much of the rail network has been, at least in recent times, in public ownership.

The aim of this paper is to explore some of the key issues which underlie this upsurge in interest in treating modes such as rail in much the same way as road transport has always been handled. In particular, it seeks to explore the ways in which operations may be distanced from infrastructure administration and the types of policies which have been adopted, or are in the process of being adopted, around the world in efforts to do this efficiently. Surprisingly, in relation to the amount of recent analytical work done on other aspects of transport policy, the issue of separating operations from track is comparatively under researched[1]. This should not, though, be taken to mean that the idea is the result of some sudden inspiration; indeed seminal papers on the subject appeared in the UK over half a century ago (such as Mance 1940) and the issue has been raised in previous transport policy debates in countries such as Canada[2].

At the outset it is important to delineate the scope of the paper and to draw some boundaries. The concern here is with the explicit separation of operations from track and other fixed infrastructure (such as signalling) but it does exclude some forms of such separation. In particular, there are many countries with multiple domestic rail road suppliers which have long standing agreements allowing one operator to buy a path through another's track network. In others, such as with Canada's duopoly structure, there is a history of joint ownership of terminals as well as track arrangements. Similar agreements exist at the international level to allow operators to provide cross-border services. Indeed, in this latter context the European Union now requires national governments to allow open access to their rail networks and to produce separate track accounts to prevent unfair pricing (Commission of the European Communities 1991). Finally, there are also a number of special arrangements at many tourist locations whereby special trains hire space on track owned by a vertically integrated rail road – the Orient Express between London and Venice being an example. We are, however, much less concerned with these types of arrangement than with the direct removal of operational activities from the ownership of track.

The paper initially proceeds by looking at the economic justifications for the vertical separation of the responsibilities of the fixed infrastructure and the operations of

railways. There is also an examination of the privatisation issues which are accompany the separation debates and policy changes. The paths of disintegration being pursued by countries around the world are categorised and explained. Finally there is a discussion of some of the problems which are involved in a separation strategy together with some observations on the types of regulation which may be required to tackle them.

Economic Justifications for Separation

Initially, it seems reasonable to consider why the matter of removing vertical integration in rail transport has suddenly interested so many governments around the world. While there are naturally a number of local reasons for this interest, not least the problems encountered by some governments in financing their currently integrated systems, some key common features seem to emerge.

Efficiency has been widely held to be a prime motivation underlying recent market liberalisation and privatisations in all spheres of transport supply and this extends to arguments for separating rail operations from track. In fact, though, there are at least two independent issues here.

First, there has been a gradual increase in concern with what can loosely be described as supply side economics and with the costs of providing transport services. This has entailed a shifting of emphasis from normative, distributional considerations to matters of positive economic efficiency. What this has meant in transport policy terms is that, for a variety of reasons[3], the so-called 'Anglo-Saxon' approach to transport policy has gained ground against the 'European' philosophy. Whereas the former is primarily directed at providing the transport services customers demand at the lowest possible cost, the European philosophy sees internal transport efficiency as secondary to the achievement of wider, often distributional, objectives – as, for example, typified by the French notion of *droit de transport*. and the concept of *gemeinwirtschaftliche Aufgabe* of the German railways[4].

Linked with this general change in emphasis, and more directly to our interest in vertical separation in rail supply, is a shift in the attention policy makers have given to various forms of efficiency itself. This is a change which, as with most sea changes in public policy, also transcends the narrow confines of the transport industries. The interpretation of the term 'efficiency' has, of course, many dimensions and, in the context of public policy, the economist's traditional taxonomy has proved to be important in the revision of objectives (see Table 1).

Table 1. The nature of economic efficiency

allocative efficiency	– requiring first or second best pricing of the final products
scale efficiency	– requiring possible limitation on sub-optimal entry to the industry
technical(X) efficiency	– requiring cost minimisation by the incumbent firms
product choice and dynamic efficiency	– requiring innovation by incumbents

One strongly defensible interpretation of European and Canadian privatisations, for instance, is that they represent a change in emphasis from the first two categories of efficiency described in Table 1 to the second two. The traditional arguments in favour of the large size of the public sector in many Western European and other economies rested on the assumption that nationalisation and public enterprise organisation were essential to avoid consumer exploitation by natural monopoly utilities and also to ensure that, so-called, strategic industries behaved in the national interest. The industries themselves were usually urged to adopt second best pricing policies, such as Ramsey pricing, in order to simulate optimal resource allocation even though the industries, through their information monopolies, could retain the final say over the level and structure of marginal costs. To ensure scale economies could be reaped, entry was generally discouraged by other than approved suppliers which in practice often meant state owned monopolies.

The change in attitude has come about ,in part, due to mounting concern about the levels of subsidy which have often either explicitly or, in the case of cross subsidies, implicitly arisen as a result of this policy and with the accompanying questions regarding of the value for money achieved[5]. In a more dynamic framework, there has also concern that many of these rail industries have been losing market share to newer technologies and have themselves been slow to innovate either in the technology deployed or the management structures adopted.

There has been a further element to this trend, and one of more particular relevance to the railway industry. Many of those that had initially supported public ownership of rail or, as in the US and Canadian case, strict regulation of vertically integrated rail supply provision had done so on arguments concerning the intrinsic nature of the costs incurred by the industry. It was traditionally assumed that, because of high fixed costs in railway supply, there are economies of scale in railroad operations and that, as a result, some form of controlled large scale supplying agent (or agents) was thus optimal (an idea which goes back at least as far as Lardner 1850 in the academic literature). This line of argument supporting the natural monopoly hypothesis was further supported by arguments about the multi-product nature of railways which provide a variety of origin and destinations service, offered at different times, often for both passenger and freight customers, and the consequent need for horizontal integration which stems from this. This can be seen as essentially an extension of the Coasian (Coase 1934) argument of internal transactions cost minimisation.

The more recent econometric evidence brought about through improved modelling and estimation procedures[6], though, indicates that in the US (see Table 2 for a summary of some of this evidence) and in many European countries[7] that there are limited scale economies overall except for very small rail roads,. What does exist, however, are very significant economies of density[8]. In short, what this effectively means is that the economies of scale that are to be found are associated with the rail infrastructure (track and signalling) and not the operations making use of this infrastructure. Further, some of these studies (for example, Friedlaender *et al* 1993) have found that these operational economies are increased when the capital stock is optimised. In such circumstances, the logic suggests that to obtain high levels of dynamic and X-efficiency there should be competition for the provision of these services, since there is little tendency toward natural monopoly in providing rail services. The economies of scale argument (at least up to a certain network size) still seems to applies to the track, however, and the associated problems of natural monopoly, therefore, remain in infrastructure provision. The argument, however, for vertical integration of operations and track is broken.

Table 2. Economies of scale in US freight transport (1= constant returns)

	Data base	*Returns to Scale*	
		Fixed haul and trip length	*Increased haul and trip length*
Friedlaender and Spady (1981)	1968–70	0.88–1.08	1.07–1.37
Caves *et al* (1981)	1963	1.01	1.13
Harmatuck (1979)	1979	1.01	1.02
Harris (1977)	1977	0.93	1.02
Keeler (1974)	1974	1.01	–
Caves *et al* (1985)	1951–75	0.98	1.00
Friedlaender *et al* (1993)	1974–86	1.27*	1.21**

* Short run; **Long run

Finally, there is increasing evidence that centralised control of publicly owned railways leads to higher levels of internal cost inefficiency. Table 3 provides some evidence on this with regard to nineteen European railway companies. Taking an index of overall autonomy and comparing it with a measure of overall efficiency, Gathon and

Pestieau (1993) find a high positive correlation to exist. While this, in itself, does not provide a case for vertical separation, it does suggest that the efficiency of any aspect or segment of rail activity is likely to improve if it is freed from high degrees of regulatory intervention. Vertical separation provides more scope for achieving this.

Table 3. Efficiency of European railways 1986–1988

Railway	*Country*	*Autonomy (%)*	*Gross Efficiency*
BLS	Switzerland	100.0	0.873
SJ	Sweden	80.0	0.835
BR	UK	76.3	0.877
NS	Netherlands	70.3	0.897
SNCF	France	69.8	0.875
FS	Italy	67.0	0.830
CFF	Switzerland	66.0	0.883
SNCB	Belgium	64.5	0.813
CP	Portugal	64.0	0.856
CFL	Luxembourg	63.5	0.731
DB	Germany	61.0	0.802
TCDD	Turkey	60.0	0.888
CIE	Ireland	58.3	0.862
RENFE	Spain	52.3	0.822
CH	Greece	47.3	0.743
NSB	Norway	45.3	0.702
OBB	Austria	41.8	0.785
DSB	Denmark	41.5	0.693
VR	Finland	40.0	0.828

Source: Gathon and Pestieau (1993)

Role of Privatisation

Of course not all of the recent interest in vertical separation of rail functions has also involved debates over privatisation but many have embraced at least a degree of interest in privatisation. In practice, the term privatisation is, however, freely used but seldom is specific in meaning (Gomez-Ibanez and Meyer 1993). It is sometimes taken to mean the direct transfer of assets from the public to the private sector (as with Air Canada)[9]. Others have preferred somewhat broader definitions which include deregulatory measures opening up former public sector monopolies to private sector competition (as with European aviation markets since 1993). Further, as with the UK bus sectors, such deregulation is very often followed by the transference of ownership from the public sector supplier to private ownership. In other cases, as with many European urban transit systems (Button and Rietveld 1993) the franchising out of services to the private sector is brought within the remit of privatisation. Equally, there are franchising arrangements which involve private companies tendering for transport services formerly directly provided by local or central government. The franchising system can also extend beyond simply providing operating services to the construction of major pieces of infrastructure under, what the French term, 'concessionaire' arrangements. Publicly defined infrastructure is built and operated by a private company but reverts to public ownership under pre-agreed terms (for example after a set time period, as with the Channel Tunnel). Privatisation is sometimes seen as involving the retention of public ownership but with private capital financing – ventures such as the French TGV high-speed rail network have been so funded. Alternatively as with German and Japanese railways it has meant the creation of public companies albeit with 100% government share holding in the short term.

The nature and division of public and private sector participation is important in many of the debates which have surrounded the discussions over rail track/operations separation. Much of the interest relates back to the basic objectives of policy. If they are

primarily to do with dynamic and technical efficiency then the degree and nature of both regulation and public ownership are clearly important. Available evidence suggests that unit financial costs tend, in virtually all conditions, to be lower with more liberal regulatory regimes and less public sector participation. The detailed nature of the regimes do, however, also seem to bring about variability in these costs. The issue when efficiency is the key criteria is thus one of the form privatisation should take and the ways in which transference from the public to the private sector is most smoothly achieved. As can be seen from the earlier discussion, there are many options available for policy makers to consider.

In contrast to this, in countries such as France, where the priorities are still more to do with raising funds for new investment, ownership considerations are only relevant as far as they influence the flow of capital to finance new constructions. If private capital markets offer a greater and smoother flow, and at lower shadow price, then these tend to be tapped by public sector rail companies. Equally, this means that with much less interest in economic efficiency, concerns over the desirability to separate operations from infrastructure are less intense.

Methods of Separation

There have been a surprisingly large number of alternative options examined around the world regarding the form of vertical disintegration of the railways might take. Further, a number of different systems have already been put in place or are about to be implemented. While much of the theoretical literature focuses on the idea of the monopoly supply of track (often by a public agency) with competition for access to that track, and this has been the favoured approach in, for example, the UK, in practice there have been significant deviations from this. Our concern here is in placing the schemes which are currently operational, or at a stage of near implementation, into context rather than looking at those which are still theoretical 'will o' the wisps'. What is emerging is a taxonomy of alternatives which can, at this stage, be classified the following way;

Public operations/private track

We can take the USA as the main example of public operations on privately owned track. Amtrak was created in 1971 as a mixed public/private passenger concern[10] which contractually hires track from the private freight railroad companies[11]. Indeed, one of the primary aims of creating Amtrak was to remove the financial burden of providing unprofitable passenger services from a predominantly freight railroad system. Another was to meet the public obligation of providing that passenger rail service as part of a 'balanced transportation system'. The contractual arrangements between Amtrak and the railroads providing track infrastructure have varied with time but initially involved payments by the latter based upon the 1969 passenger deficit with the them giving equipment as part of their payment. Some government finance was also given to Amtrak.

The system, though, provided no real mechanisms for subsequent rationalisation or for reinvestment in run-down capital. Operations by Amtrak were often initially hindered by some freight railroads which gave their freight trains priority over passenger services. The resultant financial problems confronting Amtrak have not entirely been resolved despite the fact that the 1976 Railroad Revitalisation and Regulatory Act transferred the Northeast Corridor Boston-Washington line and some branch lines to Amtrak, removing the need to negotiate with fright railroads over access to these links. In addition frequent injections of public moneys have been given to up-date rolling stock and to improve the bed. With the exception of the Northeast Corridor, inter city passenger rail transport in the US holds only a very small share of the markets where it is offered.

The Canadian experience with the inception of VIA Rail in 1977 is similar. Again the aim was to device a strategy which would remove the burden of loss making passenger services from essentially freight railroads and at the same time maintain adequate passenger services. VIA Rail was established with the aim of providing transcontinental

services and services on the Windsor–Quebec City Corridor. As with Amtrak it bought track space. In this case, it cost about 5% of the full financial cost of the track supplied by CN (although, of course, this was a publicly owned corporation) and CP with variations by tonne-kilometres covered and by specific link. Again the system has not proved successful in generating sufficient patronage to keep a full network operational.

One of the features of both the US and Canadian experiences is that the organisational structure adopted was an attempt to graft a passenger services onto networks of integrated freight railway companies. Equally, one might add that the policies were not designed with the objective of maximising economic efficiency but rather to resolve serious fundamental problems with wider rail transport policies. In consequence, while in theoretical terms, one could easily say that the outcomes of these separations have simply confirmed *a priori* economic expectations, namely that public monopoly supply of operations is unlikely to maximise efficiency, this must be tempered by the peculiarities of the institutional arrangements which have existed. There has obviously been little incentive for the passenger operators to be flexible and innovative, but equally it would have been strange for the track suppliers to do other than pursue strategies which would favour their own freight activities.

Private monopoly operations/public track

New Zealand has been innovative in several respects with regard the way transport infrastructure is treated; it has, for example, a direct user charge for road freight transport and extends this to rail transport. Considerable emphasis has been placed on retaining possible scale and network benefits of co-ordinated operations, including linking ferries services. The core policy in New Zealand has been to attempt to inject greater efficiency and open up the resource base by privatisation of the operations of New Zealand Rail (both passenger and freight) through a trade selling to a New Zealand–US consortium. At least part of these operations are ultimately likely to floated on the stock market. The shadow of competition is retained by the ability of the New Zealand government, which still retains ownership of the track, to introduce other operators if freight and passenger traffic falls below critical levels. Further control is possible through the level of national and regional subsidies provided to the operator.

A particular variation on this theme was been introduced in Argentina in 1991. Because of the run-down nature of much of the system considerable emphasis has been put on mechanisms which will generate investment. As a result, Argentine Railways has granted, after tender, a number of area monopolies for freight operations. These private companies will invest in up-grading the facilities and maintain operating rights for stipulated periods on track still publicly owned. The necessary economic rent for the investment is anticipated to come from the market dominance each company enjoys. In particular, differing gauges make is impossible for the three monopolies so far created to encroach on each other's domain.

Private competitive operations/public track

In contrast to the idea of a monopoly operator buying capacity in a monopoly (or oligopoly) track market, the UK government, in line with several other European countries, has been exploring the possibility of privatising more of the nation's rail operations but with retained public ownership of the track (UK Department of Transport, 1992a,b)[12]. Given the greater importance rail passenger transport has in Europe the reasons why this is being done are a little more complex. It also comes at a somewhat later time than the North American changes. In part, the interest should be seen as a device to attract new investment into the system – private firms being considered to have better access to capital – but equally there is concern that efficiency is not maximised under public ownership and that private sector involvement would reduce the element of shelter currently enjoyed by British Rail. The degree to which a private system would respond to consumer demands and provide the price–quality mix the customer wishes, of

course, depends on the degree of effective competition available. It is considered in the UK, in particular, that a monopoly private undertaking is unlikely to prove more dynamic or market oriented than a nationalised concern. This, is however, open to some debate. The extensive UK motor way network which parallels many of the InterCity lines coupled with a reasonable, and effectively deregulated, domestic air transport network over longer routes means that InterCity operations are, in fact, open to actual as well as potential competition within a privatised railway structure.

The method of privatisation selected (as expressed by the Railways Act 1993), at least at the outset, is to establish a separate Railtrack Company to control the basic rail infrastructure[13] and to then franchise a number of services currently being supplied by British Rail.[14] In the longer term an increasing number of services will be taken from British Rail. A Franchising Authority will be responsible for the process. The anticipation is that some of the routes will attract positive bids but that others will require subsidies and hence go to the operator seeking the lowest subsidy. Railtrack itself is seen as a cost recovery concern which, while initially remaining in the public sector, will be independent of British Rail (UK Department of Transport 1993a). It will operate on the basis of a 10 zone network with most of its £1 billion annual infrastructure maintenance programme undertaken by 14 service companies which are currently part of British Rail's profit centre organisation. The subsequent cost of use borne by operators will be on an avoidable cost basis with differential contributions to common costs according to ability to pay.[15] Where conflicts arise over 'paths', willingness to pay (i.e. ability to pay) will, after an initial transition phase, determine the outcome. This may well mean that commercial services gain priority over subsidised services even if the latter are supported by the Franchising Authority. Some freight traffic may avoid part or even full payment (and receive a government grant) if it is demonstrated to generate a social benefit by not going by road.

The programme of passenger operations privatisation has gained in its scope over time and now embraces some 20–30 groups of services. The seven services which were initially singled out in February 1993 for franchising in February 1994 (with British Rail operating a shadow franchise arrangement in the interim) included three important InterCity passenger routes.

- The East Coast Main Line which in 1992 had revenues of £210 million and carried 26,000 passengers a day.
- The Great Western Line from Paddington to Penzance and Fishguard Harbour.
- The Gatwick Express linking the airport to Victoria which carried 5 million passengers in 1992 and generated £25 million in revenue.

In May 1993 a further 18 rail services were added to the list for franchising. Included were a number of InterCity routes of which the West Coast Main Line was one and the Midland Main Line another. These are less attractive commercial propositions than, particularly in the case of the West Coast Main Line, extensive investment is required. To lubricate the process, funds have been made available for the refurbishment required on these routes. The West Coast Main Line, for example, which last benefited from major investment twenty years ago, is estimated to require some £400-£500 million being spent on it over the next seven years if it is not to become dangerous; initial proposals for the investment are being examined by the Franchising Director in 1994.

The reaction of the private sector to the new situation has been rather luke warm. In part this may be explained by initial political wrangling over whether British Rail would be allowed to bid for franchises (under strong opposition from the government they are to be permitted) and over pension obligations – which the government has now agreed to act as guarantor for. In several cases where there are potential bidders many of these are existing bus operators interested in developing individual routes within their traditional areas of operation. They feel there are network benefits to be gained by providing passengers with integrated services. It is not yet clear how this will fair under UK competition control policy.

Rail freight is also included in the privatisation process (UK Department of Transport 1993b) with proposals to create three regional private freight companies to take over trainload and service contract activities. The companies will have first choice of British Rail rolling stuck and locomotives and retain the contractual obligations of British Rail. The companies will then buy track space from Railtrack. Existing customers of British Rail may also elect to enter into direct negotiations with Railtrack to buy 'slot' directly from it.

Public operator/public track monopoly

Sweden has moved somewhat faster than the UK in its efforts to separate operations from track and has done so within a different institutional framework. Under a successive string of policy reforms in the 1980s (Jansson and Cardebring 1989; Banks 1992) the Swedish authorities attempted to improve the financial performance of Swedish Railways. This culminated in 1988 with measures to separate some of the operations of Swedish Railways (*Statens Järnvägar*) from the ownership of the track. Swedish Railways, which is state-owned but in its activities autonomous of government, was given responsibility for operations while the National Railway Administration (*Banverket*) stays in control of the track. A limited number of routes were also put out for tender; the public operating company won all but one of the contracts with the private concern BK-Tag gaining two passenger lines.

The actual charges levied on the operating companies, unlike the UK private/public model, are not designed to enable full track cost recovery but only about a third of its costs (although these do embrace estimates of externality costs). Further, and to make the charging regime comparable to the charging for road use, the track authority charges contain both a fixed and variable cost component. Clearly it is early to comment on the impact of the system, especially since its initial years have seen a 45% annual rise in investment in rail infrastructure. What the public operating company fears in the longer term is that, while it has a remit to operate commercially (with the government buying socially necessary services through subsidies), the track authority may make investments on other, conflicting criteria (Larsson 1992). The situation, however, seems to be in accord with the underlying policy of achieving broader social goals at the lowest possible cost. The extent of the managerial co-ordination problem is also likely to be limited by the ability of the operator, unlike in the UK case, to be extremely proactive in terms of the track facilities required to meet the services it wishes to supply.

Private operators/private partnership owned track

With the removal of many regulatory constraints, and accepting that the bulk of scale economies are in the track side of rail service supply, there is an increased incentive for rail undertakings themselves to begin to seek ways of vertical separating infrastructure from operations. This would seem to be particularly so in the context of the long standing duopoly structure found in Canada. One manifestation of the changing commercial environment, albeit small in comparison with rail developments elsewhere, has been efforts by CN and CP Rail to rationalise operations in eastern Canada and in particular to consolidate operations in the Ottawa Valley where traditionally they have operated parallel infrastructures.[16] A joint subsidiary company will control and maintain a single line with the two operators offering competitive services on it by buying a path from this partnership company. Additionally, VIA rail passenger service would operate under existing agreements.

In these types of situation where, when confronted with conditions of falling demand, the costs of infrastructure duplication, in the context of decreasing costs of providing infrastructure services, seem to be increasingly out weighing any allocative efficiency gains associated with competition between infrastructure, partnership arrangements may be socially, as well as commercially, sensible in the short term. Longer term difficulties could emerge, however, if policy moved in the direction of allowing common access to

track. If, as under European Union regulations, this implied access at rates comparable to the partnership undertakings then questions of unfare competition would be avoided. This would, presumably, require statutory measures. Additionally, however, there is the more general question of the rates to be charged operators. Unlike a public track authority with a remit to meet specified social criteria, or a private track concern dealing with a monopsony operator, the track company has considerable market power and, *ipso facto*, the ability to levy non-cost related charges. This is even more the case if the track company is made entirely independent of the operating companies.

Regulatory Issues

Railways have been regulated almost since their inception (for example, since 1844 in the UK) and in many countries have involved either direct, or indirect, public financing of their activities. Moves to separate track from operations, therefore, inevitably raises issues of the appropriate regulatory framework to install in a post vertically integrated World. Much, of course, depends both on the form of vertical separation adopted and the objectives being pursued. A number of more general issues can, though, be highlighted.

Maximising efficiency

Different countries are clearly pursuing different paths in their efforts to separate operations from track matters. In part, and because of the high costs involved in even marginal changes to its nature, these variations are influenced by the character of the vertically integrated rail network which is to be divided. In the case of countries where there has been considerable under investment in infrastructure in recent years, and where the shadow cost of external financing is high, conferring monopoly rights on an operator for a period provides both the ability to invest in the track system, even if it is owned by another body, and the ability to generate the economic rent required for this. In a sense, the role of regulation in this environment is to ensure that such rent is attained.

In most industrialised economies this is not, however, the major problem. The issue is to find ways of making more efficient use of a mode of transport which is gradually losing market share. There is also often a residual interest in attracting some funding for a certain amount of redevelopment of links which have more buoyant prospects. Technical and dynamic efficiency in these circumstances would tend to favour as much competition in markets which exhibit constant costs of supply. This is why the UK has favoured its strongly market oriented, private sector approach to operations. Unlike Sweden and, to a lesser degree, New Zealand where monopoly operations are seen as preferable, the UK is also a country where this strategy fits in with the overall regulatory ethos. While market failures are accepted as an inevitable element of any liberal regime, the UK regulatory philosophy of the past fifteen years has centred around the notion that workable competition is likely to be less distortive and lead to higher levels of efficiency than a strongly controlled environment.

Subsidies

Whichever model one reviews there are problems when moving away from the simple question of efficiency towards examining the ways of attaining wider goals and, especially, the provision of social services. Cross-subsidisation, which was common under the regulatory regimes found accompanying many monopolised and vertically integrated railways, is demonstrably inefficient in the short term and provides little stimulus for improvements in the long term. Separating track and operations into two monopolies, along the Swedish model, is only likely to reduce these problems if there are accompanying changes in the regulatory framework. Without these, there is limited incentive for the operating company to do other than mimic previous strategies when vertical integration existed.

The New Zealand approach of allowing the private company taking over its operations to essentially act as a commercial concern does, as we have noted, have the legal fall back position that competition can be initiated if capacity is cut below specified levels.

The interesting question then becomes the degree to which it is in the operator's interest to maintain a degree of cross-subsidisation before this threshold is reached. Further, if it does need to continue cross-subsidisation, then there is the policy matter of whether the pattern of cross-subsidies, which will emerge in this purely rent protecting strategy, deviate to that which would maximise welfare at the given asset transfer level.

Direct subsidies are easier to handle when there is a competitive operations market. They can be embraced within a franchising framework and there are a number of possible mechanisms for ensuring that problems often highlighted by economists, such as the capture of the system by incumbent franchise holders, are minimised (Anderson 1993). The issue then becomes one of who administers the subsidies. In the UK the system is structured to operate through the Franchising Director but equally there should be no reason why any local community or regional authority may not provide subsidies to operators serving their areas.

Co-ordination

A further issue is the matter of the logistics of managing operations over a rail track network. A monopoly operator must internalise this problem and develop its own service frequencies. The issue is much more complex when there is competition between operators, especially over an extensive, heavily used and complex rail network.[17] These types of difficulty are likely to be particularly pronounced, therefore, in the context of the European system. One initial approach, and the one deployed in the UK, is essentially to initiate competitive bidding for parts of the existing timetable over clearly defined segments of the network (see Starkie 1993). One could then think of subsequent trading of parts of these segments between operators as the dynamics of the system bring about the desirability of new timetables and reformed services. To retain competitive (or contestable) forces in this context would require some form of regulation – a function which is effectively performed by the Franchising Director in the UK.

Monopoly power

The key regulatory issue regarding rail track infrastructure provision is that of controlling the potential monopoly power which could be exercised by either the public or private supplier. Of course, the degree of the monopoly enjoyed depends on the level of competition from alternative modes in the short term and the ability of users of the system to relocate, and thus change their transport dependence, in the longer term. It also depends on the relative power of the operators; a monopsony operator having more leverage over the track owner than when there is competition amongst operators. Institutionally a number of possibilities are currently being experimented with to contain the monopoly power problem.

When there is public ownership of the track it is comparatively simple to limit monopoly exploitation by imposing rate of return regulation[18]. This, however, is recognised to lead in the long term to potential over investment (since there are usually a locus of possible capacity/charge regimes which offer the set rate of return) and to possible technical inefficiency. In the UK case, to combat these problems the Franchising Director acts as a buffer between the operators and the Railtrack and, hence, effectively maintains strong 'purchasing' powers. One could argue that direct price-capping regulation as used in other sector of the UK economy, such as electricity where there has also been vertical separation, may be a more effective procedure with the Franchise Director merely serving a clearing house function. While price-capping regulation has the well known advantage of a closer principal-agent relationship, if for no other reason than that the costs of gaining information is lower, it is more effective in industries experiencing rapid technical progress and, consequently, continually changing cost structures. Rail track does not seem to fall into such a category.

Similar types of difficulty are likely to be encountered in Canada if the need for freight rail rationalisation found in recent studies are valid[19] and their freedom to respond in

newly competitive transport markets remains excessively regulated (Canada House of Commons Standing Committee on Transport 1993). If the operators do seek to rationalise costs through setting up quasi independent track arrangements this has implications for the underlying government strategy of the two railway policy. More explicit forms of direct regulation would seem inevitable but their exact form seems uncertain at this stage. As an alternative approach the state could take over responsibility for the track and device an overall structure not dissimilar to the UK model with bidding taking place for paths.[20] The same difficulties inherent in the UK approach, namely allocation of paths, funding investment and regulating the track undertaking would emerge and need to be resolved.

Pricing the infrastructure

Vertical separation of track from operations inevitably means setting a price for the infrastructure. One problem is that discussed above, namely the fear of monopoly exploitation by a unitary supplier, but equally even if regulations are devised to contain this there is the difficulty of setting price to ensure full costs are recovered. The unattributable common cost problem which bedevilled integrated systems is, therefore, not removed but rather reduced and pushed back a stage. There is some debate about the extent to which common costs exist, but even the studies which provide the lowest estimates still produce figures of around 30% of track costs[21]. To recover costs there is a need for some arbitrary allocation of some parts of the fixed costs involved. Regulation here, where some form of discrimination is inevitable, is needed to ensure that this mark-up on marginal costs is consistent with an agreed set of principles. In the UK this is crudely being done on the basis of the conventional Ramsey pricing criteria with those showing the greatest willingness to pay making the largest contribution to the common costs. If equity or regional development considerations are important there may be a need to pursue some other course and the function of the regulations would be to ensure this is done.

Some Concluding Thoughts

A cursory glance through any transport history will show that in virtually every country there are frequent, and often quite dramatic, changes in transport regulations and in the interpretation of those regulations. Longer cycles are also discernible and the on-going trend is one towards seeking regulatory environments which achieve high levels of technical and dynamic efficiency within transport industries. In the case of most railway systems this is taking place at a time when traffic levels are falling and following a period when investment levels have failed to maintain the physical integrity of the capital stock. As a result there has been a serious questioning by many countries of long held beliefs regarding the best way to restructure the industry. This questioning has been influenced by an improved understanding of the underlying cost structure of rail transport supply.

The notion of vertical disintegration is not new but its resurrection as a practical policy approach is timely in that it offers both the opportunity for greater internal efficiency within railway industries and the potential, through sensitive franchising arrangements, for better use to be made of public subsidies. It has the added advantage, in some formulations, of revealing exactly which types of operations are profitable. Actual experiments with various forms of separation are under way in different countries and it is too early to reach conclusions about the overall effectiveness of vertical disintegration or the particular form it should take. What does seem to emerge is that vertical separation can take many forms and be tailored to a variety of different national needs. There does not, therefore, seem to be some utopian model of vertical separation to aim for but rather a range of bespoke options which can be cut to meet particular national circumstances and objectives.

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Endnotes

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1 For example, in the Canadian context, 'The possible ownership of a company's right of way is an important subject, and certainly a controversial one. But it is also somewhat of an under explored one as well, particularly from the standpoint of how a property should be operated', (Maroti 1985).

2 As pointed out by Gratwick and Heaver (1985), 'An alternative approach to rail privatisation which we believe should be raised again is a radical departure from current thinking. The suggestion has been made at other times that public ownership of the right-of-way of both CN and CP would enable railway services to be provided in a more competitive environment than would otherwise be possible in Canada. Although raised following the Western Economic Opportunities Conference 1974, the proposal has not been given extensive and serious consideration.'

3 Disregarding the issue of whether transport policy can significantly influence economic performance to any extent, one reason for this shift of emphasis is that transport costs represent a relatively smaller proportion of overall production costs than in the past and hence the potency of the policy instrument is weaker.

4 The change in the specific context of Canadian railways is discussed in Ludwick (1993).

5 From the data which is available, it would appear that industries which have enjoyed, to adopt Leibenstein's (1966) terminology, an extensive degree of 'shelter', either in the form of public ownership or alternatively protection from the full rigours of competition, have also exhibited high levels of technical (or X-efficiency) – see Button and Weyman-Jones (1992).

6 Waters (1985) provides a comprehensive guide to these recent developments in the context of railway costing analysis. One might add here that the influence of the applied economic work on policy discussions in this area of vertical disintegration adds weight to Winston's (1993) recent analysis about the power of quantitative analysis in shaping regulatory reforms.

7 The European evidence is somewhat less conclusive than for US freight railroads, possibly because of their mixed traffic (which makes it difficult to isolate economies of scale and density from economies of scope) or because of the effects of direct public control which may itself influence cost levels. McGeehan's (1993) evidence, for instance, indicates a broadly horizontal cost curve but Preston (1994) finds a U-shaped curve.

8 Keeler (1983) conveniently surveys the literature on density.

9 Even here there are a wide variety of variants which usually are governed by the intrinsic nature of the market involved; its size and its dynamism. Given the considerable amount of change which has taken place in the UK since 1980, developments there provide a useful set of examples of what privatisation may mean. In the context of the privatisation of the National Freight Corporation in 1982 and the sale of elements of the National Bus Company following the 1985 Transport Act, the competitive nature of the market and the relatively low capitalisation involved led to worker and management buyouts. With larger undertakings, such as British Airways and the British Airports Authority, in part because of the capital requirement, public sales of shares in the company have taken place. Alternatively, as with British Rail's Sealink ferry operations, the undertaking has been sold as a trade sale to an existing supplier in the market.

10 Strictly, it is a private, for profit corporation supported by the government (Tobey 1987).

11 In the cases of the Boston area and Southern California Amtrack is contracted by public track authorities to operate services.

12 A number of alternative methods of privatisation have been considered in policy debates, see Adamson *et al* (1991) for a discussion of their natures. For an account of the structure adopted see, Nash (1993); Glaister and Travers (1993). A critical assessment of the structure is contained in UK House of Commons Transport Committee (1993). Else (1993) explores the potential efficiency effects of the system.

13 In order to ensure that users have full information regarding services, Railtrack will be responsible for publishing a full timetable.

14 Prior to this there had been partial privatisation of British Rail activities through the sale of its ferries and hotels. Additionally, many functional activities, such as catering, engineering and cleaning have been privatised. Perhaps more germane to this paper, a very small inroad into the public sector monopoly of long distance rail services was made for a time by the addition of private coaches (e.g. by Stagecoach in Scotland) to BR services.

15 The powers of Railtrack to meet this objective are controlled by a regulator who, amongst other criteria, must abide by EC Directive 91/440 which places a requirement on railway infrastructure managers not to discriminate between train operators in the fees they charge them for the use of infrastructure.

16 In fact this type of approach to the financial problems confronting rail transport in Canada is very much in line with recommendations of the National Transportation Act Review Commission (1993), *viz*, 'We recommend that the government encourage CN and CP Rail in their joint rail plant usage initiatives by developing policies and practices which are supportive of such initiatives.'

17 The problem in the context of passenger operations is well expressed in a quotation from Adamson *et al* (1991). 'The availability of platform space at a given time would in turn affect the availability of paths on other routes, and so on. Hence all scarce capacity which critically affected other stress points on the network would have to be simultaneously traded and subsequently operated in a co-ordinated manner to ensure efficient competition. If a tenderer were not successful in its initial bid, it would have to re-optimise iteratively its needs for paths through the network to arrive at a second choice, in the light of the fact that some paths were already committed to a competitor. the interdependence inherent in train planning would make time tabling with competitive bidding a tortuous process, with the likelihood of unclear product definition and unstable prices'.

18 One of the problems with the rail sector in many countries, however, is of existing excess capacity, well above that likely under a rate-of-return regulatory regime, coupled with extremely long waits for returns to be made when investment is undertaken. Defining appropriate institutional frameworks to stimulate investment in the short term is particularly difficult (Helm and Thompson 1991).

19 For example, 'based on these findings we conclude that neither CN Rail nor CP Rail can be considered financially viable if their financial performance during the three years 1989–91 is not improved', (National Transportation Act Review Commission 1993).

20 This should be put in the context of recommendations from the National Transportation Act Review Commission (1993), which were not accepted by the Standing Committee on Transport, that '...the Minister of Transport commission a comprehensive study of the feasibility of separating railway operations from the ownership and maintenance of rail plant' and '...the Minister and of Transport and the Agency explore the possibilities of making trackage in eastern Canada available for use by any rail carriers on a pilot project basis to test the common user rail plant concept'.

21 This estimate comes from an Australian study by Beesley and Kettle (1985) who found that about 20% of system total costs and 30% of track and signalling costs were common . The UK position which underlies its policy is that, 'Work carried out...has confirmed that the majority of rail infrastructure costs are common, that is, they cannot be uniquely attributed to any particular operator or even class of operator. The majority of costs also tend to be fixed, at least in the short to medium term' (UK Department of Transport 1993a).

North/South Trade - Transportation trends between Canada and the rest of the Americas

Michel Cloutier - Statistics Canada

1.0 Introduction

It is well documented that the United States is Canada's largest trading partner. With NAFTA now in place, trade with the rest of the Americas is expected to gain in importance. Given the recent emphasis on North/South trade it might be reasonable to expect that trade with all regions to the south of Canada is growing. As will be shown in this study this is, in fact, not the case. Growth in North/South trade actually stops at the Mexico/Guatemala border. More details will be given throughout the paper. In addition, two important transportation trends are evident from the data presented here:

- Intermodal transshipments through the U.S., generally combining trucks (in and out of Canada) and vessels at U.S. ports, are taking an ever increasing share of shipments to and from the Americas (Central America, the Caribbean and South America).
- Related to this first trend, there is a significant shift away from the marine mode (direct shipments to and from Canadian ports), to road transport, especially for imports into Canada from Mexico.

Data Sources

1) Statistics Canada's International Trade data ($ value) and Marine International Shipping data (tonnages) are the principal data sources used in this study (sections 2, 3 and 4).
2) The study by Wardlow, K., Dahm D.: Canadian International Marine Cargo Flows: A Profile of Transshipments through U.S. Ports, 1989-1991, published in the 1993 CTRF Proceedings, was used as the source for tonnage and TEU figures through U.S. ports (section 2.2.1)
3) Marketing Data for the Canadian Transportation Services Industry - Canada Mexico Trade, 1991, Part III: Estimated Weights in Metric Tonnes for Top Ten Exports and Imports by Region and Mode of Transportation, from External Affairs and International Trade Canada, (June 1993) was used for section 4.1 tonnage estimates.

The first part of this paper examines trade data to establish trends for North/South trade, presenting the value of trade by region, country, mode of transport and commodity. The second part examines marine transport tonnages to give a more complete picture of transportation flows to Central America, the Caribbean and South America. The

third section focuses on Mexico as Canada's dominant trading partner in Latin America, giving tonnages and $ value.

2.0 Canada's Trade with the Americas

Canada's trading relationships with other countries in the Americas is characterized by a number of key considerations. These include our resource based economy, our geographic proximity to each market and the varying demand for products depending on market conditions. These factors have resulted in very uneven trading patterns with various regions in the Americas, with the exception of trade with the United States and Mexico. Exports to these countries have grown substantially while increasing only marginally to the rest of the Americas. Imports from Mexico have also made significant advances, whereas the U.S. share of Canada's imports has diminished somewhat.

Data Limitations

1) The Mode of Transport (MOT) is not always available on export documents and is sometimes imputed. As stated in the text the MOT only reflects the mode for part of the trip (usually the MOT at the Canadian border crossing).
2) There is some undercoverage of Exports to Mexico and other countries in the Americas. This may therefore cause an underestimation of the growth of North/South trade, especially since 1990, when changes in Customs procedures were implemented due to the Canada/U.S. data exchange.

Although this paper will not focus on trade with the U.S., this country remains Canada's major trading partner, with 65.2% of total imports in 1992 and 77.3% of total exports in 1992. The following sections will outline in greater detail the trading patterns with each of the other regions in the Americas.

2.1 Trade by region - 1984 to 1992

Between 1984 and 1992 exports to the Americas (South America, Central America and the Caribbean) [1] increased slightly from $3.1 billion to $3.3 billion (up 6.5%). Imports showed a more substantial increase of 16.5%, going from $4.7 billion to $5.5 billion in the same period (see figure 1).

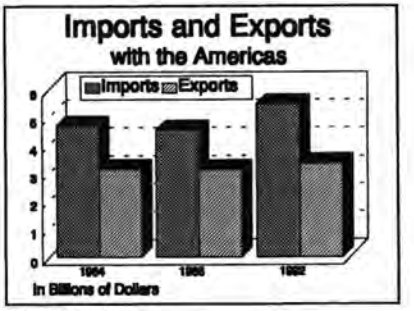


Figure 1

Despite this apparent overall growth, trade has been uneven by region from 1984 to 1992. The strong growth of imports from Central America and the Caribbean has offset a substantial drop in imports from South America. Reversing

this pattern a moderate increase in exports to South America made up for a slight drop in exports to Central America and the Caribbean. (see table 1).

In terms of percentage of total trade with Canada, the regions have actually diminished in importance. The Americas accounted for only 2.1% of Canada's exports in 1992, down from 2.8% in 1984, while only 3.7% of our imports in 1992 came from the same region, down from 4.9% in 1984. Only Mexico has increased its share of trade, keeping Central America's share relatively stable. Canadian exports to Mexico were up to 0.5% of total exports in 1992 and imports from Mexico reached 1.9% of total imports in the same year. In the Caribbean, Cuba and Jamaica are Canada's most important trading partners although they play a much smaller role as compared with Mexico.

Table 1: Trade by Country - 1984, 1988, 1992

	Imports			Exports		
Year	1984	1988	1992	1984	1988	1992
Country	Millions of dollars			Millions of dollars		
Mexico	1,432	1,327	2,780	356	500	790
Cuba	62	87	256	339	230	122
Jamaica	137	150	174	73	131	73
Costa Rica	37	50	132	21	29	25
Dominican Republic	31	36	33	32	60	70
Other	545	589	270	650	663	370
Cent. Amer.+ Carib.	2,244	2,239	3,646	1,471	1,613	1,450
Brazil	678	1,192	721	798	521	642
Venezuela	1,207	459	335	291	392	536
Colombia	109	138	151	218	250	240
Chile	121	160	203	81	141	156
Argentina	92	123	112	93	62	116
Other	241	222	299	189	138	207
South America	2,448	2,294	1,821	1,670	1,504	1,896
Sub total "Americas"	4,692	4,533	5,467	3,141	3,117	3,346
U.S.	66,466	86,020	96,514	84,928	100,851	125,683
Total All Trade	95,459	131,171	147,994	112,383	138,498	162,596

On the other hand, South America's share of imports into Canada dropped significantly going from 2.6% of total imports in 1984 to 1.2% in 1992. Imports from Venezuela have dropped from $1.2 billion in 1984 to $335 million in 1992, but the country still remains the second most important origin in South America. Taking the first place, imports from Brazil were double those from Venezuela in 1992,

completely reversing the situation from 1984. Exports to South America in 1992 went mostly to Brazil, Venezuela, Columbia, Chile and Argentina, in order of importance. All of these countries except for Brazil, have made gains since 1984, creating a much more even distribution with less reliance on exports to Brazil as compared to 1984.

Canada's trade balance with the Americas as a whole has historically been in a deficit position. This deficit has increased due to the surge of imports from Mexico. The deficit with South America has however recently been reversed with slightly more Canadian exports to the region than imports in 1992. This change is due mostly to a drop of imports from Venezuela rather than an increase in exports from Canada to Venezuela over the period of 1984 to 1992.

2.2 Intermodal transshipments through the U.S

Before giving details by mode of transport (MOT), it is important to note that trade statistics show the MOT at the point of exit from Canada for exports and at the clearance point in Canada for imports (including inland clearance). This explains why there are road and rail shipments to and from the Caribbean and South America. In fact in can be assumed that many if not most of these shipments are actually intermodal movements with transfers to/from the marine or air modes. It is likely that most of these connections are made in the United States. In addition, because imports can be cleared inland by road or rail, marine and air shipments are also understated (see also data limitations).

Table 2: Canadian Trade Transshipped Through U.S. Ports - 1991

	U.S. East Coast		U.S. Gulf Coast	
	Tonnes	TEUs	Tonnes	TEUs
Region of Origin - Imports				
Cent. Amer.+ Carib.	19 566	1,897	6 419	711
South America	116 664	8,034	11 270	68
Other	388 724	31,537	14 253	825
Total	524 954	41,468	31 942	1,604
Region of Destination -Exports				
Cent. Amer.+ Carib.	121 115	11,598	36 054	863
South America	91 652	7,263	128 084	125
Other	417 955	23,370	214 133	791
Total	630 722	42,231	378 271	1,779

2.2.1 Transshipped tonnages and TEUs

Studies of transshipments through U.S. ports have documented the extent of these transshipments in terms of tonnage[2]. In 1991, 56% of total Canadian imports transshipped through U.S. Gulf Coast ports originated in the Americas, while 43% of transshipped Canadian exports flowing through U.S. Gulf Coast ports were headed for the Americas. For U.S. East coast ports the equivalent percentages were 26% for imports and 34% for exports (see table 2). Brazil, Chile, Argentina, Venezuela, Guyana, Trinidad, Nicaragua, Panama, Honduras and Costa Rica all contribute to transshipped cargoes moving through U.S. ports.

Table 3: A Comparison of Imports by Country of Origin and Country of Consignment/Export, 1988 and 1992

	Country of Origin		Country of Consignment/Export		Transshipments	
	1988	1992	1988	1992	1988	1992
	Millions of dollars					
Mexico	1,327	2,780	918	2,232	409	548
Cuba	87	256	87	257	0	(1)
Jamaica	150	174	153	173	(3)	1
Dominican Republic	36	33	26	21	10	12
Nicaragua	64	32	66	31	(2)	1
Honduras	27	22	2	10	25	12
Other	548	349	529	243	19	106
Cent. Amer.+ Carib.	2,239	3,646	1,781	2,967	458	679
Brazil	1,192	721	1,036	507	156	214
Venezuela	459	335	452	335	7	0
Chile	160	203	82	79	78	124
Columbia	138	151	92	83	46	68
Argentina	123	112	115	82	8	30
Ecuador	85	108	16	22	69	86
Peru	85	95	76	92	9	3
Other	52	96	52	60	0	36
South America	2,294	1,821	1,921	1,260	373	561
Total	4,533	5,467	3,702	4,227	831	1,240

Obviously, much of this cargo either arrives in Canada or leaves the country by road or rail, before interlining with the marine mode at U.S. ports. In fact, a great deal of containerized cargo uses the U.S. connection. Proportions of containers as measured by TEUs, transhipped through U.S. ports, show a similar distribution to the cargo tonnages noted above. Over the last few years there has been significant growth in the amount of cargo to and from the Americas, through U.S. ports. This explains the

emergence of road transport at the Canadian end of the movement, as will be shown using trade data by MOT. This trend in transportation arrangements is not surprising given the geographic proximity of U.S. ports to the Caribbean and South America and the greater emphasis on timely deliveries.

2.2.2 Imports by Country of Origin vs Country of Consignment/Export

Imports are usually attributed to the country of origin of the goods but can also be assigned to the country of consignment/export (which is the last country before arriving in Canada). Tabulations showing the difference between these two concepts, measured in dollars, show a significant difference for imports from the Americas. In 1992, 28.7% of all imports from South America arrived in Canada through another country while for Central America and the Caribbean this was 18.1%. South America has shown a dramatic increases since 1988 when it had only 16.0% of its imports transshipped. Central America and the Caribbean were slightly higher in 1988 at 20.4%.

These figures corroborate the evidence presented earlier, in terms of tonnage, showing a significant amount of transshipment through other countries for imports, especially for those coming from South America. In most cases these would pass through the United States although some cargo is probably also transshipped through other Latin American countries before going through the U.S.. This fact is once again supported by the data by MOT which shows large amounts of imports by rail and road from the Americas. Mexico, Brazil, Chile and Ecuador are the predominant countries for these transshipments as measured by the $ value of imports (see table3).

2.3 Exports by Mode of Transport (MOT)[3]

Exports to the Americas leaving directly from Canada are predominantly transported by the marine mode, since most of Canada's exports are bulk commodities best suited to this mode. In terms of $ value of trade in 1992, water transport dominates for most of our major trading partners except Mexico, where road transport was more important. The marine mode has lost some ground to road and air transport dropping its share of total exports from 63.1% in 1988 to 54.0% in 1992. (see figure 2).

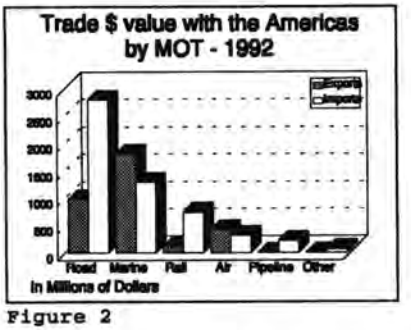


Figure 2

While rail transport remained relatively constant over the same period (3.7% in 1992), road and air shipments increased from 22.9% and 9.9% respectively in 1988

to 29.6% and 12.8% in 1992. This underlines the apparent need for faster transit times for certain cargoes, to meet competitive pressures and just in time manufacturing deadlines, as well as a change in the commodity mix.

By region a similar picture emerges, with marine as the most important mode everywhere except in Central America where road transport had a 43.3% share of exports to that region. Mexico dominated in Central America with all modes showing significant export activity in 1992. In South America almost half of all marine shipments from Canada went to Brazil ($506 million) . The top commodity exported to South America, by the marine mode, was cereals (including wheat)[4] followed by paper and paper board, mineral fuels and coal. For exports by road in 1992, automobiles, trucks and parts led the way, followed by electrical machinery, machinery and mechanical appliances.

2.4 Imports by Mode of Transport (MOT)

The 1992 imports from the Americas were dominated by road transport, with 51.3% of the total, followed by marine transport at 23.8% and rail transport third with 13.7%. There has been a significant shift of about 15% away from the marine mode to road transport since 1988, when marine was first with 38.2% and road had 37.6% of imports. The switch from marine to road may reflect a number of different considerations. There has also been a shift in countries, with a larger share going to Mexico, as well as a move away from certain bulk commodities, to cargoes which are more time sensitive. Both of these factors tend to favour road transport.

Table 4: Trade by Region and MOT - 1988, 1992

	Imports		Exports	
Year	1988	1992	1988	1992
Mode	Millions of Dollars			
Road	996	2,025	492	511
Rail	426	662	115	115
Marine	459	589	867	619
Air	228	150	138	206
Other	132	221	0	0
Cent.Amer.+Carib	2,239	3,646	1,613	1,450
Road	711	778	222	480
Rail	71	86	12	8
Marine	1,275	714	1,099	1,187
Air	191	172	171	222
Other	47	71	0	0
South America	2,294	1,821	1,504	1,896
Road	1,706	2,803	714	990
Rail	497	748	127	123
Marine	1,734	1,303	1,966	1,806
Air	418	321	310	427
Other	178	292	0	0
Total "Americas"	4,533	5,467	3,117	3,346

In addition as shown earlier shippers have increasingly chosen different transportation arrangements preferring to go through U.S. ports instead of Canadian ones. This would show up as a shift away from marine towards road transport, since the Canadian leg of the journey is done by truck even though the marine mode is used for part of the voyage to and from the U.S. Finally, air shipments accounted for 5.9% of imports while 4.1% was by pipeline, in 1992 (see table 4).

In 1992, almost $2 billion of imports (65.4%) from Central America were transported by road, with $1.8 billion of that coming from Mexico. Next was rail with 21.7% which was almost all from Mexico ($649 million). Not surprisingly, in the Caribbean, marine is the most important mode with 76.9% of all imports. As for South American imports, the transport mode at the Canadian point of clearance, is more equally shared between road (40.7%) and marine (39.2%) with air shipments in 3rd place at 9.4%. The top 4 commodities imported from the Americas accounted for 51.6% of all imports from the three regions in 1992. As well, Mexico holds six of the top ten commodity imports into Canada by MOT and country.

3.0 Marine International Shipping with the Americas

Marine International Shipping data provides us with a measurement of trade in terms of tonnage instead of $ values, which is often a more useful measure of transportation activity. With the marine mode as the principal transportation option, for most exports and a large part of imports, tonnage figures for shipping should give us a good indication of the transportation activity with the Americas. This is especially true for bulk commodities which are particularly well suited to marine transport and which represent most of the tonnage for Canada's exports and imports.

Tonnage data is not available, for other modes, from carrier surveys, since air cargo statistics are not currently compiled and the origins and destinations reported for road and rail transport are only the points within Canada and the United States. For these last two modes the ultimate origin or destination and the intermodal connections for pickups and deliveries in the U.S., are not available from these sources. This makes it impossible at this time to identify, in a comprehensive way, the cargo tonnage which is destined for or originating in the Americas.

3.1 Marine Shipping by Region - 1984 to 1992

As expected for marine cargo destined to the Americas, Marine International Shipping statistics generally reflect the same tendencies as total exports. For departures from Canada in 1992, tonnage increased 23.3%, going from 7.6 million metric tonnes (MT) in 1984 to 9.3 MT. The increase was more significant for departures to Central America and the Caribbean with a growth of 35.6%, up from 2.4 MT in 1984 to 3.3 MT in 1992 (unlike trade exports to the region which showed a small drop in $ value). Similar to the moderate increase in export $ value to South America, tonnage to that region was up 15.3% going from 5.2 MT in 1984 to 5.9 MT in 1992 (see table 5).

On the other hand, as shown for imports by the marine mode, arrivals at Canadian ports diminished substantially over the same period dropping 23.3% in terms of tonnage (from 10.4 MT to 7.9 MT). Both regions contributed equally to the decline with Central America and the Caribbean down 27.1% (4.2 MT in 1984 to 3.1 MT in 1992) and South America going from 6.1 MT in 1984 to 4.9 MT in 1992 (-20.7%).

In South America's case, the drop occurred only since 1988, as there was some growth in tonnage between 1984 and 1988. A large part of this decline was due to the reduction in imports of iron ore as well as iron and steel from Brazil and crude petroleum, fuel oil and other petroleum products coming from Venezuela. This drop can be explained by the downturn in economic activity that occurred in Canada over the same period.

Table 5: Cargo Tonnage Handled by Country and Region
International Shipping - 1984, 1988, 1992

	Loaded			Unloaded		
Country	1984	1988	1992	1984	1988	1992
	Thousands of Metric Tonnes					
BRAZIL	3 810	3 002	3 346	1 924	4 699	2 425
COLOMBIA	291	439	762	88	177	18
CHILE	337	414	701	159	147	108
VENEZUELA	364	940	697	3 785	3 399	2 137
ECUADOR	54	41	208	1	1	0
ARGENTINA	158	111	126	82	73	64
PERU	144	150	112	14	1	72
URUGUAY	20	55	18	4	2	1
GUYANA	4	0	5	74	5	42
SOUTH AMER.	5 182	5 153	5 975	6 139	8 503	4 868
MEXICO	407	1 054	1 614	1 519	786	536
CUBA	1 325	833	389	252	156	440
PUERTO RICO	132	193	353	33	3	1
BAHAMAS	66	61	206	666	141	181
JAMAICA	107	129	173	508	555	721
DOMINICAN REP.	20	12	131	27	3	3
LEEW.-WIND. IS.	16	19	130	0	0	31
BERMUDA	3	37	71	33	0	104
TRINIDAD-TOB.	51	44	55	610	348	220
GUATEMALA	16	42	54	1	1	17
HONDURAS	22	30	28	0	0	15
OTHER	276	290	106	570	539	806
CENT.AMER.+CARIB.	2 440	2 744	3 309	4 219	2 534	3 074
TOTAL	7 623	7 897	9 284	10 358	11 037	7 942

Cargo shipped to the Americas by vessel accounted for 6.0% of total marine tonnage loaded at Canadian ports in 1992. This figure compares with the 2.1% presented earlier, in terms of $ value of exports. This higher percentage is to be expected,

given that marine transport is more important for this region, when compared with total Canadian exports which are dominated by the U.S. and road transport. For marine arrivals the difference is even greater, with over 11.4% of total 1992 tonnage unloaded, originating in the Americas (compared with only 3.7% as measured by the $ value of imports). All percentage figures for the Americas, in terms of total $ value and total marine tonnage have dropped since 1984 with the exception of marine departure tonnage which has gone up slightly (see figure 3.)

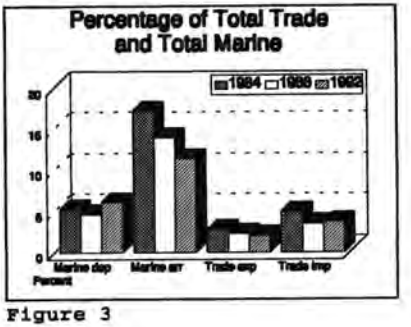


Figure 3

3.2 Departures by Region, Country and Commodity

Brazil dominates the South American market for Canadian exports in 1992, with over 56.0% of the region's marine tonnage. However, this is down from 73.5% in 1984, greatly reducing our dependence on this market. Wheat, coal, potash, sulphur and newsprint were all key commodities loaded for Brazil in 1992. Columbia, Chile and Venezuela are the next most important destinations for marine exports. For all of these countries wheat was the top export in terms of tonnage. The same commodities listed for Brazil also led for South America as a whole. A little more than half the tonnage loaded for the Americas comes from Canada's Pacific ports with the remainder split evenly between the Atlantic and St-Lawrence regions.

In Central America and the Caribbean, Mexico once again leads the way. Surprisingly marine exports have increased dramatically from 16.7% of the regions' tonnage in 1984 to 48.8% in 1992. The shift has come at the expense of cargo loaded for Cuba which plummeted from 54.3% in 1984 to 11.8% in 1992 (due mostly to reductions in wheat purchases). Emulating the pattern established for South America, wheat exports dominate in terms of tonnage both for Mexico and the entire region. In 1992, coal, sulphur, rapeseed and barley topped Mexico's commodity list.

For containerized cargo, fruits/vegetables and food products led the way, followed by paper products as well as meat and fish. Overall 3.2% of all cargo loaded for the Americas in 1992 was containerized (295 thousand tonnes), up from 2.1% in 1984 (162 thousand tonnes).

3.3 Arrivals by Region, Country and Commodity

Consistent with trade data for 1992, Brazil and Venezuela eclipse all other South American countries, with almost 94% of arrivals by sea. Almost all of the imports from Brazil were destined for St-Lawrence ports while the great majority of Venezuelan imports went to Atlantic ports. The reasons for this are clear once the commodities are identified. Brazilian imports are mostly iron ore and aluminum ore for Quebec industries, while Venezuelan crude and fuel oil are principally destined for Atlantic Canada's refineries (see figure 4).

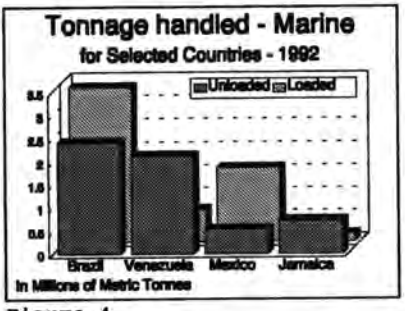


Figure 4

The distribution by country for 1992, is much more balanced for marine imports from the Caribbean and Central America. In this case Jamaica (23.5%), Mexico (17.4%), Netherlands Antilles (16.0%) and Cuba (14.3%) along with others, all share in the marine tonnage from the region. Key commodity arrivals are: aluminum ore mostly from Jamaica, the Virgin Islands and Bermuda; fuel oil and crude petroleum from the Netherlands Antilles, Trinidad-Tobago and the Bahamas, fruits and vegetables from Cuba; and salt and gypsum from Mexico. Only about 1% of these imports arriving directly in Canada by sea are containerized.

3.4 Marine services to the Americas

There are a number of marine shipping lines serving Caribbean, Central American and South American ports. However, most of the advertised liner services sail from American ports, principally New York, Philadelphia, New Orleans and Miami. For most departures, through bills of lading are issued from Montreal or Toronto, as little as 2 days before the sailing (for New York). Transit time by sea can be between 3 days (to Bermuda) and 20 days or more depending on the destination and itinerary. Frequency of service varies from 3 times a week (from Miami), anywhere to every 11 days or more. Service to the region, directly from Saint John, New Brunswick has existed for a number of years and another carrier has recently expanded its Caribbean service from Halifax.

4.0 Trade with Mexico - 1991 and 1992

As the premier country in the Americas for both Canadian imports and exports, Mexico deserves a more in depth look, especially where the mode of transport and tonnages by mode are concerned. In this section estimates of tonnages based on Statistics Canada's International Trade data will be presented (as provided by External

Affairs and International Trade Canada - see data sources). This will include data for all modes, as well as details by commodity and Canadian region. A number of studies have examined trade with Mexico but have not focused on the transportation arrangements. Marine International data will be used to complement and clarify trade statistics for the marine mode. For other modes, only trade data will be used since it is the only database which encompasses all modes and all trade transactions.

4.1 Tonnage by MOT and Commodity and Canadian Region

Exports

As previously stated road transport dominates trade with Mexico in terms of $ value. However in terms of tonnage this is not the case, since bulk commodities which weigh more are generally handled by marine and rail. This is clearly illustrated when tonnage estimates for 1991 exports to Mexico are examined (this includes only the top ten commodities as ranked by $ value). For the top ten export commodities, about 85% of the tonnage (532 thousand tonnes), is transported by the marine mode, including wheat, sulphur, gasoline and newsprint. Rail is a distant second at 72 thousand tonnes, led by exports of newsprint, asbestos and iron products. Road transport, with 24 thousand tonnes, is used mostly for motor vehicle parts and asbestos.

Other marine commodities, which dominate in terms of southbound tonnage, are not included in the list above, because of their lower $ values. They are: coal, woodpulp, iron and steel, potash and barley. The total marine tonnage departing for Mexico in 1991 was 733 thousand tonnes. In 1992, marine tonnage increased sharply doubling to 1.6 million tonnes due mainly to large increases in exports of wheat, coal, rapeseed and barley.

Most of the marine export tonnage originates in the Prairies and is shipped through west coast ports, except for wheat to Mexico which was shipped through St-Lawrence ports in 1991. Atlantic region exports included large amounts of coal, potash, newsprint and woodpulp while, in addition to wheat, St-Lawrence ports showed iron and steel departures originating in Quebec and Ontario. Road exports originate almost exclusively in Quebec (asbestos and paper) and Ontario (auto parts), while rail shipments are more evenly distributed between Quebec (newsprint, asbestos, paper), Ontario (iron products) and the west (milk powder, woodpulp).

Imports

In the case of imports, 1991 tonnages were dominated by pipeline transport of crude petroleum to Quebec. This is another case of cargo being transhipped through a U.S. port, in this case Portland, Maine, after arriving by vessel from Mexico. From there it shows up as a pipeline import into Canada. Pipeline transport was followed by road, marine and rail in order of importance. Other than crude petroleum, the northbound commodity mix includes more manufactured products and fewer bulk cargoes, explaining the higher ranking for road transport. Based on trade data, imports of parts and accessories for motor vehicles (all to Ontario) again dominate

the tonnage by road although there are significant fruit and vegetable imports destined for all regions especially the Prairies and B.C. For marine and rail the top import tonnages respectively belong to gasoline (to Atlantic Canada) and automobiles (to Ontario).

Based on Marine International data the total marine tonnage arriving in Canada from Mexico in 1991 was 517 thousand tonnes. Most of this tonnage was not included above because of the cargo's low $ value. Salt was first with 43.8% of total tonnage unloaded, followed by gypsum with 31.3%, both destined for the pacific coast followed by the gasoline as listed above. Together these accounted for the majority of inbound tonnage. In 1992, there was a slight increase to 536 thousand tonnes, with the same commodities dominating.

Table 6: Trade - Mexico by MOT

	1991	1992
	Millions of dollars	
Imports		
Road	1,545	1,794
Rail	689	649
Marine	190	87
Air	69	67
Pipeline	85	173
Other	1	1
Total	2,580	2,771
Exports		
Road	250	347
Rail	74	112
Marine	141	250
Air	60	66
Other	0	0
Total	525	776

4.2 $ Value by MOT, Province

In 1992, domestic exports to Mexico totalled $776 million up almost 48% from $525 million in 1991. Imports also increased, although less dramatically, going from $2.6 billion in 1991 to $2.8 billion in 1992, up 7.4%. These dramatic increases, in only one year, clearly illustrate the growing importance of trade with Mexico. All modes of transport shared in the increased exports, while on the import side marine, rail and air shipments lagged at the hands of road and pipeline imports. The greatest loss was for marine transport which had less then half the import $ value in 1992 ($87 million compared $190 million in 1991), while at the same time, pipeline imports doubled from $86 million to $174 million. Road imports went from $1.5 billion in 1991 to $1.8 billion in 1992, up 16% (see table 6).

Ontario was by far the principal origin of exports to Mexico with almost half of the total $ value in 1992 ($376 million), most of it by road (74%) and rail (16%). The majority of marine shipments originated from the west ($169 million), Nova Scotia ($43 million) and Newfoundland ($18 million), while Quebec exports ($83 million) were split fairly evenly between air (41%) road (28%) and rail (26%) shipments. For imports from Mexico, the domination of Ontario extends to all modes except marine

and pipeline. Almost 84% of northbound traffic was destined for Ontario for a total of $2.3 billion in 1992, followed by Quebec ($272 million) and B.C. ($110 million).

4.3 Transportation Services between Canada and Mexico

While the introduction of the NAFTA has not yet fully liberalized transportation services to Mexico, many changes are already taking place in the transportation industry and in the way goods are being shipped. This later point is evident from the modal shifts we have noted throughout this study. "NAFTA will allow Canadian trucking firms greater access to the Mexican market and improved investment opportunities in Mexico over a ten year period." [5] For railroads high priority trains, new customs pre-clearance procedures, double stack trains and improvements such as the Sarnia tunnel may provide this mode with extra opportunities also.

Since Canada and Mexico have agreed to maintain a relatively open international marine service into their respective countries, there may also be many opportunities for the marine mode, if clearance procedures in Mexico are improved. In fact, given the amount of transhipment through U.S. ports to all of the Americas, there is probably a market which might be served by vessels calling at Canadian ports instead of American ports. It therefore seems that NAFTA may provide opportunities for all modes to compete for cargo on their individual merits, although trucking certainly seems to have taken the early lead.

There is a great deal of information available to help shippers wishing to export to Mexico and develop markets there. Documentation regarding transportation services by all modes, including intermodal and freight forwarder services, gives a good indication of the number of options available to shippers. Other factors affecting trade include distribution arrangements and warehousing within Mexico and a complete understanding of the documents and regulations needed for exporting to Mexico. The key to success is to fully understand and plan the entire process, especially the transportation considerations [6].

5.0 Conclusion

While it is clear that trade with Mexico is expanding significantly, spurred on by the NAFTA, the signals are not quite as clear for the rest of Central America, the Caribbean and South America. Although trade, in terms of dollars, has increased in both directions, with South American countries such as Chile, Columbia and Argentina, trends in terms of tonnages and as a percentage of total trade are not as evident. In addition changes in the relative importance of markets such as Brazil, Venezuela, Cuba and Jamaica have contributed to the sideways drift evident in some of the statistics, especially at the aggregate level. Shifts by country, by commodity and in the trade balance, with various trading partners, have contributed to this blurred picture. Despite this, important changes have occurred in the transportation mix with trucking being favoured, predominantly on the import side.

The extension of NAFTA to include other countries in the Americas could occur reasonably soon. Chile and Argentina, as well as other countries in South America are currently discussing the possibility of joining this trading block. Once all entry conditions are met by these countries, we will likely see an acceleration in the growth of trade with the Americas. The next few years should provide a clearer direction for trade within the Americas as other players attempt to share in the benefits of NAFTA and of more liberalized trade in the new global economy.

Endnotes:

1. All references to the "Americas" will include all of South America, Central America and the Caribbean, but will not include the United States or Canada.

2. See Wardlow and Dahm, 1993 for a profile of transshipments through U.S. ports.

3. Although detailed transportation arrangements from ultimate origin to ultimate destination cannot be tabulated using trade data, the mode of transport as defined by trade can be assumed to represent the primary mode used for a significant part of the journey (with the possible exception of transshipped cargo through U.S. marine ports where marine is likely the primary mode).

4. Commodities are classified by their Harmonized System Chapter (HS 2 digit code). The commodity identified in the text is the principal one belonging in that HS chapter. Other related commodities are also included in the total $ value given.

5. Transportation Services between Canada and Mexico, Second Edition (July 1993), p.6

6. For more information please refer to the export guides listed in the bibliography, available from External Affairs and International Trade Canada.

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RAIL TRANSPORT OF CANADIAN GRAIN TO MEXICO: SOME IMPLICATIONS OF NAFTA

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Lic. Herman Guzman, M.A.**

Introduction

The expansion of the North American trading bloc to include Mexico has focused attention on the transportation connections to this market. Given the distances involved, the railways seem well-positioned to expand their traffic between Canada and Mexico. At the present time, the railways compete with ocean transport for bulk movements to Mexico, while the trucking industry carries the majority of the value-added products. There are several political, economic and technological trends that are moving in favour of increased Canada-Mexico rail movements. This is particularly evident in the potential for rail movements of grain from Western Canada to Mexico.

The purpose of this paper is to explore the changes favouring an increase in rail transport, and the factors that still create problems. The Mexican policies of trade liberalization, de-regulation and privatization are creating new investment opportunities and encouraging innovations that will improve the cost/service of rail transportation. In addition, strategic alliances are being forged between Canadian, U.S. and Mexican carriers that will make the rail system more competitive with alternative shipping modes.

The enthusiasm for north/south rail connections is tempered however, by the longstanding problems that have hampered rail transport to Mexico. The interlining U.S. and Canadian rail carriers must deal with a state-owned Mexican railway monopoly that is still struggling to modernize its operations. Congestion at the border crossings, and slow car cycle times in Mexico, reduces the profitability of moving grain by rail from Canada. Finally, the regulation and subsidization of Canadian grain transportation biases the movements of exports, such that it is often better for the shipper to use a circuitous marine route than a direct rail shipment to Mexico.

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The paper begins with a brief analysis of existing grain trade patterns and the opportunity created by NAFTA. Subsequently, some new developments that favour rail transport to Mexico are presented. This is followed by a consideration of the old problems that work against efficient north/south rail movement.

Mexican Grain Import Market

In recent years, grains have represented about 20 percent of Mexico's total agricultural imports.[1] The volume of Mexico's grain imports ranged between 2.5 million to 8.5 million tonnes annually during the past ten years. As illustrated in Figure 1, Canada has been a residual supplier to the Mexican market. The Canadian share of the Mexican grain import market peaked at about 10 percent in 1986 and 1987, but in recent years, it has been closer to one percent.

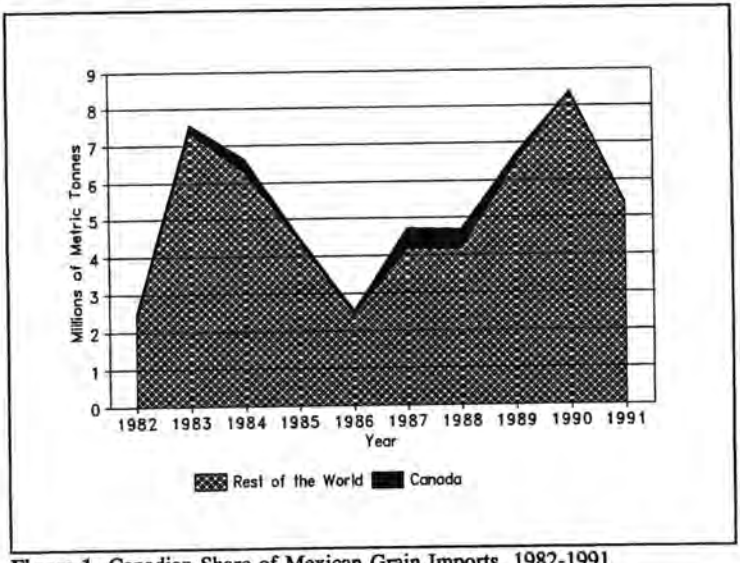


Figure 1 Canadian Share of Mexican Grain Imports, 1982-1991

Before the reform movement, the Mexican government intervened in virtually all country's agricultural marketing activities. Through the state-owned Compañia Nacional de Subsistencias Populares (CONASUPO), the government was involved in food processing, storage, warehousing, domestic purchasing, retailing, wholesaling, importation and exportation of foodstuffs and agricultural raw materials. Notwithstanding the problems of efficiently operating a state-owned enterprise, the managers of CONASUPO were commissioned with conflicting objectives. The management was expected to increase farm income levels, and expand agricultural

production for export. At the same time, CONASUPO was supposed to maintain urban real wages through the provision of abundant and inexpensive food supply. During the past five years, the government has withdrawn CONASUPO from the commercialization of all agricultural products except maize (corn) and beans, and is replacing price supports with acreage-based subsidies.[2]

The diminished role for CONASUPO is a benefit for Canadian grain exporters. Under the old system, end-users of grain in Mexico had little influence on the choice of suppliers. CONASUPO negotiated the quality and price of imports that were offered on a take it, or leave it, basis to the end-users. Now that the millers in Mexico have a choice, they are seeking the higher quality and consistency that Canadian grain exporters can offer. The Mexican millers have expressed interest in the better quality assurance and reliability of delivery that can be obtained by direct rail movements.

Trade Liberalization and NAFTA

Mexico's trade liberalization policy was already well advanced prior to the NAFTA. Table 1 presents a comparison of the pre-reform levels of tariff and quantitative restrictions to the post-reform level (Alam and Rajapatirana, 1993). Since joining GATT, Mexico cut its average tariffs rates in half, and narrowed the maximum tariff to 20 percent. In addition, the number of quantitative restrictions were reduced by three-quarters.

Table 1 Indicators of Mexico's trade liberalization, 1985 and 1990.

Indicators of trade liberalization	1985 Pre-Reform	1990 Post-Reform
Average Unweighted Tariff Rates	24%	13%
Tariff Range	0-100%	0-20%
Quantitative Restrictions	92	20

Approximately 13,000 tariffs items were negotiated by Mexico in the NAFTA. The tariff elimination schedule takes into account the different levels of development among the sectors, but offers only temporary protection to even the most sensitive parts of the Mexican industry. NAFTA will have a significant effect on the productive structure because it changes the competitive conditions and outlook for the industrial base. The phase out of Mexican customs duties on Canadian grains and oilseeds varies widely. Some products like canola seed were already subject to duty free entry, and other special crops such as rye, buckwheat and lentils have received immediate duty free entry. Most other tariffs on grains and oilseed products will be phased out within ten years. The exceptions are corn and some dry beans that are subject to a 15 year duty phase out period.

The elimination of customs duties is generally less important than the removal of quantitative restrictions, like import licence requirements, that are more effect barriers to trade. Under NAFTA, import licences are being converted to higher customs duties, or to tariff rate quotas (TRQ). For example, the import licence requirement on wheat has ended immediately, but now all wheat is subject to a 15 percent rate of duty that will be phased out over 10 years (durum wheat previously entered Mexico duty-free). In the case of barley, the import licences have been converted to a TRQ that provides duty free access for up to 30,000 tonnes (average sales for 1989-91 were 12,000 tonnes). Barley imports above this limit are subject to a duty that will be phased out over 10 years. In the case of corn, the TRQ duty-free access is only 1,000 tonnes, but this will be expanded. Canada's TRQs are scheduled to increase at 3 percent annually for corn and 5 percent annually for barley. The reduction of Mexican import barriers under NAFTA will expand the potential market for rail transport of grains to Mexico.

New Customs Procedures (Despacho Previo)

Under the old system of customs clearing, it could take from one week to four weeks for rail shipments to cross the Mexican border. The new system, which is called Despacho Previo, requires only 24 to 48 hours to clear an entire train. The Despacho Previo system is the result of a joint effort by U.S. Customs, Mexican Customs, the Customs Brokers Association of Nuevo Laredo, their U.S. affiliates, Union Pacific Railroad (UPR) and Ferrocarriles Nacionales de Mexico (FNM). The new procedures that were implemented in January 1990 allow rail car crossing seven days per week (including times when customs brokers are not working). The procedure is based on trust, and Mexican customs readily accept declarations by the importers and Mexican customs brokers.

At the Laredo, TX crossing, UPR holds Mexico-destined traffic in the U.S. until cars have been pre-cleared by Mexican customs for movement into Mexico. The system works as follows: The Mexican customs broker is given notice of a shipment as soon as a Mexico-destined rail car appears in the UPR system. UPR then gives 72-hours of free time to the shipper to pre-manifest the rail car with U.S. and Mexican Customs. During this 72-hour period the shipper and buyer must provide all the documents and the car numbers to the Mexican customs broker in order to pre-clear the rail car. After the 72 hours of free-time has expired, UPR will assess a $50.00 per day Document Delay Charge. The Document Delay Charge is a non-escalating daily assessment, that replaced demurrage charges.

While the documents are being processed, UPR moves the cars toward Laredo, halting in satellite yards (established specifically for holding cars that have not cleared Mexican customs) in Fort Worth, Houston and close to Kansas City. The main reason for satellite yards is that UPR does not have sufficient capacity at San Antonio and Laredo to hold/switch all the traffic destined for Mexico. Holding time in the satellite yards depends on the congestion of the port of Laredo. When the cars are cleared, they are moved to San Antonio, where UPR assembles the inbound

Mexico-destined traffic into solid trains for the major urban centres in Mexico. UPR then delivers the pre-blocked run-through trains to the FNM, thereby eliminating the need for further switching at Laredo or Nuevo Laredo.

With the Despacho Previo procedure of clearing cars, a daily average of 600 rail cars cross the border in each direction, and on some days 700 cars are moved. The inspections made by the Mexican quality control inspectors have been largely reduced to a random selection of trains. Although the system was pioneered at the Laredo crossing, which is the largest rail interchange, it has now been extended to other ports of entry.

At this time, the Despacho Previo system is mainly used by trains that move automotive parts from Chicago-Laredo to Mexico City, and some trains moving grains. Other trains that move freight such as milk powder, scrap paper, chemicals or products that are not given high priority by the rail carrier, or the Mexican authorities, may still experience delays despite the implementation of pre-clearing.

Strategic Alliances and Intermodal Innovations

The U.S. railroads that do not have direct access to Mexico have formed strategic intermodal alliances. Protexa-Burlington International (PBI) is an alliance between Grupo Protexa, a Mexican conglomerate, and the Burlington Northern Railroad (BN). The service combines the advantages of marine and rail transportation. At the present time, BN moves unit trains (108 cars) to Galveston, Texas where they are rolled on to two barges. The barges are towed to the Mexican gulf port of Coatzacoalcos. From Coatzacoalcos, the 108 cars are divided into three Mexican unit trains of 36 cars each, which are moved to destination by the FNM.

The PBI system is moving mostly grains into Mexico, and petro-chemicals that are produced in the south of Mexico. Future plans call for a more diverse range of goods, including containerized freight. A second rail-barge route from Galveston to Vera Cruz is scheduled to open in mid-1994. The Despacho Previo system of customs clearing is used to pre-clear the cars while on route from Texas.

A competing rail-ferry service, called "Gato Marino" (sea cat), is being planned by SEA/LAND and the CSX railroad (Beilock, Dunn and Prentice, 1994). Current plans envision the Gato Marino operating from either New Orleans, or Mobile, in the U.S. to the Mexican Gulf ports, such as Vera Cruz. The design of the ports will depend on the vessels employed. Apparently, ex-Soviet rail ferries are available that would hold about 80 railcars, and could be modified to incorporate roll-on/roll-off trailers on a top deck. Alternatively, sea going barges could be employed to carry railcars and trailers. The barges would be able to hold a larger contingent of railcars (approximately 100 cars and 80 trailers), but the ex-Soviet ships could offset the lower capacity with their higher cruising speeds.

The Gato Marino will have access to grain movements, especially through the port of New Orleans, but anticipates a more diverse mix of freight. Unlike the PBI service which is designed to serve the BN, the Gato Marino hopes to attract freight from several railways that have terminals at New Orleans/Mobile. These railways include: CSX, Norfolk-Southern, Illinois Central and Burlington Northern. Their main catchment area, which lies east of the Mississippi River, would also provide interline services for ConRail and the Canadian railways.

The anticipated mix of southbound freight is: Agricultural, 17 percent; Food and Consumer Goods, 12 percent; Paper, 26 percent; Chemicals, 16 percent; Minerals, 10 percent; Metals, 9 percent; and Automotive, 10 percent. No projections of northbound freight from Mexico are available, and are likely to be more difficult to secure given existing trade patterns.

Ferropuertos (Railports)

The Mexican government is fostering private participation in the expansion of the rail-based storage and handling infrastructure. Private interests are now allowed to construct and manage intermodal container facilities, grain terminals, and bulk transfer rail ports. Ferropuertos S.A. and Grupo CONTRI S.A. are two of the leading Mexican ventures that are developing the concept of inland terminals, or railports, as they are known in Mexico.

Ferropuertos S.A.

Ferropuertos has developed railports at Torreon and Celaya, with plans to establish additional facilities at Mexico City, Monterrey and a northwestern location. In the first phase of development, these distribution centres are designed to handle imported grain. Subsequent development will include dry and refrigerated warehouses, bulk commodity terminal and an intermodal container facilities for import and export shipments. The Torreon facility, which began operation in October, 1992, has a 64,000 metric tonne grain storage facility and handling equipment to unload rail cars at 1,000 tonnes per hour. The 100 hectare terminal area has 12 kilometres of track and is designed to handle 90 car unit trains.

The Ferropuertos facility at Celaya is smaller (57 hectares) and contains 7.3 kilometres of track. The handling system can move 500 tonnes of grain per hour, and store 45,000 tonnes.

Grupo CONTRI S.A.

Grupo CONTRI has developed a railport in the outskirts of Mexico City for handling imported and nationally produced grain. The firm that owns Grupo CONTRI mills 25 percent of the wheat in Mexico and last year consumed 650,000 metric tonnes of wheat. The Mexico City railport has storage capacity for 72,000 metric tonnes, and can unload a 45 car train (70 tonnes of cargo per hopper) in 8

hours. There storage is being expanded to 105,000 tonnes , which will make it the second largest grain terminal in all Mexico, after the Pacific port terminal at Lazaro Cardenas. In total, the Mexico City facility has 2.5 kilometres of rail lines. The capacity of the rail is 112 pounds/yard, which will enable 90 metric tonnes per car to be delivered to this terminal when the FNM bridges are upgraded to North American weight standards.

The Grupo CONTRI railport has three scales that can weigh and unload 3 hopper cars at the same time, plus a trailer end tipper. At full capacity, the unloading system is designed to can handle 800 tonnes per hour. Tractor-trailer units and straight trucks, which are known in Mexico as "Tortons", are used to distribute the grain in central Mexico and Mexico City. Several criticisms were voiced regarding the new railport facilities. Representatives of the grain trade considered the handling tariffs to be too high[3]. Also, there are questions about the real motives of the developers. It was suggested that the developers were more interested in real estate speculation than grain handling. The invitations to invest in construction were not considered to be very attractive.

Canada's high quality wheats have an advantage in the markets of Mexico City (20 million) and central Mexico. With the development of facilities such as the Mexico City railport, that will market and distribute high quality grain, all rail shipments from Canada have a new potential.

Old Problems

The costs of moving merchandise to and from Mexico by rail are influenced by the level of utilization of the rail lines and border crossings at the Mexico-U.S. border, and the co-ordination/competitiveness of freight charges. The commercial flows generated by the NAFTA have the potential to increase the pressure on the existing infrastructure and raise congestion costs. The railways in Canada, the U.S. and Mexico are working to overcome the barriers to the development of a "seamless" transportation system. Some remarkable successes have been achieved, but in many cases progress is limited by the lack of investment capital and management constraints in Mexico.

Equipment Utilization

Reducing the number of days spent by foreign railcars in Mexico has been one of FNM's tangible improvements. From 38 days in 1980, the average length of a round-trip for UPR grain cars in Mexico is now 12 days, as calculated from the border crossing. One reason for the improvement in the turn around time is that CONASUPO no longer holds control of all the grains imported to Mexico[4]. Most of the grain moving by rail is now going in unit or semi-unit trains to the private sector receivers that have larger unloading facilities. In addition, the Mexican

railway has acquired a new computer information system (from UPR) for car tracing that should reduce the turn around times of foreign rail cars.

Although rail car turn around time within Mexico has improved, the average turn around time for a Canadian rail car bound to Mexico is at least 30 days. The Canadian railways are reluctant to provide rail cars for that duration, unless they have excess capacity. Although the Canadian companies receive a per diem compensation equal to the leasing value (car-hire rental, which is estimated by age and type of car among other factors) of the car, the Canadian carriers lose the opportunity cost of having the car in their system earning revenue. Consequently, Canadian rail companies are generally reluctant to have their rolling stock cross into Mexico.

Congestion at Border Crossings

Laredo handles the largest portion of total rail traffic (an estimated 50 percent) between Mexico and the United States/Canada. The dominance of Laredo is explained primarily by its location, which is the shortest rail distance between the Mexico-U.S. border and the major population centres of Mexico. Also, given the class/distance system of freight rates of FNM, it is the least cost route. This route also benefits because it has some of the best track in Mexico (the link from Nuevo Laredo to Monterrey is equivalent to Canadian/U.S. standards) and because the climb into the plateau ranges of the central region is less steep, it is possible to move longer trains.

FNM has improved and augmented rail services and capacity at Nuevo Laredo, but there is still a great deal of congestion at that border crossing. "In the past 15 years, there has never been a time when Laredo was not somewhat congested."[5] The UPR manages the Laredo rail gateway very intensively to maximize its throughput. The Laredo rail yard still has limited capacity to manage southbound and northbound trains, even with the expansion of the rail yard in the last two years. As a result, the UPR does not offer through rates for grain to other North American railways. This could be a limitation on the movements of Canadian rail cars through this port.

The Tex-Mex Railway owns the rail bridge at the Laredo crossing. The UPR has announced plans to build a new rail bridge at Laredo to expand capacity. Construction is not expected to be completed before the end of 1995. A representative of the Tex-Mex suggested that their bridge could handle the expected traffic for the next 5-6 years, and pointed out that the present degree of congestion on the rail line from Laredo to Monterrey may limit the potential gains from a second rail bridge.

Rate Setting of the Mexican Railway

The tariff structure of the FNM is based on the Tariff Unica de Carga Express, TUCE (Unique Tariff of Cargo and Express) which dates back to 1976.

The TUCE had 20 classes of tariffs, to each of which a fixed factor per tonne and variable factor per tonne/kilometre was applied. The calculated tariff depended on whether the shipment was a car load, or less than a car load, and in some cases whether the shipper accepted a limit on the responsibility for damaged cargo. In turn, this was influenced by the way the cargo was packaged. The tariff class did not consider the route (rates were equal for flat or mountainous areas), or the traffic volume (highly congested, or relatively empty). The differences in marginal costs of transporting goods create implicit cross subsidies in the TUCE.

In May 1991, as a result of a program of integral modernization of the Mexican rail system, new tariff schemes were defined. In order to create intermodal competition, tariff negotiation between shippers and the FNM was introduced. The new negotiated tariff rates must be within 5 percent above the TUCE tariff as upper limit, and the long run variable cost of the railway as lower limit. For international trade, the FNM is attempting to offer through rates from origin to destination in conjunction with U.S. railroads. In October, 1992, FNM and UPR published their first through rates for corn, sorghum, soybeans and wheat.

The new liberalization allows U.S. rail firms to create subsidiaries in Mexico, who will be able to solicit business in Mexico. In response to this opportunity, the UPR has formed the Union Pacific de Mexico. Also, when shippers provide equipment, they will be awarded discounts and reduced tariff rates. The FNM is promoting special freight rates to take advantage of empty back-hauls and implementing special tariff rates for the pulling of private unit trains, with equipment owned by the FNM.

The connecting U.S. railroads consider the reform of FNM's rate setting to be one of its most pressing needs. The current rates are based more on political than business decisions. A recent example of this was the FNM rate increase that was inspired by lobby pressure from the trucking industry. Notwithstanding the lack of truck competitive traffic (less than 20 percent of surface freight moves by rail), the Mexican Government instructed the FNM to make an across the board rate increase to support higher trucking rates

The cross subsidy implicit in the FNM rates creates a bias towards marine shipments of grain. The Port of Veracruz is only 424 (rail) kilometres from Mexico City, while Laredo, Texas is approximately 1,200 kilometres away. The 424 kilometre route from Vera Cruz climbs over 10,000 feet, and entails many tight curves and steep grades. Unit trains on this route are restricted to 36 cars. In contrast, the route from Laredo has more gradual grades and long sections of straight track that permit 90 car trains (these trains maybe broken in sections of 45 cars out of Monterrey where steep grades are encountered. If FNM rates were based on its true costs, grain movements across the U.S.-Mexico border would be much more competitive with the gulf ports.

FNM Service Quality

The U.S. railways note that the FNM can operate reliable services when they enter into partnerships to provide scheduled services, however most Mexican shippers describe the FNM's service as inconsistent and unpredictable. One example of these service deficiencies is the poor supply of rail cars to the ports. In the case of grain, there is a shortage of hopper cars, and most are used in Northern Mexico. Even though the unloading capacity of the Port of Vera Cruz ranges between 850 and 3,000 tonnes per day (depending on the type of equipment) this mostly depends of the timeliness of boxcar delivery and pickup. Rail car service at Vera Cruz was described as seriously wanting (empty cars arrive too slowly, in inadequate number, and in poor condition).

The gulf ports account for about half of all grain imports, but lack modern grain handling equipment. The costs of port handling tend to offset some of the benefits of low cost maritime transport. Handling damage can affect 10 to 20 percent of the cargo (especially during the rainy season), and spillage losses are also evident. A shipping agent interviewed (August 1993) noted that dockage fees for the boat were only US$600 per day, but this cost would be greatly exceeded by the carrying cost of the inventory in transit. Also, the charter rates would reflect the length of time in port. The shipping agent complained bitterly about the service of the FNM, which required him to hire trucks at much higher cost.

Grupo CONTRI use rail and truck for movements of domestic wheat production from northern Mexico, and to bring imports from the coast. Despite their shortcomings, Grupo CONTRI used the gulf ports to serve their Mexico City location, with only one exception in 1993. One direct rail shipment from the U.S. was tried but, it took 25 days after placing the order for the railcars to get to the Laredo border crossing. Based on this experience, they are continuing to use the less expensive marine routes for imports[6].

FNM's Clouded Future

Years of state control and unprofitable operations have left the FNM with a bloated workforce and shortages of locomotive power and rolling stock. Although the nationalization of the railways occurred prior to 1950, the unification of the five operating lines did not take place until 1987. Not surprisingly, they still experience poor coordination of different areas. Other management problems include a very limited marketing and sales force.

For the FNM to regain profitable operations, they need an injection of new capital and a level playing field vis a vis the trucking industry. At the present time, the trucking industry is permitted to operate with overloaded vehicles that approach rail weights. Enforcement of Mexico's highway weight regulations would go a long way to making the FNM competitive, but three previous announcements to "get tough" with the trucking industry have all been rescinded. The question of additional

capital is clouded by persistent rumours that the government would like to privatize the FNM. Until the ownership issue is resolved, the railway will be left to live from hand to mouth.

Impact of Canadian Regulations and Subsidies on North/South Rail Moves

The Western Grain Transportation Act (WGTA) and the other regulations associated with grain handling and transportation present interesting obstacles to the development of north/south rail movements of grain. The method of paying the Crow Benefit to the railways creates an east/west bias in grain shipments. Grain shippers only pay 42 percent of the cost for shipments to either the Pacific ports, or Thunder Bay, while they must pay the full costs for southbound movements. The benefits of the east/west subsidy are such that southbound exports are regularly moved first to Thunder Bay before heading south[7].

Adding to the freight subsidy bias, the Canadian grain shippers are discouraged from negotiating with U.S. railways for competitive rates by rail car regulations. Special permission must be obtained to use the government-owned grain hopper cars outside Canada, and no record exists of these cars having ever entered Mexico. The shippers can import U.S. rail cars to move grain to Mexico, but under the rail car allocation regulations imported rail cars would be deducted from their entitlement of available rail cars that are allocated to all grain shippers. As a result, a shipper who imports the foreign rail cars to move Canadian grain to Mexico would have less Canadian rail cars to meet his other commitments. These regulatory hurdles virtually eliminate any incentive for grain exporters to import railcars to Canada.

Conclusions

The signing of NAFTA should make the Mexican market more interesting to Canadian grain exporters. Given the distances involved, all rail shipments could be a competitive route alternative, but several obstacles in Canada and Mexico have to be overcome.

Current routings of Canadian grain to Mexico illustrate some of the external problems and opportunities. One would expect that Canadian grain exported to Mexico City via the Pacific seaboard would be unloaded on Mexico's Pacific coast. Instead, most of these Canadian grain exports are unloaded at the Mexican gulf ports of Vera Cruz and Tampico. This is a reflection of the combined effects of Mexico's poor port facilities at the Pacific ports, and inadequate transportation services/biased freight rates from Mexican Pacific ports to the main markets (Mexico City area). Interviews with representatives of Mexico's grain importers confirm that at this time it is cheaper to unload grain at Vera Cruz, than at Manzanillo or Lazaro Cardenas. The cost of moving wheat from Vera Cruz to Mexico City is NP$42/tonne by rail and NP$55/tonne by truck. The freight rates from Lazaro Cardenas to Mexico City are NP$55/tonne by rail and NP$65/tonne by truck.

Canadian grain exporters observe that the returns from shipping to Mexico City via the gulf ports can range from US$2 to US$7.50 per tonne more than the returns available using the Pacific ports. Handling and transportation costs within Mexico account for much of this difference, but it is also a reflection of the breakeven tolls that are currently charged by the Panama Canal. In the year 2000, the ownership of the Panama Canal will be transferred to the Republic of Panama. Subsequently, tolls on the canal may rise substantially. If this happens, it is likely to favour the direct rail movement of grain to Mexico relative to marine routes.

The inefficiency of grain handling within Mexican diminishes the interest the U.S. and Canadian rail carriers. Congestion at the border crossings, and within the Mexican rail system, is a chronic problem. Longer car cycle times reduce the profitability of moving grain to Mexico by rail from Canada, while federal freight subsidies, under the WGTA, bias grain exporters to take east/west shipping routes. This is reinforced by grain car allocation regulations that deter the trading companies from importing foreign rail cars for southbound shipments of Canadian grain. Some of the problems that have hampered rail transport to Mexico are being resolved, but until these Canadian rail policy constraints are eased, it is difficult to envision more than "niche" market shipments to Mexico by rail.

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1. Mexico's grain imports considered here are: wheat, wheat flour, corn sorghum, barley, rye and oats.

2. These new subsidies, which are being distributed under a program called PROCAMPO, will double the income support to the agricultural sector.

3. The handling tariffs are NP$6.00/tonne for unloading, and NP$0.20/week for storage. The Mexican New Peso (NP) is currently trading at NP$2.4 per C$1.00.

4. CONASUPO used to direct single grain cars to many small receivers that were not frequently served by the FNM.

5. Personal interview with UPR representative, Omaha, Nebraska.

6. These delays may have been a result of the Mississippi River flooding, rather than inefficiency, per se.

7. Grain movements are excluded from the provisions of the NTA (1987) because of the WGTA. As a result, they are not covered by the Competitive Line Rate (CLR) requirement. This prevents the shipper from demanding a shorter direct route to an interlining U.S. railroad.

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1992 RAIL MOVEMENTS FROM CANADA TO THE UNITED STATES

by Jerry Fruin and Dan Halbach[1]

The United States Interstate Commerce Commission (ICC) annually requires a statistically valid sample of railroad waybills for public policy, economic information and regulatory purposes. In 1992, the overall waybill sampling rate was 2.79% with the sample containing almost 397,000 records. Although much of the data is confidential, each year the ICC releases a *Public Use Waybill Sample* that has been edited to protect the confidentiality of railroads and shippers.

Information in the *Public Use Waybill Sample* for each sampled waybill includes the 5 digit standard transportation commodity code (STCC), the number of carloads, the tonnage, the Bureau of Economic Analyses Business Economic Area (BEA) of origin, and the destination BEA. There are 183 BEA's in the United States. Each province of Canada has a BEA code for data purposes. The sample records also include mileage, freight revenues, tonnage, information about car type, whether the shipment was intermodal, whether it contained hazardous commodities, etc. The sample is stratified by carloads per waybill and has a sampling rate of 1 in 40 for shipments of 2 cars or less increasing to 1 of 2 for shipments of more than 100 cars. Appropriate expansion factors are provided.[2]

As a statistical sample, the 1992 *Public Use Waybill Sample* includes 14,761 waybills recording shipments from Canada to the United States. We have used this data to estimate and analyze the commodity movements by rail by 5 digit commodity code from each Canadian province to each U.S. BEA number by carloads, tonnage and freight revenues. This paper summarizes those results.[3] For brevity, we use the five U.S. Freight Territories (see Figure 1) as destinations rather than report movements by the 183 United States BEA's and have summarized to 2 digit STCC for some commodity groups.

The 14,761 sampled waybills of Canadian origin represent 21,017 cars with an average shipment length of 1,351 miles. Using the sampling rates to expand the sample there were an estimated 617,955 carloads shipped from

TABLE 1

MAJOR COMMODITY GROUPS

STCC	Discription
01137	Wheat Exc. Buckwheat
01xxx	Farm Products (Exc. 01137)
10xxx	Metallic Ores
11xxx	Coal
14716	Sulphur, Crude, Liquid, Molten or Solid
20xxx	Food or Kindred Products
24211	Lumber, Rough or Dressed
24xxx	Lumber or Wood Products (Exc. 24211)
26111	Pulp
26211	Newsprint
26212-999	Pulp, Paper or Allied Product (Exc. 26111-211)
28122-123	Sodium Alkalies; Sodium Compounds
28125	Potassium Compounds Exc. Potassium Alkalies
28193	Sulphuric Acids
28198	Anhydrous Ammonia
28xxx	All Other Chemical and Allied Products
29xxx	Petroleum or Coal Products
32xxx	Clay, Concrete, Glass, or Stone Products
33xxx	Primary Metal Products Including Galvanized
37111-112	Motor Vehicles
37xxx	Transportation Equipment (Exc. Motor Vehicles)
40xxx	Waste or Scrap Materials
42xxx	Containers, Carriers, Devices, Shipping; Empty
46xxx	Miscellaneous Mixed Shipments

Canada to the U.S. with total estimated freight revenues of more than $2,058,000,000. We reviewed the sample data to identify the most important commodities or groups of commodities.

Table 1 identifies the 24 most important commodities groups and their 2 or 5 digit STCC codes.[4] The general criteria for a commodity or commodity group to be included was that the expanded carloads were 1% or more of the total carloads shipped from Canada to the United States. These 24 commodities or commodity groups in total account for 99.2% of carloads, 99.5% of tonnage and 99.5% of rail freight movements. The expanded freight volume statistics for each of the 24 commodities are shown in Table 2. The most important 5 digit commodity in terms of carloads, tonnage and revenue was STCC 24211 (Lumber, Rough or Dressed). This commodity also had the longest average trip distance. The most important 2 digit commodity group was STCC 28 (Chemical or Allied Products) which totaled almost 123,000 carloads or almost 20% of the total. However, for study purposes we broke chemicals out in five categories. The largest of which was STCC 28/25 (Potassium Compounds), i.e., potash fertilizer, which accounted for 7.8% of total cars, 9.9% of total revenue and 11.6% of total tonnage with an average distance of 1237 miles. STCC 46 (Mixed Shipments) accounted for 10.6% of shipments but only 2.4% of revenue and 3.3% of revenue with an average shipment distance of 972 miles. Over 95% of STCC 46 are TOFC/COFC movements.[5] There are three 5 digit groups STCC 26 commodities (Pulp, Newsprint and Paper) which combined accounted for 17.5% of total cars, 20.6% of revenues and 18.1% of total tonnage. STCC 37111-112 (Motor Vehicles) accounted for 7.7% of carloads and 8.6% of revenue but only 2.7% of the total tonnage.

TABLE 2

1992 WAYBILL SAMPLE
ESTIMATES OF TOTAL POPULATION
CANADIAN ORIGINS, ONLY
CARLOADS, TONNAGE AND REVENUE BY MAJOR STCC

STCC	EXPANDED CARLOADS	%	EXPANDED REVENUE	%	EXPANDED TONNAGE	%	AVE. MILES
01137	6,760	1.1	10,777,704	.5	659,136	1.6	949
01xxx	6,656	1.1	14,673,456	.7	581,186	1.4	1,035
10xxx	6,708	1.1	12,860,808	.6	612,928	1.5	491
11xxx	6,400	1.0	17,508,240	.9	633,240	1.5	1,643
14716	25,496	4.1	96,323,881	4.7	2,503,600	6.1	2,222
20xxx	10,648	1.7	30,002,068	1.5	784,088	1.9	1,208
24211	89,360	14.5	413,933,200	20.1	6,374,920	15.4	2,389
24xxx	11,292	1.8	24,754,800	1.2	697,316	1.7	1,258
26111	39,888	6.5	179,483,556	8.7	3,079,972	7.4	1,588
26211	50,060	8.1	183,420,400	8.9	3,324,960	8.0	1,156
26212-999	17,800	2.9	62,574,580	3.0	1,115,480	2.7	1,240
26212-123	6,920	1.1	22,098,600	1.1	656,960	1.6	689
28125	48,464	7.8	204,610,984	9.9	4,793,386	11.6	1,237
28193	9,100	1.5	19,709,892	1.0	901,448	2.2	709
28198	10,300	1.7	41,935,220	2.0	813,020	2.0	904
28xxx	47,960	7.8	210,282,900	10.2	4,285,960	10.4	1,266
29xxx	29,552	4.8	85,585,256	4.2	2,190,248	5.3	787
32xxx	12,824	2.1	27,598,224	1.3	1,201,600	2.9	666
33xxx	29,288	4.7	98,969,508	4.8	2,359,228	5.7	1,085
37111-112	47,600	7.7	177,915,960	8.6	1,107,960	2.7	1,265
37xxx	12,356	2.0	35,135,880	1.7	343,320	.8	962
40xxx	7,200	1.2	10,328,748	.5	409,568	1.0	823
42xxx	15,060	2.4	17,880,472	.9	400,348	1.0	883
46xxx	65,503	10.6	48,502,734	2.4	1,356,150	3.3	972
xxxxx	4,760	.8	11,254,160	.5	192,520	.5	1,448
TOTAL	617,955		2,058,121,231		41,378,542		1,351

Table 3 shows the most important movements by 2 or 5 digit STCC code by Canadian province to the United States. The criteria for inclusion in Table 3 was that expanded carloads of the commodity were one-half a percent or more of the total Canadian-U.S. movement. The percentages of carloads, revenue and tonnages on the commodity lines of Table 3 are the percent of that province's shipments to the United States. However, the percentages on the subtotal lines are of total Canadian shipments to the United States. For example, STCC 26211 (Newsprint) accounted for 56.0% of the carloads, 57.2% of the revenue and 54.5% of the tonnage shipped from the Maritimes to the U.S. The Maritimes shipped a total of 6,040 carloads to the U.S. or 1% of the total Canadian shipments.

The Province of Quebec was identified as the origin of an estimated 126,775 carloads or 20.5% of the total but only 13.9% of the revenue and 14.8% of the tonnage. Average haul distance was 1,030 miles or 82% of the average distance. STCC 46 (Mixed Shipments) which are primarily TOFC/COFC accounted for 40.7% of the carloads from Quebec but only 11.2% of revenue and 14.8% of tonnage with an average distance of 991 miles. STCC 26211 (Newsprint) accounted for 23.1% of the carloads but 37.4% of revenue and 31.4% of tonnage.

TABLE 3

1992 WAYBILL SAMPLE
ESTIMATES OF TOTAL POPULATION
CANADIAN ORIGINS BY REGION
CARLOADS, TONNAGE AND REVENUE BY MAJOR STCC

STCC	EXPANDED CARLOADS	%	EXPANDED REVENUE	%	EXPANDED TONNAGE	%	AVE. MILES
			* MARITIMES *				
26211	3,380	56.0	11,351,620	57.2	230,320	54.5	1,282
MARITIMES TOTAL	6,040	1.0	19,838,480	1.0	422,500	1.0	1,245
			* QUEBEC *				
24211	10,040	7.9	28,166,480	9.8	657,960	10.7	1,246
26111	5,380	4.2	19,767,260	6.9	409,000	6.7	948
26211	29,320	23.1	107,088,240	37.4	1,928,160	31.4	1,056
26212-999	5,540	4.4	21,306,800	7.4	346,640	5.6	1,192
28XXX	3,220	2.5	16,519,560	5.8	307,740	5.0	1,147
32XXX	3,152	2.5	4,713,448	1.6	312,604	5.1	385
33XXX	8,520	6.7	38,754,920	13.5	709,200	11.6	1,134
42XXX	3,720	2.9	2,161,720	.8	49,200	.8	939
46XXX	51,619	40.7	31,960,778	11.2	887,630	14.5	991
QUEBEC TOTAL	126,775	20.5	286,546,570	13.9	6,140,186	14.8	1,030
			* ONTARIO *				
01137	5,760	3.9	8,139,424	2.0	563,616	7.5	998
24211	4,000	2.7	9,852,840	2.4	242,520	3.2	1,359
26111	13,320	9.0	49,703,300	11.9	1,015,900	13.5	1,156
26211	13,200	9.0	46,467,140	11.2	886,640	11.8	1,108
26212-999	5,940	4.0	17,371,640	4.2	389,400	5.2	1,042
28193	6,056	4.1	10,814,208	2.6	599,876	8.0	649
28XXX	3,860	2.6	13,453,840	3.2	341,540	4.5	689
29XXX	14,960	10.1	35,834,220	8.6	1,087,040	14.4	597
33XXX	4,920	3.3	12,769,760	3.1	397,920	5.3	856
37111-112	46,800	31.7	174,091,720	41.8	1,090,760	14.5	1,250
37XXX	7,080	4.8	20,044,920	4.8	203,480	2.7	719
42XXX	8,052	5.5	4,121,568	1.0	118,220	1.6	587
46XXX	8,944	6.1	5,252,436	1.3	205,120	2.7	751
ONTARIO TOTAL	147,408	23.9	416,667,068	20.2	7,532,312	18.2	991
			* MANITOBA *				
MANITOBA TOTAL	600	.1	2,219,320	.1	29,200	.1	1,777
			* SASKATCHEWAN *				
28125	47,764	89.2	202,667,344	87.5	4,737,106	90.0	1,241
SASK. TOTAL	53,572	8.7	231,663,276	11.3	5,262,886	12.7	1,250
			* ALBERTA *				
14716	24,556	31.7	93,199,221	27.4	2,415,420	35.3	2,230
20XXX	3,320	4.3	11,337,160	3.3	261,040	3.8	1,574
24211	8,220	10.6	37,570,900	11.0	640,240	9.3	2,101
26111	7,560	9.7	48,519,200	14.3	618,800	9.0	2,197
28198	9,080	11.7	39,312,200	11.6	715,680	10.5	954
28XXX	15,380	19.8	75,029,820	22.1	1,458,620	21.3	1,450
29XXX	5,200	6.7	21,886,360	6.4	372,920	5.4	1,254
ALBERTA TOTAL	77,576	12.6	340,172,033	16.5	6,847,828	16.5	1,735

TABLE 3 (cont.)

1992 WAYBILL SAMPLE
ESTIMATES OF TOTAL POPULATION
CANADIAN ORIGINS BY REGION
CARLOADS, TONNAGE AND REVENUE BY MAJOR STCC

* BRITISH COLUMBIA *

STCC	EXPANDED CARLOADS	%	EXPANDED REVENUE	%	EXPANDED TONNAGE	%	AV MILE
24211	64,700	80.8	332,722,660	84.7	4,672,560	81.8	2,712
26111	10,728	13.4	47,926,016	12.2	815,492	14.3	2,070
B.C. TOTAL	80,104	13.0	392,990,500	19.1	5,709,984	13.8	2,572

* CANADIAN PROVINCE UNKNOWN *

10XXX	6,192	4.9	10,181,384	2.8	563,116	6.0	388
11XXX	6,400	5.1	17,508,240	4.8	633,240	6.7	1,643
20XXX	6,768	5.4	17,752,868	4.8	476,248	5.0	1,049
24XXX	7,252	5.8	14,706,120	4.0	407,276	4.3	1,348
26211	4,160	3.3	18,513,400	5.0	279,840	3.0	1,899
26212-999	6,320	5.0	23,896,140	6.5	379,440	4.0	1,474
28122-123	5,120	4.1	11,430,040	3.1	477,160	5.1	372
28XXX	24,980	19.8	102,530,840	27.6	2,136,700	22.6	1,219
29XXX	9,172	7.3	27,200,156	7.4	715,528	7.6	833
32XXX	9,672	7.7	22,884,776	6.2	888,996	9.4	757
33XXX	15,848	12.6	47,444,828	12.9	1,252,108	13.3	1,129
37XXX	5,276	4.2	15,090,960	4.1	139,840	1.5	1,289
40XXX	6,004	4.8	8,387,980	2.3	303,892	3.2	893
UNKNOWN TOTAL	125,880	20.4	368,023,984	17.9	9,433,646	22.8	1,126
TOTAL	617,955		2,058,121,231		41,378,542		1,351

Ontario was identified as the origin of 147,408 carloads or 23.9% of the total carloads but of only 20.2% of the revenue and 18.2% of the tonnage. Average shipment distance was 991 miles or 73% of the average. The most important commodity group was STCC 37111-112 (Motor Vehicles) which account for 31.7% of provincial shipments, 41.8% of revenue and only 14.5% of tonnage. STCC 29 (Petroleum or Coal Products) was second in carloads shipped followed by STCC 26111 (Wood Pulp) and STCC 26211 (Newsprint).

Manitoba was identified as only originating 600 carloads. However, as discussed on the next page, this may be the result of the origin not being reported for confidentiality purposes.

Saskatchewan accounted for 8.7% of carloadings, 11.3% of revenue and 12.7% of tonnage. Average shipment distance was 1,250 miles or 93% of the average. The primary commodity was STCC 2815 (Potassium Compounds) (potash) which accounted for almost 90% of the shipments.

Figure 1



Alberta accounted for 12.6% of carloads, 16.5% of revenue and 16.5% of tonnage with an average distance of 1,735 miles, or 128% of the average. The most important product was STCC 14716 (Crude Sulfur) followed by STCC 28 (Other Chemicals), STCC 28198 (Anhydrous Ammonia), STCC 24211 (Lumber) and 26111 (Pulp).

British Columbia accounted for 13.0% of carloads, 19.1% of revenue and 13.8% of tonnage shipped an average distance of 2,572 miles or 190% of the average. Lumber accounted for 80.8% of carloadings following by pulp with 13.4%.

In some instances the origin or termination of a shipment is omitted from the sample record to protect the confidentiality of shippers (or railroads). In those cases the origin BEA is coded as "0". Of the 14,761 records, 3,030 did not give the province of origin in Canada. These are shown in the final section of Table 3. These records expanded to 125,880 carloads representing $368,000,000 or about 20.4% of the expanded carloads, 17.9% of the expanded freight revenues and 22.8% of the tonnage from Canada. The average haul 1,126 miles or 83% of the overall average length of haul. The highest volume commodities with unknown origins are STCC 28xxx (Other Chemicals) and STCC 33 (Primary Metal Products.) with about half of the carloads being coded with masked origins. Some commodities such as STCC 10 (Metallic Ores) and STCC 11 (Coal) have virtually all of their origins masked.

As mentioned previously, the sample data provides the destination BEA of most shipments (unless also masked for confidentiality). However, because of space limitations this paper has aggregated shipment destination by the five ICC Freight Rate Territories shown in Figure 1 rather than report by the 183 U.S. BEA's. Table 4 shows the shipments from Canada to each of the U.S. Freight Rate Territories. The percentages given for carloads, revenue and tonnage in Table 4 are of all Canadian shipments (not the percentage of the shipments to the territory). Over 52% of all Canadian shipments were to the "Official" Territory (FRT1) which includes New England, New York and the agricultural/industrial states generally north of the Ohio River and east of the Mississippi River.

STCC 46 (Mixed Shipments) which is over 95% TOFC/COFC accounts for 16.1% of the carloads to FRT1, but only 3.8% of revenue and 4.9% of tonnage. Average shipping distance of STCC 46 is only 897 miles or 66% of the overall average. The next largest volume commodity is STCC 24211 (Rough Lumber) which accounts for 12.8% of carloads to the region. Average distance for STCC 24211 is 2,144 miles or 159% of the national average. The next largest categories are 26211 (Newsprint), 28xxx (Other Chemicals), 26111 (Wood Pulp), 33xxx (Primary Metal Products), 28125 (Potassium Compounds), 29xxx (Petroleum or Coal Products) each of which accounted for more than 5% of the carloads shipped to the Official Territory from Canada.

The Southern Territory (FRT2) received 14.3% of the total carloads from Canada and accounted for 21.2% of the revenue and 14.6% of the tonnage. Average length of haul to the Southern Territory was 2,135 miles or 158% of the average. Code 24211 (Lumber) was the most important product accounting for 27.2% of carloads, 35.0% of revenue and 29.2% of tonnage shipped to the Southern Territory. Average shipment distance for STCC 2411 was 3,030 miles or 225% of the average. Other important commodities are STCC 37111-112 (Motor Vehicles) and STCC 14716 (Crude Sulfur).

The Western Trunk Line Territory (FRT3) of the Upper Midwest and Great Plains received 17.6% of the carloads, and accounted for 18.3% of the revenue and 19.2% of the tonnage. Average shipment distance to FRT3 was 1,238 miles or 92% of the overall average. The most carloads (18.7%), revenue (20.9%), and tonnage (25.4%) were shipped of STCC 28125 (Potash). Average distance shipped was 862 miles or 64% of the overall national average. Code 24211 (Lumber) accounted for 14.2% and STCC (Wood Pulp) account for 12.7% of carloads to FRT3.

TABLE 4

1992 WAYBILL SAMPLE
ESTIMATES OF TOTAL POPULATION
CANADIAN ORIGINS TO U.S. FREIGHT RATE TERRITORY
CARLOADS, TONNAGE AND REVENUE BY MAJOR STCC

U.S. FREIGHT RATE TERRITORY 1 - OFFICIAL

STCC	EXPANDED CARLOADS	%	EXPANDED REVENUE	%	EXPANDED TONNAGE	%	AVE. MILES
11xxx	6,400	1.0	17,508,240	.9	633,240	1.5	1,643
14716	10,860	1.8	28,372,260	1.4	1,062,780	2.6	1,740
24211	41,660	6.7	163,200,680	7.9	2,873,220	6.9	2,144
24xxx	3,960	.6	9,254,720	.4	265,800	.6	1,173
26111	19,088	3.1	86,919,556	4.2	1,463,412	3.5	1,571
26211	35,540	5.8	117,404,880	5.7	2,368,900	5.7	949
26212-999	9,320	1.5	28,014,340	1.4	574,280	1.4	1,058
28122-123	5,760	.9	16,170,680	.8	545,240	1.3	526
28125	17,616	2.9	77,206,756	3.8	1,713,904	4.1	1,300
28193	8,260	1.3	16,895,212	.8	817,968	2.0	653
28xxx	19,820	3.2	71,359,300	3.5	1,704,220	4.1	1,070
29xxx	16,940	2.7	40,862,600	2.0	1,236,852	3.0	608
33xxx	18,280	3.0	53,058,000	2.6	1,465,160	3.5	822
37111-112	15,600	2.5	33,856,880	1.6	368,760	.9	517
37xxx	6,000	1.0	15,348,600	.7	147,800	.4	490
40xxx	4,076	.7	5,989,768	.3	239,716	.6	919
42xxx	11,684	1.9	9,065,608	.4	222,200	.5	768
46xxx	52,287	8.5	32,939,434	1.6	1,019,698	2.5	897
SUBTOTAL	325,035	52.6	867,086,670	42.1	20,574,842	49.7	1,115

U.S. FREIGHT RATE TERRITORY 2 - SOUTHERN

14716	13,196	2.1	62,799,661	3.1	1,299,620	3.1	2,826
24211	24,120	3.9	152,574,320	7.4	1,770,440	4.3	3,030
26211	5,000	.8	26,767,280	1.3	311,120	.8	1,628
26212-999	4,040	.7	20,387,560	1.0	262,160	.6	1,578
28125	5,780	.9	31,092,252	1.5	575,208	1.4	1,969
28xxx	6,080	1.0	33,321,320	1.6	537,480	1.3	1,595
37111-112	13,640	2.2	49,538,680	2.4	324,680	.8	1,198
SUBTOTAL	88,648	14.3	435,936,121	21.2	6,055,268	14.6	2,135

U.S. FREIGHT RATE TERRITORY 3 - WESTERN TRUNK LINE

24211	15,420	2.5	59,615,080	2.9	1,110,780	2.7	2,018
26111	13,860	2.2	61,706,960	3.0	1,079,800	2.6	1,437
26211	5,700	.9	19,911,960	1.0	382,940	.9	1,283
26212-999	3,160	.5	8,274,560	.4	197,360	.5	969
28125	20,308	3.3	78,555,056	3.8	2,027,834	4.9	862
28198	7,440	1.2	31,110,440	1.5	586,480	1.4	918
28xxx	7,700	1.2	32,402,560	1.6	710,460	1.7	1,099
29xxx	3,360	.5	10,141,780	.5	248,700	.6	751
37111-112	5,360	.9	17,305,880	.8	117,840	.3	1,130
42xxx	3,216	.5	8,720,464	.4	177,508	.4	1,222
46xxx	8,816	1.4	12,316,420	.6	255,972	.6	1,325
SUBTOTAL	108,748	17.6	376,294,776	18.3	7,962,724	19.2	1,238

U.S. FREIGHT RATE TERRITORY 4 - SOUTHWESTERN

24211	5,960	1.0	31,805,280	1.5	451,160	1.1	2,862
28xxx	3,440	.6	19,327,880	.9	307,000	.7	2,131
33xxx	3,960	.6	18,260,520	.9	324,440	.8	1,938
37111-112	5,240	.8	21,576,520	1.0	119,320	.3	1,566
SUBTOTAL	30,260	4.9	136,346,480	6.6	1,979,680	4.8	2,159

U.S. FREIGHT RATE TERRITORY 5 - MOUNTAIN PACIFIC

24xxx	3,640	.6	7,660,400	.4	250,840	.6	863
28125	4,000	.6	15,004,280	.7	400,320	1.0	1,446
28xxx	10,280	1.7	51,316,080	2.5	969,480	2.3	1,281
29xxx	5,812	.9	20,943,396	1.0	443,656	1.1	752
32xxx	5,412	.9	9,654,756	.5	501,576	1.2	643
37111-112	7,760	1.3	55,638,000	2.7	177,360	.4	2,777
SUBTOTAL	61,020	9.9	234,473,064	11.4	4,433,620	10.7	1,311
TOTAL	617,955		2,058,121,231		41,378,542		1,351

Shipments to Southwestern Freight Territory (FRT4) accounted for only 4.9% of carloads, 6.6% of revenues and 4.8% of tonnage. Average distance was 2,159 miles or 160% of the national average. The most important categories were 24211 (Lumber) and 37111-112 (Motor Vehicles).

The Mountain-Pacific Territory received 61,020 carloads which accounted for 9.9% of the carloads, 11.4% of revenues and 10.7% of tonnage. Average distance hauled was 1,311 miles or 97% of the national average. The most important commodities were 28xxx (Other Chemicals) and 37111-112 (Motor Vehicles).

Table 5 summarizes major shipments by STCC codes by Canadian Province to each U.S. Freight Territory. The criteria for a 2 or 5 digit commodity to be included in Table 5 is that the particular commodity/province/freight territory movement accounts for half a percent or more of the total Canadian-U.S. shipments. The percentages given in Table 5 are of all shipments from Canada. For example, shipments of STCC 26211 (Newsprint) from the Maritimes to FRT1 are 3,140 carloads or 0.5% of all Canada-U.S. shipments. The total of all shipments from the Maritimes to FRT1 is 5,320 carloads which includes the 3,140 carloads of STCC 26211. All identified shipments from the Maritimes to the U.S. including those to FRT1 total 6,040 carloads.

Shipments from Quebec to FRT1 total 16.3% of the carloads but only 9.3% of revenues and 11.5% of total tonnage. The low percentage of total revenue is primarily due to the high proportion of STCC 46 (Mixed Freight) which is primarily TOFC/COFC. This accounts for 43% of Quebec carloads to FRT1 but only 12.5% of the revenue. The 43,419 carloads STCC 46 from Quebec to FRT1 is by far the largest volume from a single province to a U.S. FRT. Also, the 23,280 cars of STCC 26211 (Newsprint) from Quebec to FRT1 is the third largest volume from a province to a FRT.

Other large movements from Quebec are STCC 24211 (Lumber) and STCC 33 (Primary Metal Products) to FRT1 and STCC 46 (Mixed) to FRT3.

The most carloads from Ontario are STCC 37111-112 (Motor Vehicles) to FRT1. Note that STCC 37111-112 accounts for significant shipment volumes from Ontario to all five U.S. FRT's.

TABLE 5

1992 WAYBILL SAMPLE
ESTIMATES OF TOTAL POPULATION
CANADIAN ORIGINS TO U.S. FREIGHT RATE TERRITORY
CARLOADS, TONNAGE AND REVENUE BY MAJOR STCC

STCC	EXPANDED CARLOADS	%	EXPANDED REVENUE	%	EXPANDED TONNAGE	%	AVE. MILES
*** MARITIMES TO * U.S. FREIGHT RATE TERRITORY 1**							
26211	3,140	.5	9,949,740	.5	214,680	.5	1,203
FRT1 TOTAL	5,320	.9	16,147,880	.8	371,660	.9	1,118
MARITIMES TOTAL	6,040	1.0	19,838,480	1.0	422,500	1.0	1,245
*** QUEBEC TO * U.S. FREIGHT RATE TERRITORY 1**							
24211	7,280	1.2	17,174,440	.8	469,800	1.1	1,013
26111	3,700	.6	11,743,900	.6	282,280	.7	652
26211	23,280	3.8	76,959,660	3.7	1,540,420	3.7	863
26212-999	3,660	.6	11,372,080	.6	231,960	.6	904
32xxx	3,152	.5	4,713,448	.2	312,604	.8	385
33xxx	5,880	1.0	22,392,080	1.1	479,920	1.2	866
42xxx	3,240	.5	1,761,920	.1	40,040	.1	882
46xxx	43,419	7.0	24,926,418	1.2	746,430	1.8	916
FRT1 TOTAL	100,955	16.3	192,168,430	9.3	4,743,626	11.5	877
U.S. FREIGHT RATE TERRITORY 2							
26211	3,120	.5	15,825,080	.8	196,560	.5	1,473
FRT2 TOTAL	11,400	1.8	52,317,960	2.5	746,480	1.8	1,656
U.S. FREIGHT RATE TERRITORY 3							
46xxx	6,960	1.1	5,906,600	.3	118,480	.3	1,301
FRT3 TOTAL	11,200	1.8	23,027,660	1.1	400,360	1.0	1,390
QUEBIC TOTAL	126,775	20.5	286,546,570	13.9	6,140,186	14.8	1,030
*** ONTARIO TO * U.S. FREIGHT RATE TERRITORY 1**							
01137	2,832	.5	3,892,524	.2	278,044	.7	1,118
24211	2,960	.5	6,504,440	.3	181,360	.4	1,153
26111	7,380	1.2	28,993,640	1.4	564,220	1.4	1,097
26211	7,720	1.2	24,420,840	1.2	520,240	1.3	905
28193	5,656	.9	9,611,768	.5	560,436	1.4	615
29xxx	13,160	2.1	30,135,020	1.5	950,000	2.3	492
33xxx	3,000	.5	4,584,800	.2	239,280	.6	326
37111-112	15,480	2.5	33,613,560	1.6	364,120	.9	517
37xxx	4,520	.7	10,014,400	.5	106,040	.3	407
42xxx	7,092	1.1	3,048,976	.1	81,820	.2	538
46xxx	7,376	1.2	3,415,596	.2	169,700	.4	583
FRT1 TOTAL	85,772	13.9	178,658,796	8.7	4,702,304	11.4	656
U.S. FREIGHT RATE TERRITORY 2							
37111-112	13,640	2.2	49,538,680	2.4	324,680	.8	1,198
FRT2 TOTAL	22,152	3.6	78,448,488	3.8	853,680	2.1	1,261
U.S. FREIGHT RATE TERRITORY 3							
26111	4,140	.7	11,657,420	.6	315,000	.8	850
26211	2,880	.5	8,582,020	.4	198,120	.5	870
37111-112	5,320	.9	17,134,680	.8	116,840	.3	1,124
FRT3 TOTAL	19,844	3.2	53,565,064	2.6	1,172,728	2.8	927
U.S. FREIGHT RATE TERRITORY 4							
37111-112	5,040	.8	21,056,280	1.0	118,000	.3	1,563
FRT4 TOTAL	10,120	1.6	41,761,600	2.0	478,120	1.2	1,647
U.S. FREIGHT RATE TERRITORY 5							
37111-112	7,320	1.2	52,748,520	2.6	167,120	.4	2,771
FRT5 TOTAL	9,320	1.5	63,947,600	3.1	308,600	.7	2,746
ONTARIO TOTAL	147,408	23.9	416,667,068	20.2	7,532,312	18.2	991

TABLE 5 (cont.)

* SASKATCHEWAN TO *

U.S. FREIGHT RATE TERRITORY 1

STCC	EXPANDED CARLOADS	%	EXPANDED REVENUE	%	EXPANDED TONNAGE	%	AVE. MILES
28125	16,916	2.7	75,263,116	3.7	1,657,624	4.0	1,316
FRT1 TOTAL	18,820	3.0	85,202,516	4.1	1,840,064	4.4	1,338
U.S. FREIGHT RATE TERRITORY 2							
28125	5,780	.9	31,092,252	1.5	575,208	1.4	1,969
FRT2 TOTAL	6,060	1.0	33,022,292	1.6	600,328	1.5	1,971
U.S. FREIGHT RATE TERRITORY 3							
28125	20,308	3.3	78,555,056	3.8	2,027,834	4.9	862
FRT3 TOTAL	23,452	3.8	93,653,948	4.6	2,298,294	5.6	890
U.S. FREIGHT RATE TERRITORY 5							
28125	4,000	.6	15,004,280	.7	400,320	1.0	1,446
FRT5 TOTAL	4,440	.7	16,805,520	.8	444,160	1.1	1,439
SASKATCHEWAN SUBTOTAL	53,572	8.7	231,663,276	11.3	5,262,886	12.7	1,250

* ALBERTA TO *

U.S. FREIGHT RATE TERRITORY 1

14716	10,560	1.7	27,835,880	1.4	1,036,880	2.5	1,755
24211	4,160	.7	14,631,220	.7	304,760	.7	1,925
26111	2,800	.5	18,948,640	.9	218,520	.5	2,580
28XXX	2,920	.5	15,103,800	.7	266,320	.6	2,039
FRT1 TOTAL	22,860	3.7	84,003,832	4.1	2,002,188	4.8	1,932
U.S. FREIGHT RATE TERRITORY 2							
14716	12,596	2.0	60,304,141	2.9	1,241,180	3.0	2,850
FRT2 TOTAL	17,556	2.8	92,926,541	4.5	1,664,620	4.0	2,767
U.S. FREIGHT RATE TERRITORY 3							
26111	3,400	.6	20,595,600	1.0	284,000	.7	1,701
28198	7,000	1.1	29,809,560	1.4	551,960	1.3	939
28XXX	4,660	.8	21,655,220	1.1	447,940	1.1	1,163
FRT3 TOTAL	17,840	2.9	82,126,420	4.0	1,507,580	3.6	1,230
U.S. FREIGHT RATE TERRITORY 5							
28XXX	6,120	1.0	27,847,440	1.4	588,680	1.4	1,098
29XXX	3,200	.5	14,277,560	.7	231,160	.6	819
FRT5 TOTAL	16,280	2.6	66,510,360	3.2	1,403,600	3.4	1,019
ALBERTA TOTAL	77,576	12.6	340,172,033	16.5	6,847,828	16.5	1,735

* BRITISH COLUMBIA *

U.S. FREIGHT RATE TERRITORY 1

24211	25,780	4.2	121,742,300	5.9	1,821,420	4.4	2,680
26111	3,588	.6	21,345,396	1.0	275,052	.7	2,736
FRT1 TOTAL	30,528	4.9	147,911,456	7.2	2,169,272	5.2	2,688
U.S. FREIGHT RATE TERRITORY 2							
24211	17,920	2.9	121,634,480	5.9	1,321,720	3.2	3,353
FRT2 TOTAL	18,600	3.0	125,672,920	6.1	1,368,560	3.3	3,347
U.S. FREIGHT RATE TERRITORY 3							
24211	13,400	2.2	53,712,600	2.6	951,140	2.3	2,088
FRT3 TOTAL	18,836	3.0	77,353,884	3.8	1,359,352	3.3	2,085
U.S. FREIGHT RATE TERRITORY 4							
24211	5,440	.9	28,968,920	1.4	409,880	1.0	2,889
FRT4 TOTAL	6,340	1.0	32,725,800	1.6	459,320	1.1	2,919
U.S. FREIGHT RATE TERRITORY 5							
FRT5 TOTAL	4,760	.8	8,703,960	.4	274,080	.7	679
B.C. SUBTOTAL	80,104	13.0	392,990,500	19.1	5,709,984	13.8	2,572

TABLE 5 (cont.)

1992 WAYBILL SAMPLE
ESTIMATES OF TOTAL POPULATION
CANADIAN ORIGINS TO U.S. FREIGHT RATE TERRITORY
CARLOADS, TONNAGE AND REVENUE BY MAJOR STCC

* CANADIAN PROVINCE UNKNOWN TO *
U.S. FREIGHT RATE TERRITORY 1

STCC	EXPANDED CARLOADS	%	EXPANDED REVENUE	%	EXPANDED TONNAGE	%	AVE. MILES
10xxx	3,040	.5	4,262,280	.2	288,600	.7	299
11xxx	6,400	1.0	17,508,240	.9	633,240	1.5	1,643
20xxx	4,308	.7	11,657,628	.6	303,288	.7	1,024
26212-999	2,960	.5	9,014,980	.4	173,680	.4	1,234
28122-123	4,880	.8	10,542,440	.5	457,120	1.1	337
28xxx	12,620	2.0	41,526,940	2.0	1,052,700	2.5	950
33xxx	9,400	1.5	26,081,120	1.3	745,960	1.8	952
40xxx	2,920	.5	4,122,520	.2	127,320	.3	1,100
FRT1 TOTAL	60,460	9.8	161,840,440	7.9	4,729,328	11.4	974
U.S. FREIGHT RATE TERRITORY 2							
28xxx	3,600	.6	19,494,040	.9	307,800	.7	1,459
FRT2 TOTAL	12,040	1.9	49,806,800	2.4	768,080	1.9	1,707
U.S. FREIGHT RATE TERRITORY 3							
29xxx	2,840	.5	8,126,860	.4	211,580	.5	712
FRT3 TOTAL	17,536	2.8	46,337,480	2.3	1,222,250	3.0	1,042
U.S. FREIGHT RATE TERRITORY 4							
FRT4 TOTAL	7,620	1.2	30,852,560	1.5	502,720	1.2	2,089
U.S. FREIGHT RATE TERRITORY 5							
24xxx	3,640	.6	7,660,400	.4	250,840	.6	863
28xxx	3,920	.6	21,276,840	1.0	358,000	.9	1,477
32xxx	5,412	.9	9,654,756	.5	501,576	1.2	643
FRT5 TOTAL	25,220	4.1	72,070,584	3.5	1,935,140	4.7	977
UNKNOWN TOTAL	125,880	20.4	368,023,984	17.9	9,433,646	22.8	1,126
TOTAL	617,955		2,058,121,231		41,378,542		1,352

Large volumes of STCC 28125 (Potash) is shipped from Saskatchewan to U.S. FRT1, 2, 3, and 5. (The U.S. potash mines are in FRT4.)

The largest volume movements from Alberta are of STCC 14716 (Crude Sulfur) to FRT1 and 3. Other major moves includes STCC 28 (Chemicals) to FRT1, 3 and 5 and STCC 28198 (Anhydrous Ammonia) to FRT3.

STCC 24211 (Lumber) British Columbia to FRT1 accounts for the second largest province to FRT movement. Average distance of this move is 2,680 miles or 198% of the average. STCC 24211 is also shipped in large quantities to FRT2, 3 and 4. Average distance shipped to FRT2 (the Southern Territory) is 3,353 miles or 248% of the average. (These long shipment distances are one of the reasons that although British Columbia originates only 13.0% of the carloads and 13.8% of the tonnage, their shipments account for 19.1% of the rail revenues.)

TABLE 6
1992 WAYBILL SAMPLE
ESTIMATES BY ICC CARTYPE

ICC CARTYPE	EXPANDED CARLOADS	%	EXPANDED REVENUE	%	EXPANDED TONNAGE	%	AVE. MILES
36	400	.1	375,600	.0	16,000	.0	80
37	46,988	7.6	184,714,596	9.0	3,310,932	8.0	1,659
38	113,260	18.3	424,361,120	20.6	7,665,440	18.5	1,275
39	10,776	1.7	31,027,336	1.5	897,304	2.2	907
40	8,052	1.3	17,123,508	.8	667,648	1.6	805
41	112,676	18.2	417,864,864	20.3	10,909,532	26.4	1,101
42	6,320	1.0	17,119,720	.8	617,480	1.5	1,586
43	1,200	.2	3,179,760	.2	114,840	.3	1,360
44	440	.1	1,783,980	.1	21,220	.1	2,240
45	1,000	.2	3,838,880	.2	63,880	.2	2,182
46	95,495	15.5	67,308,722	3.3	1,682,882	4.1	1,063
47	47,680	7.7	177,970,000	8.6	1,110,840	2.7	1,263
48	1,456	.2	5,394,840	.3	94,356	.2	1,234
49	69,320	11.2	352,034,620	17.1	5,256,560	12.7	2,257
50	52,316	8.5	176,708,285	8.6	4,977,156	12.0	1,516
51	49,900	8.1	175,743,800	8.5	3,937,512	9.5	957
52	356	.1	1,280,640	.1	19,720	.0	1,867
54	320	.1	280,960	.0	15,240	.0	849
TOTAL	617,955		2,058,121,231		41,378,542		1,351

ICC CARTYPE		ICC CARTYPE	
36	Plain Box Cars 40'	45	Refrig. Car Non-Mechan.
37	Plain Box Cars 50'	46	Flat Car TOFC/COFC
38	Equipped Box Cars	47	Flat Car - Multi Level
39	Plain Gondola Cars	48	Flat Car - General
40	Equipped Gondola Cars	49	Flat Car - Other
41	Covered Hopper Cars	50	Tank Car < 22,000 gal.
42	Open Hopper - General	51	Tank Car > 22,000 gal.
43	Open Hopper - Special	52	All Other Freight Cars
44	Refrigerator Car Mechan.	54	Caboose

The last section of Table 5 shows the FRT destination of the shipments with unreported Canadian origins. Of these 60,460 cars (48.0%) went to the U.S. FRT1 in the northeast and 25,220 cars (20.0%) went to U.S. FRT5 in the west. Shipments from unreported locations in Canada to FRT1 accounted for 9.8% of total carloads from Canada. Average distance shipped from unknown origins to FRT1 was only 974 miles. The largest volume was of STCC 28xxx (Other Chemicals) followed by 33xxx (Primary Metal Products) with average distances of 950 and 952 miles. Some movements such as STCC 10 (Metallic Ores) and STCC 28122-123 (Sodium Compounds) were much shorter with average distances of 299 and 337 miles from Canadian origins to U.S. destinations.

Although not apparent in this paper, the sample can provide a substantial amount of information even if the identification of the origin province is masked. For instance, our more detailed analysis showed that the 6,400 carloads of STCC 11 of unstated origin to FRT1 had a 5 digit STCC of 11212 (Bituminous Coal, prepared), was shipped on single car waybills and all went to BEA 83 (the Chicago area). Two rail shipping distances were recorded--1,580 miles and 1,670 miles.

Similarly our detailed analysis found that 4,172 cars of the 5,412 cars of STCC 32 from unknown origin to FRT5 were STCC 32411 (Hydraulic

Cement). Of these 400 cars went to BEA 171 (Seattle), 332 cars went to BEA 172 (Portland) and shipping distances from Canada to FRT5 ranged from 240 miles to 830 miles.

As an example of additional types of information available from the *Public Use Sample* Table 6 shows the breakdown of Canadian-U.S. shipments by car type. Although not discussed here, it would be possible to analyze shipments by car type from province to FRT or BEA. We have also used the sample to analyze intermodal movements in the United States and the movements of hazardous materials to and from Minnesota BEA's.

To summarize, the annual *ICC Public Use Waybill Sample* is a statistically valid source of information about U.S. rail shipments. Until recently this data source was so large and unwieldy that it required a main frame computer for processing. Although still a very large data set, it is now possible to analyze waybill sample data on a desk top computer.

This paper summarized such an analysis of Canadian to U.S. rail movements using the waybill data for 1992. We anticipate increased use of this data set on both sides of the border as the North American economies become more integrated in the future.

ENDNOTES

1. Minnesota Agricultural Experiment Station paper 21029. Jerry Fruin and Dan Halbach are Associate Professor and Research Fellow in the Department of Agricultural and Applied Economics at the University of Minnesota. This research was supported by the Center for Transportation Studies and the Agricultural Experiment Station.

2. Information about the 1992 sample and listings of STCC codes and BEA are available in *User Guide for the 1992 ICC Waybill Sample*, Economics and Finance Department, Association of American Railroads, Washington, D.C., 1993.

3. *An Analysis of Canadian Rail Movements to the United States Using the 1992 Public Use Waybill Sample*, Jerry Fruin and Dan Halbach, 1994.

4. Individual commodities have a 7 digit STCC code, e.g., Wood Pulp is 2611135. Similar commodities can be grouped into 5 or fewer digit codes. That is, the 5 digit STCC 26111 includes pulp products while the 2 digit STCC 26 includes all pulp, paper or allied products. The seven digit STCC is reported on the original waybill. However, the Public Use Sample only reports the 5 digit STCC.

5. TOFC/COFC movements are also common in some other STCC's, for example, STCC 20 (Food Products), but are not the dominant factor as in STCC 46.

DEVELOPMENT OF ALTERNATIVE TRANSPORTATION TECHNOLOGIES: A FOCUS ON RECENT TRANSPORTATION INITIATIVES

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INTRODUCTION

The liberalization of trade into the Mexican apple market in 1991 opened the door for Washington apple exporters to significantly expand sales in that country. Exporters wasted no time in capitalizing on this opportunity, but in the process have encountered problems which have shifted attention to transportation capacity and efficiency. Transport availability, reliability and cost are all becoming increasingly important as Mexican apple imports continue to rise and formidable competitors begin to enter the market. The critical nature of these issues is further accentuated by dramatic overall U.S.-Mexico trade expansion and associated problems of congestion at major border crossings.

In response to these constraints on transportation reliability and efficiency, several potential transport alternatives have recently emerged. The purpose of this paper is to evaluate the cost and performance characteristics of three transportation alternatives (thru-rail, rail-barge-rail, and steamship) which will soon be serving Washington apple exports into Mexico. The specific objectives are to:

1. Review the transportation system serving Washington apple exporters.
2. Discuss transportation system imbalances and efficiency constraints.
3. Detail the recent development of potential transportation alternatives.
4. Determine the relative costs and benefits associated with each alternative.
5. Draw conclusions regarding how the introduction of new alternatives can help improve transportation efficiency and export competitiveness.

WASHINGTON APPLE EXPORT DYNAMICS

During the 1990/91 season, Washington exported 574,229 boxes of apples. One year later (1991/92), following the opening of the Mexican apple market, Washington exports were a record 4,025,435 boxes, an increase of more than 700%. In one year, Mexico moved from being of moderate interest as an export target to becoming the number one foreign market for Washington apples (Washington Apple Commission).

The export volume in 1991/92 was indeed astonishing and yet in the following 1992/93 marketing season, more than 5.7 million boxes of apples were exported to Mexico, a 42% increase over the explosion of exports in 1991/92. Preliminary 1993/94 export figures indicates that this level may well continue to rise. The recent signing of the North American Free Trade Agreement (NAFTA) lends further support to such a trend. Mexico's 20% tariff on apple imports has already been lowered to 18% for the U.S. and Canada and is scheduled to be reduced 2% per year for the next nine years. Furthermore, NAFTA will serve to standardize and streamline import/export documentation which could help alleviate paperwork congestion at the border.

CURRENT MODES OF TRANSPORTATION

Currently, three transportation alternatives are utilized for moving fresh apples from Washington into Mexican markets. These alternatives are transhipment by truck, thru-shipment by truck and transhipment by rail.

Most Washington apples reach Mexico by way of truck transhipments. Apples are loaded on U.S. trucks in Washington and are delivered to one of several destinations along the U.S.-Mexico border. McAllen and Laredo, Texas, are the most common destinations (Chacra). A freight forwarder then transloads the apples onto Mexican trucks. At its most efficient, this procedure takes approximately 15-30 minutes if the load is on pallets or slipsheets and two-four hours if it must be transloaded by hand rather than by forklift.

The loaded Mexican truck then clears customs at the border and continues to its final destination. Truck shipments from Washington to McAllen or Laredo are typically "fourth morning delivery," meaning that a truck loaded in Washington on Monday morning will arrive at the border on Thursday morning. This is true for truck transhipments as well as well as thru-shipments.

The major difference between transhipments and thru-shipments is that with thru-shipments the apples are not transloaded onto a Mexican truck. While the

load stays on the same trailer the entire journey, the U.S. tractor is replaced by a Mexican tractor at the border. Transhipment by rail is essentially the same as transhipment by truck, except that the first leg of the journey (Washington to border) is by refrigerated boxcar. A boxcar holds approximately 2,100 boxes of apples, while a truck holds 930-1070 boxes (a box is typically 42 pounds). The per box cost of transloading a railcar is the same as for a truck.

Truck rates to the south Texas border are highly variable. Depending on backhaul availability and seasonally high demand for competing goods, rates can range from $2.40-$3.75 per box (Welch). Thru-truck rates are much steadier, but availability can be even more troublesome. Representative rates and transit times for delivery from Washington to Monterrey and Mexico City (two major destinations for Washington apples exports) are given in Tables 1 and 2.

Table 1. Apple Transportation: Washington to Monterrey, Mexico, by Rate and Delivery Time, April 1993.

Rate/Time	Thru-Truck	Transtruck	Transrail
Wash.-Laredo	$2.92/box	$2.75/box	$2.46/box
Transload	--- 0 ---	$0.20/box	$0.20/box
to Monterrey	$0.55/box	$0.45/box	$0.45/box
Total Cost	$3.46/box	$3.40/box	$3.11/box
Delivery Time	6 days	6 days	13 days

Table 2. Apple Transportation: Washington to Mexico City, Mexico, by Rate and Delivery Time, April 1993.

Rate/Time	Thru-Truck	Transtruck	Transrail
Wash.-Laredo	$2.92/box	$2.75/box	$2.46/box
Transload	--- 0 ---	$0.20/box	$0.20/box
to Mexico City	$1.40/box	$1.27/box	$1.27/box
Total Cost	$4.32/box	$4.22/box	$3.93/box
Delivery Time	7 1/2 days	7 1/2 days	15 1/2 days

As indicated in Tables 1 and 2, the transrail rate is the lowest of the three alternatives. Although transrail can at times be as much as $1.00 per box cheaper than either truck alternative, it is the least utilized system for moving Washington apples to Mexico. This can be partly explained by the fact that transrail delivery times are substantially higher than for truck deliveries. Furthermore, transrail delivery time has been very inconsistent due to a lack of daily service on certain segments of the route from central Washington to the border.

Transtruck and thru-truck have very similar rates and transit times. As mentioned earlier, the primary differences are that thru-trucking service avoids transloading at the border and has steadier (but generally higher) rates. Transtruck service, on the other hand, has greater capacity and many more firms to choose from. Both systems have problems of availability at certain times of the year.

TRANSPORTATION SYSTEM IMBALANCES

The tremendous increase in Washington apple exports to Mexico has created, or at least accentuated, problems of availability and associated high truck rates at certain times of the year. Nearly all current apple movement to Mexico is by truck and during the summer months, truck rates to Laredo and McAllen, Texas (where most apple shipments to Mexico cross) tend to be very high. While apple exports to Mexico are relatively steady throughout the year, backhaul opportunities out of south Texas are not. During the summer there are very few return loads from this region and it is not uncommon for a truck to deadhead (travel empty) as far as California to get a load. Truck rates also tend to be high from mid-November through December due to greater alternative demand for refrigerated transport during this period (i.e., Christmas trees, frozen turkeys). In fact, during this time period truck rates can increase by 30%-40% and availability is still problematic (Welch).

Rapid market expansion in Mexico has not been limited to apples. As a prelude to the recently signed North American Free Trade Agreement, many trade restrictions were or are currently being phased out. The result has been a large increase in border traffic in the past few years and associated problems of congestion at the major crossing points. Significant growth in U.S.-Mexico trade began in 1986 when Mexico joined GATT; however, the increase in trade has been even more dramatic in recent years. During the period from 1989-92, total trade grew 45%. The volume of trade quickly outgrew the infrastructural capacity of Mexico's transportation system and the result has been excessive delays (U.S. Department of Transportation).

Delays have been due to both logistical capacity and administrative capacity. In an attempt to alleviate extreme congestion at the border, several infrastructural investment projects have been initiated and many more are in the planning stages. These projects include investment in several of the major bridges as well as the roads near the primary crossing points. However, it is not just increased truck and rail volume that has led to bottlenecks. The flow of paperwork has also grown dramatically. While Mexico has taken steps to streamline customs procedures at the Laredo crossing, there is still a large and growing need for further improvement in this area. This need arises because U.S. exports to Mexico are projected to increase by 65%-70% by the year 2000 and Mexican exports crossing at south Texas ports of entry are projected to increase by 120%. These projections are even more alarming considering that more than half of all overland exports to Mexico already cross in south Texas (U.S. Department of Transportation).

When dealing with perishable products like apples, reliable transportation is essential to preserving fruit quality. Furthermore, the timing of shipment arrivals is of particular importance in Mexico as cold storage is often limited or unavailable at the retail level. Clearly the efficiency of the transportation system is critical in exporting Washington apples to Mexico. In the following section, three potential transportation alternatives for shipping apples are examined:

Thru-rail. Direct rail service whereby apple shipments bypass border controls and clear customs and agricultural inspection upon arrival in Monterrey, Mexico. Railcars are transloaded into refrigerated trucks for delivery to final delivery to local buyers or interior destinations such as Mexico City or Guadalajara.

Rail-barge-rail. Rail service to Galveston, Texas, where boxcars are loaded onto barges and towed to a subport of Veracruz, Mexico. Railcars are then unloaded and continue to central Mexico.

Steamship. Refrigerated containers are transported by ship from Vancouver, B.C., to Los Angeles, California, where they are transloaded onto another steamship line for final delivery to Manzanillo, Mexico. Alternatively, containers are trucked from central Washington to Los Angeles and then are loaded onto a steamship bound for Manzanillo.

The rates and physical attributes of each system were developed through two research trips to the Texas-Mexico area and through interviews of exporters, brokers, carriers, freight forwarders and importers. It should be noted and

emphasized that all three of the alternatives examined in this paper are scheduled to begin serving Washington apple exports to Mexico in 1994.

POTENTIAL TRANSPORTATION ALTERNATIVES

Thru-Rail

Thru-shipment by rail has the potential to eliminate the additional cost and extra handling of transloading while at the same time providing quicker, more reliable service than transrail (Hurson). With this system, apples will be loaded on refrigerated boxcars in Washington. These cars travel on the Burlington Northern to Fort Worth, Texas, taking approximately five and one-half days. They are then switched to the Southern Pacific which takes the cars to the border at Eagle Pass in two days. At the border, they are picked up by the F.N.M. (Mexican National Railway) and approximately 16 hours later are in Monterrey. The total time expected from Washington to Monterrey is eight to nine days.

Unlike current transport alternatives, thru-rail shipments will not be inspected at the border. The shipments clear customs and agricultural inspection upon arrival in Monterrey. There are customs agents and Mexican agricultural inspectors at the offload site and, thus, congestion delays at the border are avoided. The projected cost of thru-rail to Monterrey is $5900 per railcar. This rate is equivalent to $2.95 per box (a railcar holds approximately 2000 boxes of apples). For interior destinations, such as Mexico City and Guadalajara, the additional truck freight would be approximately $1.00 per box. The transload into trucks in Monterrey is included in the rate paid to Monterrey.

This transportation alternative has been under development for more than two years and is very close to being implemented. A number of administrative barriers have delayed start-up of the thru-rail system. Most of the obstacles have been related to the inland customs clearance. Mexican law previously required all goods to be inspected and clear customs at the border. This is the first and only transportation system in which the Mexican government has permitted inland customs clearance. While authority has been granted for thru-rail's streamlined customs process in Monterrey, the laws must be officially changed before operations can begin. The physical system has been firmly established and it appears that the only obstacles are in the paperwork.

The warehouse facility in Monterrey has been completely remodeled and is ready for operation. It is capable of docking up to ten railcars at a time and the anticipated transload time is 20-30 minutes per truck. The F.N.M. is in the

process of building Monterrey's first intermodal yard beside the thru-rail warehouse and it is expected that intermodal movement of Washington apples through Monterrey will soon be possible. Additionally, several companies have expressed interest in developing cold storage facilities in Monterrey. Currently, there is no commercial chill facility in Monterrey; however, railcars at the thru-rail warehouse will have seven days free demurrage and can serve as temporary cold storage as needed (Hurson).

Rail-Barge-Rail

This potential transportation alternative began service in April 1993. Initially, the system served primarily grain transport, but is now handling perishable commodities as well. With this system, apples would be loaded onto refrigerated boxcars in central Washington and travel on the Burlington Northern to Galveston, Texas. There they would be moved onto barges equipped with track. The barges would then be towed in tandem to Coatzacoalcos, Mexico, a subport of Veracruz. Upon arrival, the cars would be taken by the F.N.M. to the customer's facility in Mexico, D.F. The delivery time from Washington to Mexico City is an estimated 16 days. The current capacity is 108 cars every three and one-half days (each barge can carry 54 cars). This transportation system does not currently serve Monterrey or any northern Mexico destinations. It targets destinations between Veracruz and Mexico, D.F., and--until a port farther north can be served--only the south-central destinations will be available (Asplund).

The rail-barge-rail rate effective until April 1, 1994, is $10,000 per railcar (approximately $5.00 per box). The rate from central Washington to the port of Coatzacoalcos is $8500 ($4.25 per box) and includes inland rail freight from origin to Galveston, handling and port charges in Galveston, ocean freight to Coatzacoalcos and full cargo insurance up to $30,000. The Mexico portion costs $1500 ($0.75 per box) and includes all port operations in Coatzacoalcos, wharfage and dockage, services and charges of Mexican customs broker to preclear cargo, overland rail transportation to customer facility (in Mexico, D.F.), shipment tracing and full cargo insurance up to $30,000 per car. Also, railcars will have 48 hours free demurrage at the customer's facility.

While rail-barge-rail has only been in operation a short time, grain shipments have thus far met and in many cases exceeded stated timelines. Refrigerated cargo began moving by rail-barge-rail in November 1993 with frozen foods southbound and fresh fruit northbound. To date there have been no serious logistical or administrative problems. One potential problem related to perishable movement is the availability of refrigerated boxcars. Current reefer capacity on rail-barge-rail is 5-10 cars per week. Industry-wide availability of

reefer boxcars is expected to decrease as equipment continues to be removed from service and no new cars are being built (Asplund).

Steamship from Vancouver, B.C., or Los Angeles, California, to Manzanillo, Mexico

With a steamship-based transportation system, apples would be loaded in refrigerated containers in central Washington. They would then be trucked to Vancouver, B.C., where they would be loaded onto a steamship. The steamship line would deliver the containers to the port of Manzanillo (via Los Angeles, California) where they would be transloaded into Mexican trucks and carried to their final destination.

The total time estimated for delivery from Vancouver, B.C., to Manzanillo is 12 days (Edwards). Inland transport from origin to the port of Vancouver and from Manzanillo to final destination would be an additional two to four days.

Alternatively, containers would be trucked to Los Angeles, California, where they would be loaded onto a steamship bound for Manzanillo. The containers would have a single bill of lading for the overland and water freight. The truck portion to Los Angeles would take approximately two days. Transloading would take one day and the water transit time to Manzanillo would take approximately three days. Offloading and inland transit to Mexico City or Guadalajara would take an additional one to two days. The estimated cost for each of these alternatives is $3500 per 40-foot container, approximately $3.50 per box (Edwards).

This alternative is physically ready to begin moving Washington fruit and current capacity on both steamship lines is over 400 containers with eight-day cycle times. The only obstacle remaining is the declaration of Manzanillo as an official port of entry for U.S. fruit. Customs officials and agricultural inspectors are already located in Manzanillo to inspect Chilean and New Zealand fruit; however, it is not clear if or when U.S. fruit will be allowed to enter Mexico through the port of Manzanillo (Dunbar).

COMPARISON OF ALTERNATIVES BY RATE, TRANSIT TIME AND MARKET AREA

Monterrey

The three potential transportation alternatives are best compared with existing transport options by market area. Both steamship and rail-barge-rail are currently targeting the heavily populated area in central Mexico which encompasses Mexico City and Guadalajara, Mexico's two largest urban

centers. Both systems will enter Mexico far south of the border and the much greater geographical distance to northern Mexico and the industrial center of Monterrey (Mexico's third largest city) will preclude any attempts to serve this market area. Currently, neither of the steamship alternatives nor rail-barge-rail is offering deliveries to northern Mexico. Thru-rail, on the other hand, will serve both the northern markets with a competitive direct rail service as well as markets farther south via trucks transloaded in Monterrey. Estimated rates and transit times for apple transport from central Washington to Monterrey, Mexico, are detailed in Table 3.

Table 3. Representative Rates and Delivery Times for Apple Transport From Central Washington to Monterrey, Mexico.

Transport Options to Monterrey	Rate per Box	Total Transit Time
Transtruck	$3.40	6 days
Thru-truck	$3.46	6 days
Transrail	$3.11	13 days
Thru-rail[a]	$2.95	8 1/2 days

[a]Potential alternative.

Thru-rail appears to be the best choice with minimizing cost as an objective and delivery by truck is the most attractive if speed of delivery is to be minimized. However, the figures do not capture the dynamics of the various alternatives. The modal selection process is far more complex than merely selecting the lowest rate that satisfies the desired delivery time. Rate variability, system capacity, service reliability and seasonal availability must also be considered.

As mentioned earlier, transtruck rates are highly variable relative to the other alternatives. Transtruck rates have ranged from $2.40/box to as high as $3.75/box. Thus, transtruck rates to Monterrey can be significantly higher than for the other alternatives at certain times during the year. Availability can be a problem during these periods, even for those willing to pay higher rates (Welch).

One apparent solution to this problem would be switching to thru-truck service. However, unless one is a regular customer of a thru-truck company, availability can be as troublesome at any time of year. The four thru-truck companies serving Washington are all large carriers with a well-established clientele. Their business strategy is to maintain regular service at steadier, more dependable rates (Aaron, Dolloff, Forston, Ward). Between the four

companies there is capacity for 80-100 truckloads of apples per week. Each has the equipment to meet increased demand for apple shipments to Mexico, although this would require decreasing service to regular, steady customers. Taking higher bids for sporadic shipments at the expense of losing regular customers is simply not done under the managerial approach of these firms.

The transrail rate is clearly lower than either truck alternative (Table 3). In fact, the per carton cost of transrail has been more than $1.00/box cheaper than truck service. However, the lower price has not attracted any significant level of use. This suggests that the true cost of transrail is higher than that indicated by the nominal rate. When comparing transrail with the other alternatives, it appears that the lower price per carton is significantly offset by the relatively long 10-13 days travel time to the border and some concern about reliability and damage (Buak, Steensma).

The thru-rail system offers a unique combination of attributes. If the proposed time and rate schedules are achieved, thru-rail will provide speedier delivery than transrail (approximately five days quicker) and less rate variability than transtruck (apple freight rates will remain at $2.95/box for 1994). Furthermore, potential logistic and administrative congestion at the border is also avoided. Thru-rail capacity is conservatively estimated at 500 cars (1000 trucks) for the first year of service and is expected to expand as the system becomes well established (Hurson).

It should be noted, however, that not all of the attributes of the thru-rail service are necessarily appropriate for all users. For example, thru-rail delivery time, while less than transrail, will still be about three days longer than truck service. Additionally, thru-rail service is currently planned only to Monterrey. Thus, shipments to any other Mexican destination (such as Mexico City or Guadalajara) must be transloaded onto trucks. Thru-rail may also be less attractive to those importers who wish to inspect the load prior to its crossing the border and those interested in only a single truckload quantity.

Mexico City/Guadalajara

Considering the size and importance of the Mexico City and Guadalajara markets, it is understandable that all three potential transportation alternatives are targeting this area. The combined population of these two urban areas is more than 20 million people, roughly one-fourth of the entire country's population. Accordingly, this area has been the primary destination for Washington apples. The rates and transit times for the various transportation options to Mexico City are given in Table 4. Corresponding figures for the

Guadalajara market are not given, but are very similar to those given for Mexico City.

Table 4. Rates and Delivery Times for Apple Transport From Central Washington to Mexico City, Mexico.

Transport Options to Mexico City	Rate per Box	Total Transit Time
Transtruck	$4.22	7 1/2 days
Thru-Truck	$4.32	7 1/2 days
Transrail	$3.93	15 1/2 days
Thru-Rail[a]	$4.24	10 1/2 days
Steamship[a] (Vancouver, B.C.)	$5.95	16 days
Steamship[a] (Los Angeles, CA)	$5.25	8 days
Rail-Barge-Rail[a]	$4.76	16 days

[a]Potential alternatives.

The two rate extremes, transrail (cheapest) and steamship via Vancouver, B.C. (most expensive), are the least likely to be used for moving Washington apples to Mexico. It was pointed out earlier that transrail takes a very long time and is considered to be very inconsistent. Despite its relatively low rate, it is very seldom used. A comparison of the figures listed in Table 4, indicates that the proposed steamship service from Vancouver, B.C., to Manzanillo has little chance of being used for Washington apples. For approximately $0.70 per box less, containers can be trucked to Los Angeles for steamship service to Manzanillo and will also save eight days transit time. Since capacity should not be a limiting factor and the port and inland Mexico costs are identical for each system, there is no apparent reason to use steamship service from Vancouver, B.C.

With these two options excluded, the rates to Mexico City/Guadalajara appear to be very similar for the remaining options. As mentioned earlier, however, truck rates for the U.S. portion are highly variable. Mexican truck rates are also variable, but much less than those from central Washington to Laredo and McAllen, Texas (Trevino, Chacra). The thru-rail, steamship (Los Angeles) and rail-barge-rail rates, on the other hand, are expected to be very steady. These alternatives are all offering dependable rates, but dependable transit times have yet to be proven. Rail-barge-rail has been consistently meeting or

beating scheduled delivery times since beginning operations in April 1993. The only remaining obstacle is that Coatzacoalcos has yet to be cleared for apple shipments. The port is already handling fresh fruit and other perishable items requiring agricultural inspection, but apples have yet to be formally approved.

This type of constraint would seem easily resolved as it only requires a simple clearance from Mexican authorities. The physical system and paper flow have already been established and the addition of apples on these rail barges should not require much time or effort. This same type of obstacle, however, has kept thru-rail to Monterrey waiting for more than a year. Bureaucratic constraints such as the declaration of Coatzacoalcos and Manzanillo as official ports of entry for U.S. apples are not easily overcome. While the North American Free Trade Agreement may eventually reduce these administrative barriers to U.S.-Mexico trade, it will take some time before these obstacles no longer affect the flow of goods between the two countries.

As for utilizing steamship service from Los Angeles, the primary advantages are availability and capacity. The 400 container capacity per ship is much greater than necessary. The current average for total movement of Washington apples to Mexico by all modes is approximately 110 FEUs (40-foot container equivalent units) per week. While other goods will certainly use some of this capacity, availability is not expected to be a problem (Edwards). The relatively frequent eight day sailing schedule combined with dedicated reefer service should help assure that availability is consistent.

Rail-barge-rail has a relatively long transit time (16 days) and there does not appear to be significant cost savings even during those times when truck rates are $1.00 per box higher. It appears that the main advantage to using rail-barge-rail is availability. When trucks to south Texas are simply not available, the longer transit time would become less of an issue for those users who prioritize speed of delivery. Furthermore, at these times the more dependable rail-barge-rail rate would be very competitive. With a current sailing schedule from Galveston of every 3.5 days and a projected increase to 2.25 times per week, the longer transit time could be efficiently managed if the system is able to hold close to its 16 day estimate. By getting in the habit of booking freight on 16 day notice rather than eight, shippers could maintain a steady flow of product to their markets.

One attribute unique to rail-barge-rail is that transloading is completely avoided. While thru-rail has direct service to Monterrey, shipments bound for other destinations must be transloaded onto trucks. Steamship service would avoid some risk of product damage from additional handling by using containers, but these containers will be not be allowed to travel to inland

Mexico destinations. They will be transloaded at the port of Manzanillo onto Mexican trucks for final delivery.

All three potential transportation alternatives have a number of apparent advantages and disadvantages depending on the specific needs of the user. Therefore, it is difficult to make a definitive statement favoring one system over another. Below is a summary of the attributes of each potential alternative.

Table 5. Key Attributes of Potential Transportation Alternatives for Moving Washington Apples onto Mexican Markets.

Thru-Rail	Rail-Barge-Rail	Steamship (L.A.)
* lowest rate, very steady * improved rail transit time, but longer than truck * direct rail service to Monterrey * transloaded trucks to other destinations * capacity 500 cars first year * inland customs clearance * inland agricultural inspection * 7 day free demurrage in Monterrey	* less competitive but steady rates * longest transit time * no transload * serves only south-central destinations (Mexico, D.F.) * consistent, efficient service proven for other products * reefer car availability 5-10 cars per week * 48 hour free demurrage	* relatively high rate * competitive transit time * very high capacity * 8 day sailing schedule * cold storage available at port of Manzanillo * transload into reefer trucks at Manzanillo * serves southern and central destinations

IMPLICATIONS

The benefits of an efficient and balanced transportation system are certainly not unique to Washington apple exporters. However, current and potential competition for the Mexican market has caused the costs of inefficient transport and the benefits of increased efficiency to rise dramatically. Taking advantage of the opportunity for improvement is quickly becoming a necessity.

The efficiency of current transportation alternatives is constrained by congestion, availability, reliability and cost. While the addition of thru-rail, rail-barge-rail and steamship systems has the potential to alleviate some of these imbalances, their performance and capacity have yet to be proven.

Furthermore, these new alternatives should be viewed as a step in the right direction, rather than a solution. No single mode of transportation can provide all of the attributes desired by various users. It is, therefore, critical that resolving constraints in the existing transportation system be balanced with the exploration of new avenues and alternatives.

It is obvious that increased competition for the Mexican apple market will create pressure for reducing transportation rates. However, the rate level is only one of many important attributes and, as illustrated by transrail, it is not necessarily the most critical. With perishable goods, such as apples, the quality of the product is directly related to the quality of transportation service. Reliable, high quality transport is essential to developing strong trade ties; strong trade ties are Washington apple exporters best defense against competition.

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COOPERATION EXTENDED TO TRAPPED MERGING DRIVERS INCREASES DURING RUSH HOUR AND IS HIGHEST ON FRIDAY EVENINGS

ABSTRACT

Data on seven hundred and nineteen merging subjects were gathered over three weeks of observations carried out to determine the amount of cooperation that occurs between drivers and which factors influence this type of behaviour. The numbers of cars that passed a trapped driver attempting to enter the traffic stream was determined as a function of time of day (morning rush hour, mid-morning, evening rush hour) and weekday (Monday, Wednesday and Friday). Chi-squared and Log Linear analyses indicated that drivers were significantly more cooperative during the evening rush hour than during the morning rush hour and least cooperative during the mid-morning low traffic density period. Results also indicated that drivers were most cooperative on Friday evenings. The possible relationship between this type of social behaviour and schedule or driver stress; risk factors involved with being forced to wait; and, motor vehicle accident rates might be considered.

INTRODUCTION

> Among the artifacts that have transformed North American society in the twentieth century, the automobile surely holds primary place. It is the instrument through which most of the social bonds that link North Americans to their institutions and to each other are now maintained. The automobile is now an essential component of each individual's persona, without which life as he or she knows it would be impossible.
>
> (Bogart, 1977, p. 10)

A theory of competence motivation has been suggested by White (1959) which postulates that a significant process in personality functioning is the motivation toward dealing competently and effectively with the environment. What this means in more specific terms and with respect to the car, is that the actual operation of the car and associated monitoring of the environment may be fulfilling an arousal and activity requirement which is reinforcing and satisfying. That a responsive microenvironment is reinforcing by its very nature would be predicted from the instrumental conditioning paradigm alone, but to this is added the satisfaction of a need for active maintenance and control over one's immediate environment.

Perceived loss of control over one's environment has been increasingly suggested as the principal factor responsible for the aversive consequences of environmental stressors such as noise, crowding, and general sensory overload (Glass and Singer, 1977).

The experimental research which has investigated this variable typically defines loss of control as the non-availability of an adequate response in a situation which requires one (Averill, 1973). The principal finding has been that perceived lack of control over the onset, intensity, or administration of an aversive stimulus is indeed stressful, particularly in circumstances of relative uncertainty and confusion. It is particularly noteworthy that much of the above research has involved or been directly applicable to environmental stressors, such as noise, time constraints, and crowding. One's life is regimented by alarm clocks, work hours, deadlines, and delays. Those time constraints relating to the scheduling of interpersonal contacts and workload have been designated as "schedule stress" and are thought to be a principal component of the general stress of contemporary life (McQuade, 1972).

How does the automobile fit into this picture of overload and excessive constraints? It helps us to race against the clock, it is very responsive to our needs and anxieties, and it can provide a feeling of power, competence, elation, and 'almost' freedom. An automobile is, ultimately, under our control - even if the larger world is not - and it in fact magnifies one's personal power at the same time that it compensates for one's perceived impotence. The personal control is, of course, more imagined than real, but the impression of control is what is psychologically salient and this is strongly reinforced by the immediacy and responsiveness of the car. The commuter is not entirely freed from pressures and frustrations, and will have to "fight" the rush hour traffic to work and home again.

Despite the apparent anonymity of drivers who use the streets and roads as vehicle operators, participation in traffic does not take place in a social vacuum. Driving tasks are performed in the context of the collective of road users, and this context is characterized by the central tendencies of social habits and values, expectations and communications, as well as their patterns of deviation. In a theoretical paper, Deehy (1968) has made a distinction between two types of norms or rules that influence driver behavior: formal legal norms and informal social norms. An interesting case of conflict between the two rule systems is what is called "psychological right of way" or "natural right of way" which pertains to who is actually the first to pass at non-signalized intersections. The formal rule demands yielding to traffic coming from the right but it is not uncommon for drivers to yield to traffic coming from the left. It is not known what possible factors enhance the perceived status of the merging driver: who shows yieldingness to whom; under what traffic conditions; and, on the basis of what perceptions (Wilde, 1976).

Social facilitation refers to changes in the behaviour of an individual in the presence of other people who act either as an audience or as coactors to the same task (Towler, 1986). Zajonc's (1965) general drive theory predicts that the presence of audience and coactors increases subjects' performance on a simple overlearned response, while it decreases subjects' performance on a response to be learned.

Gulian, Glendon, Matthews, Davies and Debney (1990) conducted

research on the stress of driving at two levels: general appraisal of driving and appraisal of specific incidents when driving. The general appraisal of driving was measured on the Driving Behaviour Inventory (DBI) developed by Gulian et al. (1988, 1989a). This instrument is designed to measure such personal information as: personal, domestic and work problems; mood, emotions and attitudes in relation to driving, traffic situations and other road users; and coping strategies adopted with respect to driving in general and to specific traffic situations.

Their approach was based on Lazarus' transactional view of psychological stress as the result of environmental demands being appraised as taxing or exceeding the person's resources (Lazarus and Cohen, 1977). The emphasis in this approach is on: a) cognitive appraisal of events as determining level of stress response; and, b) that driver stress may interact with factors extrinsic to driving. For example, fatigue induced by heavy driving might cause stress at work; family problems or work-related worries may interfere with the driver's ability to attend to the driving environment.

To obtain a more complete picture of driving stress, reactions to actual driving situations were examined; changes in these as a function of time of day and day of the week; and their relationships with subjects' overall appraisal of driving as stressful.

The investigation revealed that reported levels of driving stress were significantly higher for evenings on four days and approached significance on the other two days. It was also found that the extent of tiredness consistently and significantly differentiated between morning and evening. However, the overall differences in morning and evening driving stress remained significant even when tiredness was removed from the analysis. Since fatigue was not the only factor contributing to differences in morning and evening driving stress it appeared that daily events had a negative cumulative effect. Such a cumulative effect was also revealed in changes in driving stress levels over days of the week, with the peak being attained on day 4 (Thursday), just before the weekend. Gulian, et al. (1989b) also found a 'weekend' effect when examining respondents' comments about, and appraisal of, stressful traffic events encountered that day.

This thesis proposes to examine the amount of cooperation that is extended to drivers who are trapped in a merge lane. The previous studies collectively form its basis. The driver who becomes trapped in a merge lane has little control over the situation. Ebbesen and Haney (1973) reported a positive relationship between the amount of risk a merging driver is willing to take and the length of the waiting period. Social facilitation (Towler, 1986) was also incorporated as a possible factor for assisting a merging driver into the traffic stream. This concept refers to the changes in an individual's behaviour when there are observers or coactors present. Tied in with this concept is the general drive theory (Zajonc, 1965) prediction that there will be an increase in the performance of overlearned responses, such as cooperative behaviour, in the presence of an audience. Gulian et al. (1990) found that the stress level of drivers increases as the day and the week progresses. These findings made up the last component of my study.

It was hypothesized that: (1) Cooperative assists to merging

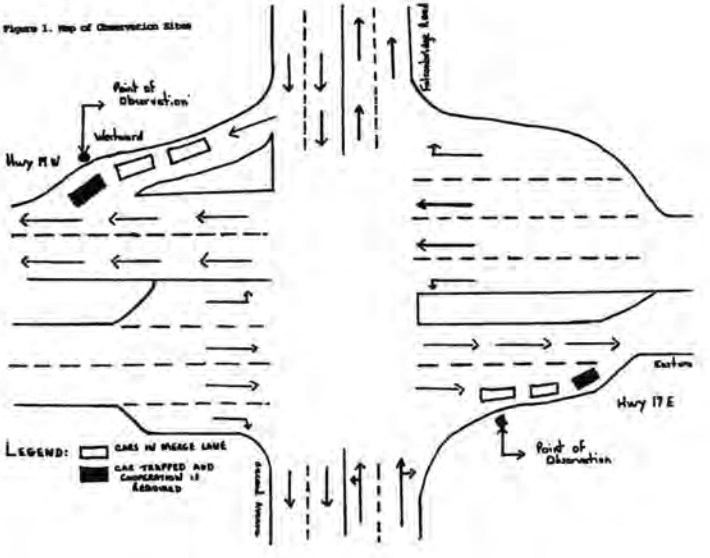
drivers would increase due to a greater number of observers during rush hours; (2) Merging drivers would remain trapped for a shorter period of time returning from work due to increased cooperative behaviours between drivers who are fatigued and stressed from the work day; (3) Assistance would increase as the week progressed and would reach its maximum on Friday evening.

METHOD

Selection of Site

The site was selected for the following reasons: 1) close proximity of the locations, reducing the time required to get from one post to the other; 2) to observe two separate disappearing lane conditions - a merge lane westward and a terminating traffic lane eastward); 3) at one of the busiest traffic areas in the City of Sudbury, where Highway 17 interconnects easterly and westerly suburbs, villages and towns; 4) protection from the elements.

Figure 1 shows the two locations which were chosen. As can be seen, Location 1 was the merge lane connecting Falconbridge Road South to Highway 17 West, with Second Avenue North situated directly across the intersection. At Location 2, the observation post chosen was to the right of the lights at Second Avenue North and East of the intersection.



Selection of Method

A pilot study of one week's duration was carried out prior to the start of data collection. Driver interactions were observed and information on would-be subjects, that is, drivers becoming trapped, was collected. This pilot study was found to be an invaluable exercise for the following reasons: 1) to develop a system for the collection of the data which would be suitable for the specific conditions at both locations; 2) to assess the amount of time involved in documenting the pertinent information for each subject at Location 1, while keeping the next vehicle under observation; 3) to devise an appropriate method for the documentation of data at Location 2; 4) to make the appropriate choice regarding which equipment would best suit the purpose; 5) to choose the hours most representative of the morning and evening rush hours, as well as one period of low traffic density.

Position of Observation Vehicle

At Location 1, the observation vehicle was parked perpendicular to the road surface, approximately 30 feet behind and 3 feet below the merge lane road surface, but back approximately 16 feet to the left of the end of the merge lane. From this position the trapped vehicles were easily observable since they were directly in the line of vision. As well, it permitted a clear view of the total merge lane area. This was necessary since the number of vehicles lined up behind the trapped driver was scored and used as an independent variable.

At Location 2, the observation vehicle was parked on a 45° easterly angle approximately 60 feet behind and 12 feet above the road surface. This position provided a clear view of vehicle interactions throughout the single filing process.

Subjects

Data on 719 subjects, who were unknowing participants, were collected over a total of 54 observation periods (27 at each location) lasting 25 minutes each, over a 3 week period. Subjects could become trapped and: 1) be forced to wait until the end of traffic to gain access to the traffic stream; or, 2) receive and accept assistance from an oncoming driver which would allow entrance into the traffic stream.

At Location 1, subjects were the westbound drivers who could become trapped when attempting to enter the traffic stream from the merge lane. This was possible during traffic movement from Hwy 17 East during one green light, and during traffic movement from Second Avenue at the next green light. Each twenty-five minute observation period contained approximately 30 green lights. Drivers who did become trapped were used as subjects only if assistance had not been refused, so as not to negatively influence the results. That a driver was chosing to remain at the end of the merge lane, until all traffic had ended, was made particularly obvious when the drivers who were being held up as a result, pulled out and merged from behind the lead driver who was still refusing to move. Since the latter drivers were actually being trapped by the lead merging driver they were also discounted as subjects.

At Location 2, subjects were the eastbound drivers who could become trapped after having crossed the intersection on the green light. This could occur only in instances when there were vehicles

in both lanes or if one or the other lane was used to pass and get ahead of other drivers. There were approximately 19 green lights per twenty-five minute observation period.

Scoring

The score each subject received was the number of vehicles that had gone by, if any, before the subject gained access to the traffic stream. At Location 1, if the subject was assisted immediately upon arrival at the end of the merge lane the score received was 0. Scores obtained by subjects who were not assisted immediately, or who had to wait until end of traffic, ranged from 1 to 9. It was possible for a subject to receive a score of 1 and be forced to wait until traffic end. This occurred mainly when subjects were being trapped by vehicles which had turned onto the highway from Second Avenue. At Location 2, subjects were the drivers who were: 1) forced to wait in the terminating lane until all traffic had passed; or 2) had received assistance at some point from the intersection to the end of the terminating lane. Interscorer reliability equal to 1 was obtained on one third of the subjects.

Apparatus

A Philips 593 Pocket Memo Voice Activated recording device was used for data collection and a paper clipboard was used for documentation purposes. At the end of each observation period the data were transcribed to free up the cassettes. Numerical codes were ascribed to each variable on 4 x 4 cm graph paper. Statistical analysis was done on the Laurentian University VAX system using the statistical package for the social sciences (SPSSX).

Procedure

Observation Schedule

Observations were carried out on Mondays, Wednesdays and Fridays, during 3 time periods, for 3 weeks, resulting in 27 observation periods of 25 minutes at each of the two locations (54 in total). The time periods were: 8:00 to 9:00 A.M. (AMRUSH hour); 9:45 to 10:45 A.M. (NORUSH hour); 4:30 to 5:30 P.M. (PMRUSH hour).

Since there were two locations at which observations had to be carried out, it was decided to remain at each location for no longer than 25 minutes, to allow time for displacement from one location to the next. However, a method had to be devised to permit observation for one hour in total. The accepted method was to reverse the order of observation; for example, Monday's AMRUSH observation at Location 1 would be from 8:00 to 8:25 A.M. one week, but from 8:30 to 8:55 A.M. the following week.

Observation Procedure

The date and time were entered at the beginning of each observation period. Any changes in weather or traffic conditions were documented as they occurred. At Location 1, a total count of all traffic moving in the westerly direction was taken for a period of 5 minutes at the beginning and at the end of all observation periods. The total traffic density count, for each 30 minute observation period, was obtained by adding the count obtained during the first 5 minutes to that of the last 5 minutes and multiplying by 3 (5 + 5 x 3 = 30 min.). Mean total traffic density was: AMRUSH = 633; NORUSH = 249; PMRUSH = 513. At Location 2, all moving traffic was incorporated into the documentation and all eastbound vehicles per green light were counted during each observation period. The

total count was 3,618 vehicles.

Variables

The first dependent variable was Score, which was the actual number of vehicles that had gone by the trapped driver. Scores ranged from 0 to 9. A second dependent variable (NOCOP) was computed from the method of assistance variable to reflect that: a) some subjects had been forced to wait for end of traffic due to noncooperation; while, b) some subjects had been assisted through the cooperation of another driver. NOCOP was scored as follows: noncooperation = 0 (subject was forced to wait for end of traffic); cooperation = 1 (subject received assistance).

The independent variables were:

1) Time of day (TOFD) - AMRUSH = 1; NORUSH = 2; PMRUSH = 3); two daily rush hours (1 and 3); low traffic density (2).
2) Day of the Week (WKDAY) - MON (Monday) = 1; WED (Wednesday) = 2; FRI (Friday) = 3).
3) Direction of traffic (DOFT) - westbound = 1; eastbound = 2), to be in agreement with locations 1 and 2.

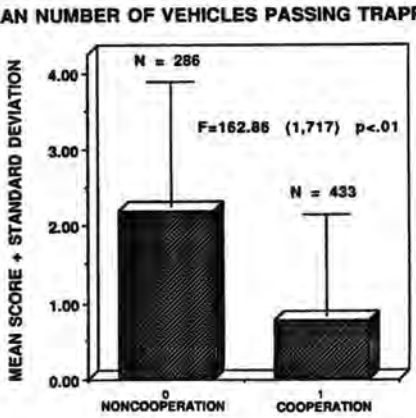
RESULTS

NOCOP (non cooperation = 0, cooperation = 1) had been computed to illustrate the two conditions (whether or not assistance had been extended). If the subject had remained trapped, NOCOP was 0; if the subject had received assistance, NOCOP was 1. In order to determine the number of vehicles passing the trapped driver under each of the two conditions score and NOCOP were analysed. ANOVA revealed that the differences were statistically significant $[F(1,717)=162.86,\ p<.01]$. The means with standard deviations are shown in Figure 2: noncooperation (2.18 / 1.65); cooperation (0.77 / 1.31).

FIGURE 2

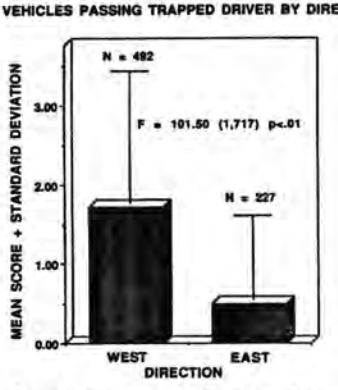
MEAN SCORES AND STANDARD DEVIATIONS

ON THE VARIABLE NOCOP (NON-COOPERATION/COOPERATION)



A Oneway analyses of variance was performed on the Score variable, with the following results. Statistically significant direction of traffic differences [$F(1,717)=101.50$, $p<0.01$], were found, and are shown in Figure 3. As can be seen, the mean score for westbound drivers who became trapped in the merge lane was 1.72, with a standard deviation of 1.67. The mean score for eastbound drivers who became trapped in the disappearing outside lane was 0.50, with a standard deviation of 1.07.

FIGURE 3
MEAN SCORES AND STANDARD DEVIATIONS BY DIRECTION OF TRAFFIC



Further analyses were done with NOCOP as the dependent variable. Chisquare found disproportionate frequencies in the time of day and direction of traffic categories, but none in the weekday category. In terms of time of day, the significance of Chisquare was Cramer's [$V(2)=0.15$, $p<0.01$]. Table 1 shows that more than twice as many trapped subjects were assisted into the PMRUSH traffic stream (223 or 31% to 104 or 14.5% unassisted) as there were during the NORUSH hour, where there were approximately equal numbers of subjects assisted and kept waiting (81 or 11.3% and 75 or 10.4%).

TABLE 1
CROSSTABULATION OF ASSISTANCE BY TIME OF DAY FOR ALL SUBJECTS

1 = Morning Rush Hour
2 = Mid-morning No Rush Hour
3 = Evening Rush Hour

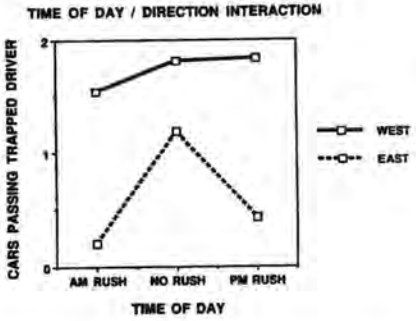
Time	1	2	3	ROW TOTAL
Waiting	107	75	104	286 39.8
Assisted	129	81	223	433 60.2
Column Total	236 32.8	156 21.7	327 45.5	719 100.0

Chisquare	Value	df	Significance
Cramer's V	0.15	2	.00030

Due to the obvious discrepancies between the westbound and eastbound locations, the data file was sorted and split by direction of traffic in order to determine what the situation was exactly. In terms of time of day, Oneway analysis of variance found no statistically significant differences between group mean scores by time of day in the westbound population of subjects [$F(2,489)=1.72$, $p > 0.05$]. However, time of day differences were shown to be significant in the eastbound population [$F(2,224)=9.23$, $p < 0.01$]. Tukey and Scheffé procedures found the pairs of groups that were significantly different at the 0.05 level to be: the AMRUSH and the NORUSH groups (means = 0.20 and 1.18 respectively); PMRUSH and NORUSH groups (means = 0.43 and 1.18 respectively). This time by direction interaction is shown in Figure 4. As can be seen, the means remained basically the same between the westbound groups (means = 1.54; 1.81; 1.84 AMRUSH through PMRUSH), whereas between the eastbound groups there were significant differences (means = 0.20; 1.18; 0.43 AMRUSH through PMRUSH).

FIGURE 4

MEAN SCORE DIFFERENCES BY TIME OF DAY IN THE TWO DIRECTIONS



Significant differences were found between the group means for the westbound population of drivers by weekday [$F(2,489)=4.38$, $p < 0.01$] on the variable NOCOP. The Tukey and Scheffé post hoc procedures denoted that the pairs of groups that were significantly different at the 0.05 level were: the Wednesday and Friday groups (means = 0.53 and 0.395 respectively) and the Wednesday and Monday groups (means = 0.53 and 0.393 respectively). In the eastbound population, group means were not significantly different [$F(2,224)=1.38$, $p > 0.05$].

These results were further analysed using Chisquare. Significant disproportionate frequencies were found for the westbound population [Cramer's $V(2)=0.13$, $p < 0.01$]. Table 2 shows that the major source of Chisquare in the westbound population of subjects was in the forced to wait categories. There was a significantly higher number of subjects being forced to wait until the end of traffic on Friday

(108 or 22%) than there were on Wednesday (78 or 16%). The results of Chisquare for the eastbound population of subjects are shown in Table 3. As can be seen the numbers remained fairly stable across the three weekdays in both the waiting and the assisted categories.

TABLE 2
CROSSTABULATION OF ASSISTANCE BY WEEKDAY IN THE WESTBOUND POPULATION

1 = Monday
2 = Wednesday
3 = Friday

Weekday	1	2	3	ROW TOTAL
Waiting	89	78	108	275 55.9
Assisted	58	89	70	217 44.1
Column Total	147 29.9	167 33.9	178 36.2	492 100.0

Chisquare	Value	df	Significance
Cramer's V	0.13	2	.01319

TABLE 3
CROSSTABULATION OF ASSISTANCE BY WEEKDAY IN THE EASTBOUND POPULATION

1 = Monday
2 = Wednesday
3 = Friday

Weekday	1	2	3	ROW TOTAL
Waiting	2	3	6	11 4.8
Assisted	85	61	70	216 95.2
Column Total	87 38.3	64 28.2	76 33.5	227 100.0

Chisquare	Value	df	Significance
Cramer's V	0.11	2	.25162

A Log Linear Analysis was performed, as a final statistic, to obtain the actual distribution of the number of cases of Cooperation and Non-cooperation for each of the three time periods and three weekdays. The results are shown in Table 4. As can be seen, in terms of Time of Day, the highest number of assists occurred during the PMRUSH hour and the lowest number occurred during the midmorning period of NORUSH. In terms of Weekday, the highest daily total number of assists occurred on Wednesday where there were almost twice as many subjects being assisted as there were kept waiting (150 to 81). The daily total was lowest for Friday, but as can be seen, this was due to both the AMRUSH and the NORUSH periods. The highest number of assists overall occurred during the Friday PMRUSH hour where there were 84 subjects assisted. This represents a Friday PMRUSH hour increase of 14 assisted subjects over Wednesday's PMRUSH total of 70 and an increase of 15 assisted subjects over Monday's PMRUSH total of 69.

TABLE 4

RESULTS OF LOG LINEAR ANALYSIS SHOWING ACTUAL NUMBER OF CASES OF COOPERATION BY TIME OF DAY AND WEEKDAY WITH NUMBER OF SUBJECTS WHO WERE FORCED TO WAIT UNTIL END OF TRAFFIC SHOWN IN PARENTHESES.

	MON	WED	FRI	TOTAL
AMRUSH	44 (39)	52 (32)	33 (36)	129 (107)
NORUSH	30 (24)	28 (14)	23 (37)	81 (75)
PMRUSH	69 (28)	70 (35)	84 (41)	223 (104)
	143 (91)	150 (81)	140 (114)	433 (286)

Goodness-of-Fit Test Statistics:

Likelihood Ratio Chi Square = 6.51 DF = 4 P = .164
Pearson Chi Square = 6.52 DF = 4 P = .164

DISCUSSION

Of a total 719 subjects collected over three weeks of observation, 433 received assistance which allowed them to enter the traffic stream and 286 were forced to wait until the end of traffic (see Figure 2). The 433 subjects who received assistance were evenly distributed between the two locations (217 westbound; 216 eastbound). However, of the 286 subjects who were forced to wait until end of traffic, 275 or 96% were from the westbound merge lane whereas 11 or 4% were from the eastbound terminating lane.

Results showed that subjects were passed by a significantly higher number of drivers when cooperation was not occurring and that non-cooperation was highest during periods of low traffic density. Subjects who were waiting in the westbound merge lane were more likely to have to wait until end of traffic than to receive assistance from an oncoming driver. Subjects in the eastbound terminating lane were significantly more likely to receive assistance than to be forced to wait until end of traffic.

The hypothesis that cooperative assists to merging drivers would occur more frequently during the two daily rush hours was supported by both Chisquare and Log Linear Analysis (see Tables 1 and 4). However, this was mainly due to the cooperation occurring between drivers in the eastbound terminating lane condition (see Tables 2 and 3). Figure 4 shows that drivers in the eastbound terminating lane received significantly more assistance during the two daily rush hours than during the single period of low traffic density. As can be seen in Figure 4 there were no significant differences between the two rush hour periods and the mid-morning period of low traffic density for westbound trapped subjects.

The second hypothesis had postulated that drivers would be most cooperative during the evening rush hour. This hypothesis was supported by both Chisquare and Log Linear Analysis. Table 1 shows that almost twice as many drivers had been assisted into the PMRUSH traffic stream than into the AMRUSH traffic stream (223 to 129 respectively). Table 4 shows the actual distribution of subjects which are included in these totals.

The third hypothesis was that assistance offered to merging drivers would increase as the week progressed and would reach its maximum during the PMRUSH hour on Friday evening. This hypothesis was supported by Log Linear Analysis. Table 4 shows the gradual increase of cooperative assists during the PMRUSH period across weekdays (69, 70 and 84).

The hypotheses which had been postulated in this experiment were based on the following: 1) that an increase in number of observers or coactors would promote a rise in cooperative behaviour; 2) that under these conditions of social facilitation the behaviours exhibited by drivers would be in accordance with learned informal social norms; 3) that this would be observable during the two daily rush hours; 4) that driving to a schedule would result in fewer instances of cooperation in the morning than in the evening when schedule would not be a factor; 5) that fatigue and stress levels would increase as a result of the work day; 6) that these would have a positive influence on cooperative behaviour; 7) that this would be observable during the evening rush hour; 8) that as the week progressed, there would be a build up of fatigue and stress level; 9) that as a result, cooperation would be highest overall on Friday, during the drive home from work.

It may be possible to explain the results obtained in this experiment with the general drive theory (Zajonc, 1965) which states that the presence of an audience and coactors increases overlearned responses. Allowing someone to pass ahead of us is a well learned response. This can easily be observed whenever there are two or more people waiting or arriving at a door between corridors or at an elevator, for example. Social facilitation refers to this as well. Towler (1986) reported that in a natural setting facilitation may occur when coactors are present. When measuring the length of time it takes two cars to travel 100 yards when they start from a neck and neck position at an intersection, his results showed that the coaction effect was robust.

From the observations carried out in the present experiment it would seem that one or both general drive theory and/or social facilitation theory may be applicable, particularly in the eastbound

terminating lane situation. There, the lanes are parallel to each other placing the cars within very close proximity of each other. This may have been a motivating factor for the behavioural response that would allow a trapped subject to enter the traffic stream ahead of the oncoming cooperative driver. In the westbound merge lane situation, the merging vehicles are at approximately a 30° angle of the traffic stream rather than parallel. This may explain the results which showed that cooperation was much more likely to occur in the eastbound direction.

The effects of fatigue and driver stress as a function of time of day and day of the week were examined by Gulian, Glendon, Matthews, Davies and Debney (1990). They reported that levels of fatigue and driver stress were significantly higher in the evening. Also, that the peak for both level of fatigue and driver stress was attained on Thursday. The conclusion reached by these investigators was that daily events had a negative cumulative effect that built up daily until a peak is reached just before the weekend.

In the present experiment, the fatigue and driver stress variables were not measured. Therefore, it can only be assumed based on the reports of Gulian et al., that fatigue and stress increased as a function of the work day and of the work week. The present results do indicate that drivers were significantly more cooperative during the return trip from work (the PMRUSH). Whereas Gulian et al. reported that the peak for both level of fatigue and driver stress was attained on Thursday, the present results did not agree with Gulian's findings of a peak on Thursday since cooperation was shown to increase in the evening, throughout the week, reaching a peak on Friday. It is probably reasonable to assume that the effects of both fatigue and daily stress may be significant factors in determining the degree of cooperation that exists between drivers.

This experiment was undertaken to measure the increase in cooperative behaviour which, it was believed, would be observable at the end of the work day as well as at the end of the work week. With that express purpose in mind locations were chosen which would allow the measurement of the cooperative behaviour of oncoming drivers in the morning; they would be the drivers who would provide assistance to the westbound merging subjects. In the evening, these same drivers would make up part of the population of drivers returning home from work; they would be the drivers who would be providing or needing assistance in the eastbound condition.

Since I cannot state that the morning and evening populations were in fact the same, I cannot conclude that work day or work week had a direct effect on cooperative behaviour between drivers. In fact, the drivers observed cooperating may do so whenever another driver is in need of assistance. For this reason, it would be preferable to carry out any future research in this area on the same morning and evening population.

In future replications of this study, it would be advisable to observe subjects becoming trapped as a result of traffic moving from one direction only (in this case, from Highway 17 East but not from Second Avenue North, see Figure 1). A large number of Second Avenue drivers made their left-hand turns, onto the highway, by going directly into the outside lane rather than into the inside

lane. This was most obvious during the period of low traffic density and the majority of subjects who became trapped during that period did so as a direct result of these inappropriate turns.

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FEASIBILITY STUDY FOR A RESERVED H.O.V. LANE FOR THE APPROACH OF THE VICTORIA BRIDGE DURING THE MORNING PEAK PERIOD

ACKNOWLEDGEMENTS

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1.0 INTRODUCTION

The Victoria Bridge is one of the five links between the Island of Montreal and the South Shore. On the South Shore approaches, Sir Wilfrid Laurier Boulevard and the Highway 132 exit are the only roadways that carry traffic to the bridge. Presently during the morning peak period (7:00-9:30 a.m.), the approaches are working at capacity or overcapacity. Consequently, the local adjacent streets are under heavy traffic loads which cause air and noise pollution. The citizens in this region of St. Lambert have been complaining to their local political representatives. Moreover, the daily users that rely on this connection to Montreal have been demanding better service in recent years.

In many U.S. cities, high-occupancy vehicle lanes have been implemented with much success. Canada has only recently been following the trend of planning reserved lanes for priority vehicles. This report analyzes the feasibility of a reserved H.O.V. lane for the approach to the Victoria Bridge. In this project it will be determined whether the time savings due to travelling in the H.O.V. lane is beneficial compared to the problems that might occur as a result of its implementation. This includes examining the effect on the remaining lanes and the cost of the project itself.

2.0 HIGH-OCCUPANCY VEHICLE LANES

High-occupancy vehicle lanes are reserved facilities implemented on roadways for vehicles satisfying specified requirements. These vehicles may include buses, carpools, and vanpools. The carpool usage of this exclusive lane can be restricted to either two, three, four or more persons per vehicle. Moreover, the majority of H.O.V. lanes are implemented on freeways, with only a few on urban highways.

Several objectives should be attained when implementing H.O.V. lanes.

As stated in An Evaluation of the Cost Effectiveness of HOV lanes: "A recent study culled the following objectives from a national survey of HOV projects" (ref. 1, pg. 3):

1. To improve traffic flow by encouraging the use of shared ride vehicles (i.e. HOV's), and thereby creating more space on the highways during the peak commuting hours.

2. To reduce energy consumption through reduced vehicle miles of daily commuter travel.

3. To reduce air pollution (hydrocarbons, carbon monoxide, nitrogen oxides, sulphur and particles) through reduced vehicle miles of daily commuter travel.

4. To reduce the cost of transportation to the commuter through the encouragement of shared ride and hence shared cost, modes of travel.

5. To remove or reduce the need for new highway construction or highway repair by reducing the traffic volume that is responsible for road surface damage.

Transportation commissions across the United States regard the above goals as the most important reasons for a H.O.V. lane to be installed.

When implementing H.O.V. lanes, three major factors must be taken into consideration. First, for the start and end conditions, the lane should start as a new lane if possible and end without merging. This will prevent bottleneck situations. Second, adequate enforcement is considered to be essential to the successful operation of the H.O.V. facilities. Third, public acceptance can have a major impact on the implementation and success of the project.

3.0 EXISTING SITUATION

3.1 VICTORIA BRIDGE

The main characteristic of the Victoria bridge is the two lever drawbridges that are located in St. Lambert. The lever drawbridge function is to facilitate the vehicle and train traffic when there is a boat crossing the St. Lambert Lock as can be seen in Figure 1. When lever drawbridge #3 is lifted, traffic flow travelling from St. Lambert to Montreal will use Road #1 while the traffic flow travelling from Montreal to St. Lambert will use Road #3. On the other hand, if lever drawbridge #2 is elevated, traffic flow travelling towards Montreal will use Road #2b and vehicles coming from Montreal will use Road #2a. The annual average maximum traffic volume of vehicles travelling over the Victoria Bridge from St. Lambert to Montreal is currently 3319 cars per hour. This occurs during the morning peak period between 7-8 a.m..

In studying the existing situation, information pertaining to the operation and functioning of the Victoria Bridge was noted. First, the average time that traffic is stopped when switching from Road #1 and Road #3 to Road #2 or vice versa is approximately five minutes. This time is required for replacing the cones to redirect the traffic towards the other lever drawbridge. Second, during the morning peak period, the lanes used for the traffic travelling from Montreal towards the South Shore (i.e. Road #3 or #2a) is closed. This permits the usage of both sides of the bridge for the people travelling from St. Lambert to Montreal. Third, the Victoria Bridge has an 11-ton weight restriction. In order to satisfy this limitation, the buses that are presently using the bridge are limited to a maximum occupancy of 42 to 45 persons per vehicle. This number represents the number of seated places on a bus.

3.2 STUDY CORRIDOR

There are two connections to the Victoria Bridge: Sir Wilfrid Laurier Boulevard and the Highway 132 Exit (Figure 2). There is currently traffic lights at the intersection of the exit and Sir Wilfrid Laurier. These traffic lights were put up to stop traffic when there is a transfer between bridge #3 and bridge #2 and vice versa. However, during the morning peak period these traffic lights are disconnected. The percentage split of vehicles travelling over the Victoria Bridge is approximately 70%/30% for the Boulevard and the Highway Exit respectively.

Presently, the vehicles using Road #3 experience no delay because they travel single file. On the other hand, the vehicles using Road #1 are more likely to encounter waiting time. This is due to the fact that the vehicles using this route tend to travel side by side starting from the intersection of the freeway exit and Sir Wilfrid Laurier. Prior to travelling over the Victoria Bridge, the vehicles using Road #1 must merge into a single lane. This manoeuvre causes slower traffic movement compared to Road #3. Therefore, it is preferable that the H.O.V. lane use Road #3.

It was decided that the H.O.V. lane would be placed on Sir Wilfrid Laurier Boulevard and St. Louis in Lemoyne rather than on the Highway 132 Exit. St. Louis connects with two major highways on the South Shore: Highway 116 and Taschereau Boulevard. A H.O.V. lane on the Highway 132 exit would be very difficult to implement because of the crossing movement which transfers the traffic to the left lane. This is necessary if Road #3 is used as the H.O.V. lane route.

The study corridor which consists primarily of St. Louis and Sir Wilfrid Laurier Boulevard has a total of eight traffic lights. They are located at the intersections of St. Georges, Cartier, Laurier, Victoria, Arran, Queen, Prince Arthur, and the Highway 132 Exit. St. Louis is a four-lane undivided arterial. It becomes Sir Wilfrid Laurier just west of Victoria and expands to a six-lane divided arterial after Arran.

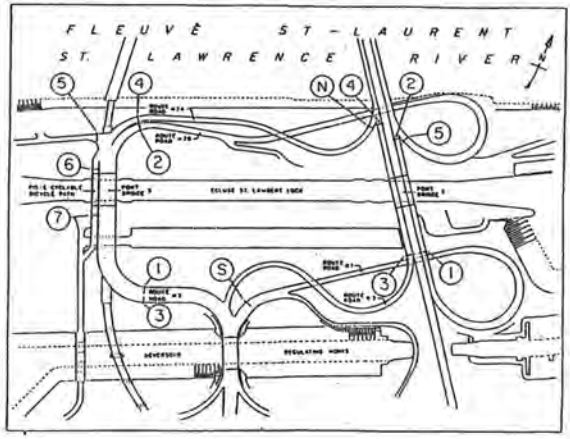
3.3 LEVEL OF SERVICE

Volume counts for Arran, Queen and Prince Arthur were obtained from M.T.Q. (Ministry of Transportation of Quebec). This project team performed short traffic counts at St. Georges, Cartier and Laurier where information could not be obtained from the City of Lemoyne. The existing phasing plan at all signalized intersections was obtained from M.T.Q. The Highway Capacity Software (H.C.S.) (ref. 3) was used to calculate the overall level of service for every intersection. It also determined the service of each approach at the intersections.

3.4 TRAFFIC CONTROL

During the morning peak period, the traffic light at Arran is disabled and operates as a flashing yellow light. Similarly, at the intersection of the Highway 132 exit and Sir Wilfrid Laurier there is a flashing yellow light to control the morning traffic flow. During the morning peak period, there are school crossing guards at Victoria, Queen and Prince Arthur to help children cross the street.

FIGURE 1: VICTORIA BRIDGE (ref. 2)

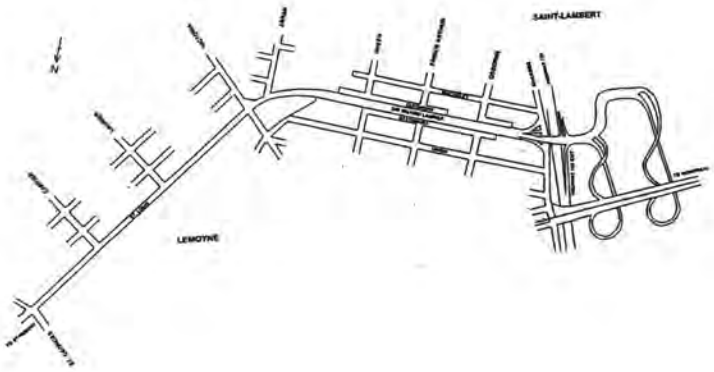


3.5 LAND USAGE

On both sides of St. Louis, there is mixed land usage. There is a combination of commercial and residential buildings. There are two schools just off Sir Wilfrid Laurier which are pedestrian generators during the morning

peak period. There are two major commercial buildings around Arran. These include a shopping centre and a McDonald's which are large pedestrian and vehicle generators throughout the day. However, the shopping centre does not influence the morning peak period because it is not open during these hours. The land in the region adjacent to Sir Wilfrid Laurier is mainly in residential use.

FIGURE 2: STUDY CORRIDOR



3.6 PARKING RESTRICTIONS AND BUS STOPS

Along St. Louis, there are parking restrictions for trucks on both sides of the street between Laurier and Victoria. Trucks cannot park between 24h and 6h. A fruit and vegetable distribution centre located at #27 St. Louis is the cause of this restriction. There are many trucks entering and exiting this location. There is no parking anywhere on both sides of Sir Wilfrid Laurier.

There are no bus stops on St. Louis or Sir Wilfrid Laurier. However, bus stops are located on cross streets: St. Georges, Victoria and Osborne. The S.T.R.S.M. #55 bus travels southbound on Osborne before turning right on Sir Wilfrid Laurier and travels over the Victoria Bridge. This is the only bus that presently travels directly onto the bridge and only operates during the peak periods.

3.7 OBSERVED QUEUE LENGTHS

The information for this section was obtained from daily users of this route and from the traffic reporter for C.K.A.C. The daily queue length usually

involves vehicles backed up to Victoria. The average travel time between Victoria and the Victoria Bridge is approximately 10 to 15 minutes. Occasionally, the line of vehicles waiting to cross the Victoria Bridge could be as far as the intersection of Cartier. The worst case of a queue length involved vehicles waiting as far as St. Georges.

4.0 GUIDELINES FOR THE DESIGN OF ARTERIAL H.O.V. LANES

A preliminary report prepared for the Quebec Ministry of Transportation by "Les consultants TRAFIX" and "Les consultants BCPTA inc." (ref. 4) outlines the major guidelines for an implementation of a H.O.V. lane. The guidelines were taken from different published reports in North America. The research was divided into three parts: minimum vehicles per hour, travel time savings and minimum length. In the first section, it was stated that the volume (person/hour) using the reserved lane must be greater than the existing volume of the present lane. Further, it was stated that a minimum volume of 650 vehicles per hour should use the H.O.V. lane during the peak period in order to justify its existence. However, a volume of 900 vehicles per hour is the more desirable quantity. The second section recommends that a time savings of approximately 10 percent be obtained. A cost savings for the users should also be 10 percent. In the last section, two reports recommend that the length of the reserved lane should be in a range of 2000 feet (0.38 mile) or 10 street blocks to 10560 feet (2 miles). A third report only specifies that the minimum length be a few street blocks. The above guidelines provided a basis for the feasibility of the different designs of a H.O.V. lane on the approach to the Victoria Bridge.

5.0 DESIGN ALTERNATIVES

5.1 DESIGN ALTERNATIVE #1

The high-occupancy vehicles use the right lane on St. Louis. For all design alternatives, the priority lane begins at St. Georges and continues until the traffic reaches the Victoria Bridge. On Sir Wilfrid Laurier just west of the intersection with Arran, there is an expansion to three lanes westbound. The H.O.V. lane remains in the same lane which is now situated in the centre until the Highway 132 exit. At that point, the H.O.V. traffic switches to the left lane and travels until it reaches Road #3 which leads the vehicles directly onto the south lane of bridge #2 (refer to Figure 3). The transfer of H.O.V. lane traffic to the left side will occur either by placing a police officer at this location to guide the movement or by changing the traffic light phasing to allow priority movement.

5.2 DESIGN ALTERNATIVE #2

In this design, the H.O.V. lane is located in the left lane on St. Louis

and Sir Wilfrid Laurier. It remains in this lane until it reaches the entrance to the Victoria Bridge where it will use Road #3 (Figure 3). There will be no parking allowed during the morning peak period on St. Louis and Sir Wilfrid Laurier on both sides of the street. Left turns from the westbound direction will be eliminated at all intersections between St. Georges and the entrance to the Victoria Bridge. Signalized posts with a red "X" will be placed above any left turn bays to indicate no access to that lane. This will also help avoid confusing any H.O.V. lane users when a left lane temporarily appears.

On Queen, the left lane northbound is designated for entrance to the H.O.V. lane only. This was designed in an attempt to avoid a queue length of vehicles waiting to advance into the H.O.V. lane. The line-up of vehicles may develop because the southbound right turning vehicles are restricted to entrance to the mixed flow lanes only. At Victoria and Prince Arthur, there are similar restrictions in turning movements. The northbound left turning vehicles are only allowed to enter the H.O.V. lane. The southbound right turning vehicles are only allowed to enter the mixed flow lane(s). Presently at Arran there is a flashing yellow light controlling the intersection. The northbound left turning vehicles are only allowed to enter the H.O.V. lane only. This will help avoid the possibility of accidents that may occur if vehicles try to travel directly into the right lane of St. Louis while traffic is flowing freely.

The location of the H.O.V. lane in design alternative #2 does not allow bus stops to be placed anywhere along St. Louis or Sir Wilfrid Laurier at any time in the future. Because the H.O.V. lane is situated in the left lane, there is no space available for buses to stop without disrupting the traffic. Another problem is truck movement especially between Laurier and Victoria where the fruit and vegetable distribution centre is located. The trucks entering and leaving this particular business during the morning peak period will disrupt the H.O.V. lane.

A decrease in overall capacity may occur because a lane is being taken from regular users. The H.O.V. lane will obviously not have as high a user vehicle volume as when it is being used as a mixed lane. If this was not true, the implementation of the priority lane would be unjustified.

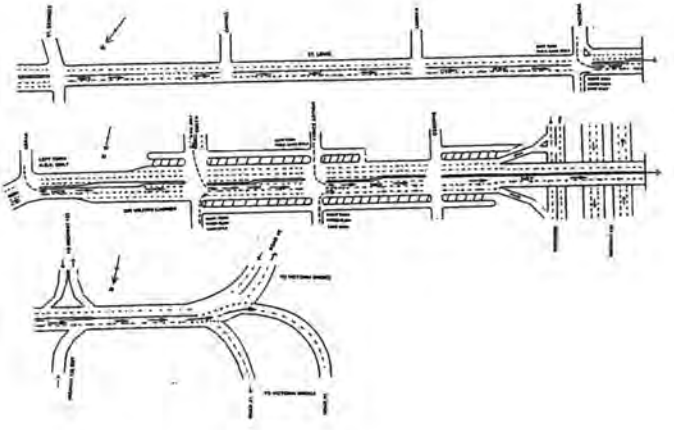
There could be much difficulty in getting the public to accept the new H.O.V. lane. There are two main reasons why this may occur. As stated above, only one lane remains for regular users. On Sir Wilfrid Laurier there are three lanes but the right lane is not frequently used because it does not continue all the way to the entrance of the Victoria Bridge. Drivers who do not choose to or cannot use the H.O.V. lane will strongly object to the decreased level of service because of the reduction to one lane. The other cause of public rejection of this design may include the many restricted turning movements specified for vehicles travelling from the cross streets to St. Louis or Sir Wilfrid Laurier.

5.3 DESIGN ALTERNATIVE #3

Alternative #3 has the H.O.V.'s travelling in the left lane on St. Louis

until the intersection of Victoria. At this point, the H.O.V. route moves across into the eastbound direction of traffic and begins to travel in contraflow. It continues in this direction until it reaches the entrance to the Victoria Bridge where it will use Road #3 for reasons already discussed (refer to Figure 3). Another option considered that was similar to this design involved the H.O.V. lane beginning to travel in contraflow at the intersection of Queen. This minor adjustment avoids the situation of leaving one lane only for eastbound traffic between Victoria and Queen.

FIGURE 3: ALTERNATIVE #2



6.0 PROCESS OF ELIMINATION OF THE DESIGN ALTERNATIVES

6.1 MATRIX DEVELOPMENT

A method to screen through the design alternatives was developed to determine the best choice for the situation. A matrix was created to consider all alternatives according to a set of criteria which are important for a H.O.V. lane design. The criteria were compared to each other to define the most prominent features. A point value was assigned to each item. Ten points was the high value while zero was the lowest. For each alternative, the list of criteria were rated under four possible status; excellent, good, acceptable and bad. Each status was worth a certain percentage of the points assigned to each criteria; 100%, 67%, 33% and 0% respectively. The values in parenthesis shown in Table 1 are the actual values of the points obtained according to the

ranking of each criteria. The points were totalled for each alternative to determine the best choice, which was design Alternative #2.

It should be noted that this is just a general screening process. A design choice cannot be based only on the alternative with the greatest total. For example, if an alternative had good ratings for all criteria except for safety, it may still be eliminated even though it appeared to be the best option by the process described.

TABLE 1: CRITERIA OF ANALYSIS

POINTS	CRITERIA	ALT. #1	ALT. #2	ALT. #3
10	CAPACITY	BAD (0)	BAD (0)	GOOD (6.7)
10	TIME SAVINGS	BAD (0)	EXCELLENT (10)	EXCELLENT (10)
10	SAFETY	BAD (0)	EXCELLENT (10)	BAD (0)
5	OPERATION OF HOV	EXCELLENT (5)	EXCELLENT (5)	ACCEPTABLE (1.6)
2	MAINTENANCE	GOOD (1.3)	GOOD (1.3)	GOOD (1.3)
8	ENFORCEMENT	GOOD (5.4)	EXCELLENT (8)	EXCELLENT (8)
6	ACCESSIBILITY	GOOD (4)	GOOD (4)	GOOD (4)
3	ON-STREET PARKING	BAD (0)	BAD (0)	BAD (0)
5	BUS ROUTES & STOPS	EXCELLENT (5)	ACCEPTABLE (1.6)	BAD (0)
7	COSTS	GOOD (4.7)	GOOD (4.7)	ACCEPTABLE (2.3)
8	PUBLIC ACCEPTANCE	BAD (0)	ACCEPTABLE (2.6)	EXCELLENT (8)
9	CROSS STREET MOVEMENTS	BAD (0)	GOOD (6)	GOOD (6)
TOTAL		25.4	53.2	47.9

6.2 EXPLANATION OF CRITERIA

CAPACITY: Overall capacity of Sir Wilfrid Laurier/St. Louis upon implementation of the H.O.V. lane.
TIME SAVINGS: The decrease in the amount of travel time.
SAFETY: The safety of the overall traffic situation after the H.O.V. lane is implemented.
OPERATION OF H.O.V.: The daily preparation of operating the H.O.V. lane.

MAINTENANCE: The process of maintaining and replacing the necessary equipment (e.g. cones, signs).
ENFORCEMENT: The amount of police enforcement necessary to ensure that the H.O.V. lane is being used by people that it was intended for.
ACCESSIBILITY: The ease or difficulty in which mixed flow vehicles can exit to the local side streets.
ON-STREET PARKING: The amount of parking available on St. Louis/Sir Wilfrid Laurier after implementation of the H.O.V. lane.
BUS ROUTES & BUS STOPS: The compatibility of the location of the present bus routes and stops relative to the placement of the H.O.V. lane. This is important because the buses will be travelling in this lane but must be able to pull-over at bus stops.
COSTS: The overall cost of implementing the H.O.V. lane.
PUBLIC ACCEPTANCE: The reaction of the public to the change in the traffic system.
CROSS STREET MOVEMENTS: The ability for vehicles to turn from the cross streets and enter either the H.O.V. lane or mixed flow lanes on St. Louis/Sir Wilfrid Laurier without being confused or delayed greatly by the motion of the vehicles coming from the other direction.

6.3 RATING OF CRITERIA

The following discussion explains the reasoning behind some of the rankings of the criteria as displayed in Table 1.

6.3.1 ALTERNATIVE #1

This was given 'bad' ratings for some of the most important criteria such as capacity, time savings, safety and cross street movements. The fact that a lane is taken away from regular mixed flow users in the westbound direction causes problems with capacity and public acceptance. The cross street movements are another difficulty because the turning motions from both directions of the cross streets are very confusing.

6.3.2 ALTERNATIVE #2

The only major concern with design alternative #2 involves capacity. Once again there is only one lane for non-H.O.V. lane users. The public can be persuaded to accept this traffic flow change if they can be shown that time savings can be achieved with a H.O.V. lane. If the priority lane is efficiently used the effect on the remaining mixed flow lane can be minimal.

6.3.3 ALTERNATIVE #3

The most influential factor for this design choice is inadequate safety. The H.O.V. lane travels in contraflow for a portion of the approach to the

Victoria Bridge. It is dangerous to have regular drivers travelling in contraflow. They are not prepared to react to certain situations that may occur such as a cone that is knocked into the middle of the lane. Bus drivers would be trained to respond to events that could result in accidents or delays. With design alternative #3, the placement of bus stops on Sir Wilfrid Laurier/St. Louis is very unrealistic. The buses would be driving in the H.O.V. lane which is located in the left lane of westbound flow. It would be difficult to pull over to the right side of the road to pick up and drop off passengers without disrupting traffic flow. It is basically impossible for the bus to stop anywhere once it is travelling in contraflow. The currently running #55 bus would find it very difficult to reach the H.O.V. lane because it would have to cross a total of three lanes without the aid of a traffic light.

6.4 DISCUSSION ON ELIMINATION

Alternative #1 was eliminated very quickly due to poor ratings in the major criteria. Therefore, the choice was between alternative #2 and alternative #3. It was the differences in safety and cost for the two options that influenced the decision. The final decision was that alternative #2 is the best design for a H.O.V. lane for the approach of the Victoria Bridge during the morning peak period.

7.0 ANALYSIS OF THE DESIGN

7.1 PROBLEM DEFINITION

The main problem with the implementation of a H.O.V. lane is the estimation of the number of vehicles that will use the facility. Presently, there are no definite methods for estimating demand. As stated by the Guide for the Design of High-Occupancy Vehicle Facilities: "There exists today no one model/procedure or group of models/procedures that have come to the forefront and been established as proven H.O.V. demand estimation procedures ... and research in this area is needed" (ref. 5, pg. 6). The H.O.V. demand analysis can be estimated with the modal-split method. That is, the choice is related to the time and cost of the mode chosen (H.O.V.). However, statistics on employment, cost of fuel, the concentration of employment and residences, and other variables difficult to measure such as comfort and convenience will need to be obtained. Therefore, a complete demand analysis with the modal-split method will be beyond the scope of this project.

The second problem encountered with this project was that the majority of the H.O.V. lanes used in the United States and Canada are implemented on freeways. However, in the documentation found on reserved H.O.V. lanes in an urban area, the increase in carpooling and the reduction in travel time are usually the only items mentioned. Yet, there is no discussion on estimation or how to calculate the demand for this type of lane. Therefore, as a last alternative, it was decided that a case study would be found where statistics

showed the percentage of car users switching to the reserved lane. Similar features of our study corridor with the case study would make it applicable to this project.

7.2 CASE STUDY

A case study was found in the report on Traveler Response to Transportation System Changes (ref. 6, pg. 66). The Kalanianaole Highway is an arterial H.O.V. reserved lane located in Honolulu, Hawaii. On this highway the H.O.V. lane is 2.5 miles in length, on which 1.9 miles runs contraflow on a four-lane undivided highway and 0.6 miles runs with-flow on a six-lane divided highway. The high-occupancy vehicle lane is shared by carpooling and buses. Following the 2.5 miles, there is another 1.5 miles of reserved lane for buses but not for carpools. A minimum of three persons per vehicle is required to use the reserved lane and the lane is only used during the morning peak period. The average time savings is 2.0 to 2.9 minutes. Further, it was determined that 8.6% of the one- and two-person vehicles found a third person so that they could qualify to use the carpooling lane.

When comparing the case study with the project, similar characteristics can be noted. First, both lanes are relatively short; 1.4 miles compared with 2.5 miles. Second, both reserved lanes begin with a four-lane undivided arterial and are followed by a six-lane divided highway. The only difference is in the restriction on the number of persons needed to use the facility. In this project, a minimum of two persons per vehicle will be required. Currently in Quebec, the majority of the population has never been offered a carpooling option so a two-person incentive to save travel time must seem realistic and attainable. Finally, it was decided to apply this case study to the project to estimate the number of vehicles which will use the H.O.V lane.

7.3 ASSUMPTIONS

In order to reduce the complexity of the analysis, four major assumptions were made. First, the area under study was considered to be isolated. In this case, all the traffic counts given by the M.T.Q. or recorded by the project team were kept for further analysis. This in turn helped determine the number of vehicles which will use the H.O.V. lane by applying the required percentage of the single drivers who will switch to the reserved lane. Second, the vehicles that already have an occupancy rate of two or more were assumed to use the H.O.V. lane. Third, a maximum of 20 buses per hour was assumed to use the H.O.V. lane. In this case, the percentage of heavy vehicles can have a major effect in decreasing the level of service at particular intersections. For example, at Laurier and Cartier, the percentage of heavy vehicles was found to be 6% for both intersections with only 20 buses per hour. Last, the traffic growth factor during the morning peak period was considered negligible. As it was said earlier, the immediate approach of the Victoria Bridge is presently running at capacity. Therefore, there should not be an expected large growth

in traffic volume.

7.4 H.C.S. ANALYSIS

7.4.1 CASE STUDY APPLICATION

A survey was made on February 14th, 1992, to determine the vehicle occupancy of the morning peak period. A sample of 1498 vehicles indicated that a percentage of 30.37% of the total had an occupance of two or more.

The Highway Capacity Software (H.C.S.), based on the Highway Capacity Manual (H.C.M.) (ref. 7), was used to calculate the approach delays for all of the intersections in the study corridor. The delay was computed in seconds per vehicle. The study period for this analysis was taken for the highest vehicle volume for one hour. Further, the calculation of delays was computed for the westbound direction only; the direction in which the H.O.V. lane will be implemented. The other intersection approaches were not modified. The analysis was first made with respect to the Do-Nothing Alternative, followed by applying the 8.6% shift taken from the case study. In this project, 8.6% of the single drivers were assumed to find someone to carpool with them and therefore switch to the H.O.V. lane. Note that the criteria for usage of the reserved lane as a carpooler is an occupancy of two or more persons per vehicle.

The first delay analysis was calculated with the Do-Nothing Alternative (Table 2). The calculation of waiting time and capacity began at Cartier Street. Since the H.O.V. lane begins right after St. Georges, the westbound approach at this intersection has the same waiting time with or without the reserved lane. Therefore, waiting time was computed between Cartier and Prince Arthur. Presently, both levels of service (LOS) at Cartier and Laurier are B, with an average waiting time per vehicle of 5.9 seconds and 5.3 seconds respectively. On the other hand, at Victoria, Queen, and Prince Arthur, all westbound approaches have a LOS F. This indicates that all three intersections are currently working at capacity. The total waiting time for the five intersections is 288.6 seconds.

By applying an 8.6% shift of one person per vehicle to two person per vehicle using the H.O.V. lane, new waiting times for the H.O.V. lane and the other lane were computed. As seen in Table 2, the people travelling in the H.O.V. lane will theoretically save 176.5 seconds (2.94 minutes) if compared with the present situation. However, it was estimated that a real time savings of 5 to 6 minutes would occur. On the other hand, the single drivers will be enormously penalized because at Victoria, Queen, and Prince Arthur the other lane will be working at overcapacity. The H.C.M. states that waiting time cannot be computed because traffic flow is considered to be unstable at overcapacity (ref. 7, pg. 9-5).

By comparing the case study (Kalanianaole Highway) with the Victoria Bridge approach study, the average time savings were found to be similar. An average of 2.9 minutes in time savings was determined in the Honolulu highway

case and an average time savings of 2.94 minutes was found in this analysis. Therefore, an application of the 8.6% shift to our study seems reasonable. However, other percentage shifts will also be analyzed in the next section.

7.4.2 OTHER PERCENTAGE APPLICATION

Shifts of 15% and 20% from one-person to two or more persons per vehicle were also tested. These new shifts were used to analyze the effect of adding more vehicles to the H.O.V. lane. The capacity and waiting time were analyzed using the same process as in the previous section and the delay time was compared with the current situation.

By applying a shift of 15%, the LOS at the intersections of Cartier and Laurier did not change (Table 2). For Victoria, Queen, and Prince Arthur the LOS remained constant at D, E and D respectively. The total time savings decreased by 10% from 2.94 to 2.67 minutes.

By applying a shift of 20%, the LOS B was maintained at Cartier and Laurier. As for the other intersections, at Queen and Prince Arthur, for example, the LOS was found to be inadequate at F and E respectively. Therefore, a shift of 20% from the other lane to the H.O.V. lane will not be considered for the benefit/cost evaluation.

TABLE 2: DELAY TIMES (IN SECONDS) AND LEVEL OF SERVICE

	DO-NOTHING	8.6% SHIFT		15% SHIFT		20% SHIFT	
		H.O.V. LANE	OTHER LANE	H.O.V. LANE	OTHER LANE	H.O.V. LANE	OTHER LANE
CARTIER	5.9 (B)	5.4 (B)	7.6 (B)	5.7 (B)	7.0 (B)	5.9 (B)	6.6 (B)
LAURIER	5.3 (B)	5.0 (B)	6.0 (B)	5.1 (B)	5.8 (B)	5.3 (B)	5.6 (B)
VICTORIA	112.3 (F)	27.5 (D)	XXXXX	31.8 (D)	XXXXX	36.8 (D)	XXXXX
QUEEN	82.2 (F)	40.7 (E)	XXXXX	46.5 (E)	XXXXX	60.1 (F)	165.3 (F)
PRINCE ARTHUR	82.9 (F)	33.5 (D)	XXXXX	39.4 (D)	XXXXX	51.6 (E)	158.7 (F)
Delay	288.6	112.1	XXXXX	128.5	XXXXX	159.7	XXXXX
Time saving vs.Do-Nothing		176.5s (2.94 min)		160.1s (2.67 min)		128.9s (2.14 min)	

Note: xxxxx = overcapacity, delay time is unstable.

7.4.3 NEW SIGNAL PHASING PLAN

The signal phasing was changed for Victoria, Queen, and Prince Arthur Boulevard because the level of service for the H.O.V. lane was found to be unsatisfactory with LOS D, E, and D respectively. The new cycle lengths were reduced from 120 seconds to 95 seconds (Table 3). By maintaining the same cycle length, the coordination of the traffic lights would be easier. On the other hand, the eastbound left turn phase was removed on Queen and Prince Arthur. Presently, 14 vehicles per hour are turning left at these two intersections. However, the new movement restriction would not have a major effect since these vehicles will be able to turn left at Victoria.

By applying an 8.6% shift, the level of service on all three intersections was brought back to C. The new overall waiting time was calculated to be 71.4 seconds which is a saving of 3.62 minutes compared with the Do-Nothing Alternative. For the 15% shift, Victoria is the only intersection which has a LOS D for the H.O.V. lane. However, the waiting time is 25.4 seconds which is at the limit of the LOS D range. The total time savings was found to be 3.44 minutes.

TABLE 3: DELAY TIMES (IN SECONDS) AND LEVEL OF SERVICE (With Changed Cycle Lengths)

	DO-NOTHING	8.6% SHIFT		15% SHIFT	
		H.O.V. LANE	OTHER LANE	H.O.V. LANE	OTHER LANE
CARTIER	5.9 (B)	5.4 (B)	7.6 (B)	5.7 (B)	7.0 (B)
LAURIER	5.3 (B)	5.0 (B)	6.0 (B)	5.1 (B)	5.8 (B)
VICTORIA	112.3 (F)	21.8 (C)	XXXXX	25.4 (D)	XXXXX
QUEEN	82.2 (F)	18.0 (C)	63.5 (F)	20.1 (C)	41.2 (E)
PRINCE ARTHUR	82.9 (F)	21.2 (C)	XXXXX	23.8 (C)	119.3 (F)
Delay	288.6	71.4	XXXXX	81.7	XXXXX
Time saving vs. Do-Nothing		217.2s (3.62 min)		206.9s (3.44 min)	

Note: xxxxx = overcapacity, delay time is unstable.
The cycle length at Victoria, Queen, and Prince Arthur are reduced to 95 seconds except for the Do-Nothing Alternative.
Eastbound left turn movements at Queen and Prince-Arthur are removed.

8.0 BENEFIT/COST EVALUATION

8.1 USER COST

8.1.1 COST OF DELAY

Because of the isolation of the study area, only people travelling by car were considered for this analysis. The calculation for cost of delay was done on the westbound approach only, i.e. on St. Louis and Sir Wilfrid Laurier. Furthermore, all vehicles using the H.O.V. lane were assumed to have two-person vehicle occupancy in order to be conservative for the calculation of user cost. For each intersection, the number of cars using the H.O.V. lane was determined and the annual cost of delay was then computed. As previously mentioned, the computation was done for a shift of 8.6% and 15%. Then, for the basis of comparison, the cost of delay was calculated for the Do-Nothing Alternative by applying the same number of cars using the reserved lane.

The annual average income of the people who are most likely to use the Victoria Bridge was determined. The average income was taken from the 1986 Canadian Government Census (ref. 8) and was brought forward to 1992 dollars by applying an average inflation rate of 5%. The present annual average income became $30,306. Then, the annual income was brought back to an hourly rate of $14.60. To calculate the cost of delay, the hourly rate was multiplied by 40%. As a result, the cost of delay was found to be $5.84 per hour. Therefore, every hour spent waiting in traffic, costs the automobile user $5.84.

TABLE 4: COST OF DELAY

INTERSECTION	NO. OF CARS	H.O.V. COST ($/YEAR)	DO-NOTHING COST ($/YEAR)
CARTIER (8.6%)	310	682	744
(15%)	348	835	835
LAURIER (8.6%)	239	484	525
(15%)	268	590	590
VICTORIA (8.6%)	376	3336	17258
(15%)	426	4383	19553
QUEEN (8.6%)	530	3895	17861
(15%)	596	4380	20085
PRINCE (8.6%)	597	5850	20447
ARTHUR (15%)	671	6575	23015

The calculation of the westbound approach delay was calculated using the Highway Capacity Software (Table 3). For all intersections, the number of cars using the H.O.V. lane was determined for the 8.6% and 15% shifts as shown in Table 4.

Then, the annual cost of delay was calculated by multiplying the daily cost of delay by the following factors: waiting time, the number of working weeks (49) and the number of automobiles using the H.O.V. lane. The same procedure was followed for the Do-Nothing Alternative. By adding all intersections, the total annual cost of delay was found to be:

Do-Nothing Alternative	$ 113,730	Do-Nothing Alternative	$ 128,156
Alternative #2 (8.6%)	$ 28,482	Alternative #2 (15%)	$ 29,146

8.1.2 FUEL SAVINGS

The annual fuel saving was calculated at each intersection separately. Annual change was computed with Equation 1:

$$\Delta F = 0.045 \times \Delta VMT + 0.60 \times \Delta VHT \text{ (ref. 9, pg. 15)} \quad [1]$$

where, ΔF = change in fuel consumption (gallons)
ΔVMT = change in Vehicle Miles of Travel
ΔVHT = change in Vehicle Hours of Travel

In this study, the change in the Vehicle Miles of Travel was equal to zero (0) because the distance travelled between each intersection was the same for Alternative #2 and the Do-Nothing Alternative. In addition, the travel time between intersections was also constant. Therefore, the annual change in Vehicle Hours of Travel will only be calculated by taking the difference in waiting time between both alternatives. By applying the formula, the annual fuel savings was found to be 4294.7 gallons/year and 4646.7 gallons/year for the 8.6% and 15% shift respectively. Next, these annual fuel savings were multiplied by 3.785 to convert gallons to liters, and the figure obtained was multiplied by an estimated cost of $0.60 per liter. The annual energy cost saving, between the Do-Nothing and Alternative #2, was found to be:

Alternative #2 (8.6%)	$ 9,753
Alternative #2 (15%)	$ 10,552

8.2 COST OF ALTERNATIVES

8.2.1 ALTERNATIVE #2

In this section, an assumption was made that the H.O.V. lane will be used for a period of 10 years. Each alternative included the cost of capital, operation, maintenance, and enforcement. Moreover, all costs were calculated on an annual basis (Table 5).

The capital cost included the purchase of traffic lights and new controllers which will be placed over the westbound left turn bays. In addition, cones and signs will have to be purchased. It was decided to include the cones in the design for better safety and to use a worst-case cost scenario, even though, the Guide for the Design of High-Occupancy Vehicle Facilities (ref. 10, pg. 71) does not require any cones for a with-flow H.O.V. lane. Two signs

between intersections to indicate the path of the H.O.V. lane will have to be placed. The total capital cost was approximated to be $157, 600. This value was converted to an equivalent annual annuity by applying an average discount rate of 10% over 10 years.

The operating cost included all daily work which is needed to operate the reserved lane. The maintenance cost was comprised of the overhaul of the signs, the replacement of the cones, and the street painting which will be needed twice per year. For the enforcement of the H.O.V. lane, a police officer will be positioned at the Victoria Bridge entrance to prosecute illegal users of the H.O.V. lane. Therefore, the total annual cost of the design Alternative #2 is expected to be $167,400.

8.2.2 DO-NOTHING ALTERNATIVE

The cost of the Do-Nothing Alternative is the cost of running the facility at the moment. The total cost included capital, operation, maintenance, and enforcement. It was also computed on an annual basis (Table 5).

The capital cost only included cones which were bought in 1991. This was calculated to be approximately $6,000. This value was converted to an equivalent annual cost using the same assumptions as for the Alternative #2 calculations. Operating costs referred to the labour needed for the daily installation and removal of the cones and for the two police officers needed for the traffic control; one at Prince Arthur and another at the Victoria Bridge entrance. Similarly to design Alternative #2, maintenance involved the replacement of the damaged cones and the regular street painting. The enforcement cost included the employment of police officers to prevent violation of the various restricted movements in the area. Therefore, a total annual cost of $112,300 is expected for this alternative.

TABLE 5: COST OF ALTERNATIVES

	DESIGN CHOICE COST	DO-NOTHING COST
CAPITAL COST	$ 25,700 /yr	$ 1,000 /yr
OPERATION COST	$ 114,000 /yr	$ 88,400 /yr
MAINTENANCE COST	$ 12,100 /yr	$ 7,300 /yr
ENFORCEMENT	$ 15,600 /yr	$ 15,600 /yr
TOTAL ANNUAL COST	**$ 167,400 /yr**	**$ 112,300 /yr**

8.3 BENEFIT/COST RATIO

To be consistent with the previous analysis, the benefits were only applied for one hour whereas the cost of alternatives were calculated for the whole peak period. A greater value of benefits would be obtained if

calculations were taken over the entire peak period.

The benefit/cost ratio was calculated by dividing the difference in benefits by the difference in costs between both alternatives. The total benefits were computed by taking the difference in benefits between the Do-Nothing situation and Alternative #2 and then adding the fuel savings to the result. The ratio was analyzed for the 8.6% and 15% shift. By having a B/C ratio greater than unity for both cases, Alternative #2 was found to be economically feasible. Because it was decided to consider only car users for the cost analysis during a one hour period, a further study in which the transit user would be included would obviously show a higher benefit/cost ratio. The computation of the benefit/cost ratio follows:

H.O.V. (8.6%): B/C = 95,001 / 55,100 = 1.72
H.O.V. (15%): B/C = 109,562 / 55,100 = 1.99

9.0 COMPARISON OF ARTERIAL H.O.V. LANE GUIDELINES AND DESIGN ALTERNATIVE #2

Table 6 shows a comparison between the arterial H.O.V. lane guidelines that were discussed earlier and alternative design #2. The length requirement was satisfied. Also, the travel time savings and the decrease in cost of travel were greater than the minimum specified. It was only the minimum vehicle per hour criteria that was not achieved by design #2. But, it should be noted that if design #2 with the new phase plan discussed earlier is implemented, the vehicles per hour will be greater than the required minimum of 650.

TABLE 6: ARTERIAL H.O.V. LANE GUIDELINES VS. DESIGN #2

CRITERIA	GENERAL ARTERIAL H.O.V. LANE	DESIGN #2 (8.6% SHIFT)
MINIMUM LENGTH MAXIMUM LENGTH	2000 FEET 10560 FEET	7392 FEET
MINIMUM VEHICLE/HOUR	650	522
MINIMUM TRAVEL TIME SAVED (%)	10%	46%
MINIMUM DECREASE IN COST OF TRAVEL (%)	10%	46%

10.0 RECOMMENDATIONS

In order to implement design Alternative #2 successfully, the external factors that negatively affect the H.O.V. lane should be eliminated or altered. There are areas in our study corridor where delays will be experienced by the

priority users. The following are recommendations of actions that should be taken if design #2 is to be brought to reality:

1) Attempt to restrict the passage of ships going through the St. Lambert Lock during the morning peak period.

2) Attempt to restrict truck movement on St. Louis near the fruit and vegetable distribution centre at 27 St. Louis.

3) In order to improve the service of bus #55, a traffic light should be placed at the intersection of Sir Wilfrid Laurier and Osborne.

4) Develop a marketing scheme to encourage the public to carpool or use the transit system.

11.0 CONCLUSIONS

Three different routes and design for a H.O.V. lane were chosen along the study corridor. A screening process based on criteria for a H.O.V. lane such as safety and capacity was established. After comparing the design alternatives, the best option was determined to be Alternative #2 with the new signal phasing plan. It was the safest design and provided excellent time savings. A possible problem can be overall capacity. A complete analysis of the chosen design was undertaken.

Overall, the implementation of a H.O.V. lane on the approach of the Victoria Bridge is physically feasible. It is realistic to state that the physical construction is possible. The many restrictive movements along the study corridor must be readily accepted as a major part of the physical implementation. The reserved facility is economically feasible as proven by the benefit/cost evaluation. The benefit/cost ratio was analyzed with the worst cost scenario to ensure that in the case of any minor changes such as cones not being used, the ratio can only increase or improve. Therefore, the reserved lane will always have its "raison d'être".

Public acceptance can be a major obstacle for the implementation of the H.O.V. lane. The many restricted movements along the study corridor and the decrease of service in the other lane will produce a negative reaction by the users. A possible solution is the establishment of a marketing plan provided by the provincial government. People would be educated in the benefits of using the reserved lane. The issues related to the fruit and distribution centre and the passage of boats in the St. Lambert lock must be dealt with before the reserved facility can be realized. Further studies should be completed to obtain a more accurate estimation of the volume of future H.O.V. lane users. This may include the use of sensitivity or modal split analysis. The studies could include the benefits for the people travelling on the buses.

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Titre:

LES AVANTAGES DE LA RÉGULATION DES FEUX DE CIRCULATION EN TEMPS RÉEL

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Résumé:

Le présent article donne en premier lieu un aperçu des problèmes de la régulation des feux de circulation à temps fixe, régulation qui ne permet pas d'adaptation aux changements de la demande et qui conduit à des pertes de temps pour les usagers, à de la pollution sonore et atmosphérique ainsi qu'à un surplus de consommation d'énergie.

Pour diminuer ces inconvénients, la stratégie de régulation des feux en temps réel a été développée par différents chercheurs. Le principe d'une de ces stratégies, basé sur la programmation dynamique, a été programmé sur ordinateur et appliqué à un carrefour isolé simple à sens unique afin d'en faire ressortir les avantages.

Des réductions considérables du temps perdu et du nombre d'arrêts ont été observées par rapport à la méthode de calcul des feux à temps fixe. Bien qu'il ne s'agisse que d'un exemple simple, l'application a contribué à une meilleure compréhension de la méthode de calcul et de ses avantages. Étant donné ses avantages et compte tenu du fait que l'algorithme permet de suivre de près l'évolution de la demande, il est à prévoir, dans un avenir proche, que de plus en plus de feux fonctionneront selon ce principe du temps réel.

Mots clés: FEUX DE CIRCULATION, RÉGULATION, OPTIMISATION, TEMPS RÉEL, RÉSEAU URBAIN, PRODYN

INTRODUCTION

Les feux de circulation constituent un moyen efficace de gérer le trafic dans les villes. Nous distinguons deux types de feux, les feux à temps fixe et les feux commandés par la circulation. Les feux en temps fixe utilisent des plans de feux prédéterminés, c'est-à-dire que les paramètres essentiels, comme la durée du cycle, le partage du vert et les décalages sont calculés hors ligne, à partir de données historiques. Ces plans de feux sont stockés dans le contrôleur de chaque carrefour ou dans le poste central et sont appliqués aux différentes périodes de la journée et de la semaine (heures de pointe, heures hors-point, week-end). Chaque plan de feux peut être en vigueur pendant une période variant entre 15 minutes et plusieurs heures durant la journée.

Réalisée de cette manière la gestion du trafic reste cependant éloignée de l'optimum car on ne parvient pas à suivre les fluctuations de la demande puisque les plans étaient calculés pour une valeur moyenne des débits "historiques". Inapte à s'adapter aux changements de la demande, la régulation des feux de circulation en temps fixe conduit à des pertes considérables de temps pour les usagers, à de la pollution tant sonore qu'atmosphérique, ainsi qu'à un surplus de consommation d'énergie.

Ces faits on été constatés dès les années 20 et on a développé des feux utilisant des stratégies de contrôle plus efficaces, basées sur la détection de la demande réelle aux carrefours. Ces feux portent le nom feux adaptatifs ou feux commandés par la circulation. Pendant les années 30, de nombreux feux commandés par la circulation ont été installés et des détecteurs de type sonore, magnétique, photo-électrique, infrarouge, ont été développés.

Le premier essai à grande échelle d'une implantation de ce type de contrôle en milieu urbain revient à la ville de Montréal où il y avait, en 1933, environ 50 carrefours à feux commandés par la circulation (Sessions, 1971). Le fonctionnement de chaque carrefour sur un cycle différent rendait cependant impossible la coordination des feux d'un réseau ou même d'une artère avec les algorithmes disponibles à cette époque-là. Les feux commandés par la circulation ont donc connu moins de succès par la suite. Ils étaient réservés presqu'exclusivement à la régulation des feux aux carrefours isolés, où ils rendaient des services incontestables.

L'avènement des ordinateurs au début des années 60 a permis de développer des méthodes de calcul de plus en plus complexes et efficaces. L'objectif était toujours de développer des algorithmes permettant de suivre de plus en plus près la circulation, telle qu'elle se présentait au carrefour. Mais on gardait le principe des

feux à cycle fixe utilisant des plans prédéterminés. Le cycle commun à tous les feux permettait une coordination entre eux. On croyait atteindre le but poursuivi à savoir une meilleure adaptation à la demande, en changeant les plans à des intervalles de plus en plus rapprochés.

Mais des problèmes reliés à la transition entre les plans et la difficulté insurmontable de la prévision de la demande à très court terme ont démontré que cette voie de développement menait à une impasse. Il était nécessaire de développer une nouvelle approche très différente, éliminant la notion d'un cycle commun pour tous les carrefours et permettant quand même la coordination des feux. On s'est souvenu alors des algorithmes développés pour les feux commandés par la circulation (intervalle-véhicule et débit-densité) qui fonctionnent bien pour des carrefours isolés. Mais ces algorithmes ne représentent qu'une approche heuristique sans une procédure d'optimisation clairement définie.

Miller (1965) a développé, partant de cette approche, un premier algorithme qui permettait d'optimiser un feu à un carrefour isolé, c'est-à-dire un algorithme qui réglait le feu de façon à minimiser les retards en évaluant les arrivées et les files d'attente détectées sur chacune des entrées du carrefour. Mais les nombreux calculs reliés à cette optimisation rendait, à l'époque, l'algorithme inutilisable en pratique. Ce n'est que le développement extraordinaire de la micro-informatique qui a permis aux chercheurs d'envisager d'autres méthodes d'optimisation plus efficaces mais demandant encore plus de temps d'ordinateur.

Une de ces méthodes, la programmation dynamique, a été utilisée par différents chercheurs au début des années 80 pour régler les feux aux carrefours en suivant la demande "en temps réel", c'est-à-dire en évaluant l'état de la circulation au feu à des intervalles de 5 secondes et en réagissant à des changements de la demande par une nouvelle indication des feux. La durée de l'intervalle de 5 secondes, longue pour un processus en temps réel, est uniquement nécessaire à cause du temps de jaune, temps minimum de sécurité requis avant de pouvoir changer l'indication du feu sur une entrée.

Il s'est avéré également possible d'appliquer la programmation dynamique à un réseau de carrefours à feux, rendant donc réalisable la coordination des feux, sans l'obligation d'un cycle commun et minimisant les retards pour la circulation aux carrefours. L'algorithme qui a été développé par Henry (1981) en France a été la base pour un programme et un contrôleur s'appelant PRODYN (PROgrammation DYNamique).

LE CALCUL DES FEUX EN TEMPS RÉEL

Le but du présent article est de décrire brièvement les idées sous-jacentes à cet algorithme, d'expliquer en grandes lignes le programme qui a été développé pour démontrer l'utilité et la faisabilité de cette méthode ainsi que pour fournir certains indicateurs de performance illustrant ses avantages.

La notion de la régulation des feux de circulation en temps réel suppose qu'un système soit non seulement capable de s'adapter immédiatement et continuellement à la demande, mais également de réaliser une véritable optimisation en minimisant une fonction-objectif explicitement calculée pour permettre de franchir véritablement une étape vers une plus grande efficacité. Le principe de base de régulation des feux en temps réel est de réagir instantanément aux fluctuations de la demande avec une nouvelle commande (c'est-à-dire changement de l'indication du feu ou non) calculée en ligne à l'aide de mesures prises plusieurs secondes plus tôt aux détecteurs en amont. En plus, l'algorithme "temps-réel" doit calculer cette nouvelle commande en estimant l'état futur de la circulation, tout en minimisant la longueur des files d'attente et le nombre d'arrêts.

LE PROGRAMME DE SIMULATION

Le programme PROFCI (Programme de Régulation et d'Optimisation des Feux de circulation en temps réel pour un Carrefour Isolé) a été conçu pour tester cette nouvelle méthode. Etant donné le but purement démonstratif de ce travail, notamment d'effectuer une comparaison entre la méthode "temps-réel" et celle du calcul des feux en temps fixe, il s'est avéré souhaitable de se limiter à un carrefour isolé avec une simple configuration sans piétons (voir figure 1). Les deux rues formant le carrefour sont à sens unique et les feux de circulation fonctionnent à deux phases.

Le programme comporte 5 parties:

- l'entrée des données;
- la simulation du passage des véhicules sur le détecteur en amont;
- la simulation des arrivées à la ligne d'arrêt du feu;
- l'optimisation de la suite des indications (commandes) du feu par rapport aux arrivées et aux files d'attente et ensuite, la comparaison avec un feu à temps fixe calculé pour la même demande;
- la présentation des résultats sous forme de tableaux et de graphiques.

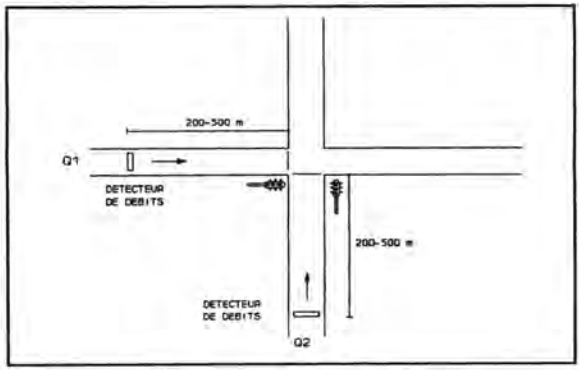


Figure 1 Configuration du carrefour étudié

L'entrée des données

L'entrée des données se fait de manière interactive. Les débits admissibles sur chacune des entrées (ou liens) du carrefour varient de 100 à 1800 v/h. Leur somme doit être inférieure ou égale aux débits de saturation qui sont de 1800 véhicules par heure de vert et par voie. De cette manière, le feu au carrefour fonctionne au régime sous-saturé donc à un degré de saturation inférieur à 1. Les vitesses aux approches varient entre 30 et 70 km/h. Pour pouvoir faire les prévisions des arrivées avec au moins 10 secondes d'avance, il faut placer le détecteur de débits en amont des feux à une distance correspondant à celle parcourue en 10 secondes à la vitesse donnée. Cette distance varie entre 200 et 500 mètres et peut être choisie par l'usager.

Simulation des arrivées aux détecteurs et à la ligne d'arrêt

Le programme évalue les débits en véhicules par heure. Pour représenter des situations réelles, les intervalles qui séparent les véhicules passant sur le détecteur peuvent être simulés et sont soit aléatoires (négatifs exponentiels, Erlang, Pearson III) soit uniformes. Pour pouvoir calculer la longueur des files d'attente à la ligne d'arrêt, le programme simule le comportement du conducteur lorsqu'il se déplace entre le détecteur et le feu. Son arrivée à la ligne d'arrêt peut être calculée soit selon l'hypothèse d'une vitesse constante soit selon l'hypothèse d'une vitesse variable, selon une loi normale et attribuée individuellement à chaque conducteur.

L'instant de l'arrivée du conducteur à la ligne d'arrêt est un facteur important pour la détermination des retards et donc pour le choix de la commande du feu.

L'optimisation de la suite de commandes (indications)

Le détecteur de débits est situé en amont de la ligne d'arrêt à une distance telle que les conducteurs mettent au moins 10 secondes à la parcourir. Alors, on connaît les futures arrivées à la ligne d'arrêt au moins 10 secondes à l'avance. En utilisant des intervalles d'analyse de 5 secondes et en faisant des prédictions supplémentaires sur quelques secondes au-delà des arrivées connues des 10 secondes prochaines, nous pouvons définir la suite des décisions optimales des indications des feux selon le principe de la programmation dynamique.

En autres termes, à chaque intervalle de 5 secondes on s'interroger pour savoir s'il faut en terme de retard continuer le feu vert sur l'entrée qui est actuellement au feu vert, donc éviter des retards pour les véhicules arrivant et détectés en amont sur cette entrée et faire attendre les véhicules déjà accumulés ou s'accumulant sur l'autre entrée, ou s'il faut faire passer l'indication au rouge.

La méthode de régulation des feux en temps réel utilisant la programmation dynamique telle que décrite par Tuffal (1981), Farges (1983), Barrière (1984), a été programmée dans le contexte simplifié du carrefour montré à la figure 1. Un intervalle d'optimisation de 10 secondes a été utilisé pour plus de simplicité. Les détails sont décrits dans Gueorguiev (1992). Afin d'illustrer les avantages de la méthode du calcul des feux en temps réel le programme PROFCI a été appliqué à différents ensembles de données.

La représentation des résultats

Le programme fournit les principaux indicateurs de performance tels que les arrivées des véhicules à la ligne d'arrêt, leur départ et la suite de commandes optimales (feu vert ou rouge) à chaque intervalle de 10 secondes. Il est ainsi possible de vérifier et de déterminer quelle est la réaction immédiate du feu en temps réel aux arrivées des véhicules sur les deux entrées du carrefour. Les résultats sont donnés sous forme d'un tableau et d'un graphique. On compare les commandes en temps réel aux commandes que l'on aurait obtenues si on avait utilisé un feu à temps fixe selon la formule de Webster (1966).

APPLICATION DU PROGRAMME PROFCI À UN CARREFOUR ISOLÉ

L'objectif de ces simulations a été de comparer du point de vue de l'efficacité les feux à temps fixe par rapport aux feux fonctionnant en temps réel. Les mesures d'efficacité servant à ces comparaisons ont été la longueur de la file d'attente, des retards et le nombre d'arrêts. Après avoir établi la configuration du carrefour étudié, on a procédé à la définition des données et des paramètres de la circulation pour les simulations à effectuer. Ensuite, on a calculé la durée du cycle optimum pour chaque simulation selon la méthode de Webster, ainsi que la longueur des file d'attente, le nombre d'arrêts et les retards correspondants. Enfin, les mêmes données ont été reprises à l'aide du programme PROFCI pour calculer en temps réel la séquence des commandes optimales à appliquer aux feux du carrefour.

Le détecteur de véhicules à l'entrée de chaque lien a été placé en amont de la ligne d'arrêt à une distance de 200 mètres. Les feux du carrefour fonctionnent à deux phases. La durée du jaune est de 3 secondes. La distribution des écarts des arrivées est générée de façon aléatoire selon la fonction exponentielle. Les véhicules entrant aux liens du carrefour traversent la ligne du détecteur de débits à une vitesse libre de 60 km/h. La dispersion des véhicules et le stationnement tout au long des liens, ainsi que les manoeuvres de dépassement et les conflits au carrefour ne sont pas pris en considération, afin de rendre moins complexes les simulations et de faciliter la compréhension du processus de la régulation des feux de circulation en temps réel. Le temps perdu au début du vert est de 2 secondes et celui nécessaire au dernier véhicule pour libérer le carrefour, est de 1 seconde (au total le temps perdu par phase est de 3 secondes). Le débit de saturation pour chacune des approches du carrefour est de 1800 v/h et la durée de chaque simulation est de 15 minutes, ce qui représente 90 intervalles de 10 secondes. Le degré de saturation du carrefour est inférieur à 1 pour que les feux de circulation fonctionnent au régime sous-saturé afin de permettre la décharge complète de la file d'attente formée pendant le rouge. Pour la simulation présentée ici le débit a été de 920 v/h sur la route 1 et de 230 v/h sur la route 2. Le cycle optimal à utiliser dans le cas d'un feu à temps fixe serait de 40 secondes avec une répartition de la durée du vert de 30 secondes sur l'entrée 1 et de 10 secondes sur l'entrée 2.

Les figures 2, 3 et 4 illustrent l'évolution des mesures d'efficacité pendant les 90 intervalles de la simulation. Chacune de ces figures comporte 3 informations, à savoir:

- l'évolution des arrivées aléatoires sur les deux branches du carrefour;
- l'évolution de la mesure d'efficacité pour le feu à temps fixe avec l'évolution de la commande correspondante (la durée de 10 secondes est représentée par un rectangle);

- l'évolution de la mesure d'efficacité pour le feu fonctionnant en temps réel avec l'évolution de la commande correspondante.

En se basant sur les résultats de cette simulation, certaines remarques générales peuvent être formulées. Les courbes de la figure 2 illustrant l'évolution des files d'attente -pour le feu à cycle fixe - montrent une première tendance générale: la méthode de calcul des feux à temps fixe permet de maintenir la longueur des files à un certain équilibre sur les deux approches, peu importe leurs débits d'entrées. D'autre part, la commande est cyclique, c'est-à-dire que les durées du vert et du cycle ne changent pas dans le temps. Cette méthode ne s'adapte donc pas à la demande changeante. Ceci provoque de longues files d'attente étant donné que les arrivées sont aléatoires et pour commuter la phase, il faut attendre son écoulement au complet. Dans le présent exemple, la longueur de la file maximale obtenue par le programme PROFCI est de 3 véhicules, tandis que celle calculée pour des feux à cycle fixe est de 6 véhicules. Cette importante diminution de la longueur de la file maximale s'explique par le fait que le principe du temps réel détermine la durée du vert pour la phase en cours selon la demande présente et, si cette dernière change, on prolonge la durée du vert ou bien on procède à une commutation de la phase. Ce processus dynamique permet de toujours maintenir de courtes files d'attente aux approches, ce qui provoque moins de retards au carrefour. De plus, on peut remarquer le fait que le calcul des feux en temps réel favorise l'approche ayant des débits plus élevés, c'est-à-dire que cette méthode réduira les files d'attente pour l'approche prioritaire.

L'évolution de la commande en temps réel est strictement adaptée à la demande et on la caractérise comme étant acyclique. Le nombre d'intervalles au vert écoulés pour l'approche 1 et ceux pour l'approche 2 peuvent former ensemble un pseudo-cycle qui varie de 20 à 80 secondes dans cet exemple (voir figure 2).

Le nombre d'arrêts et les retards au carrefour sont les deux autres indicateurs de performance utilisés pour cette analyse. Les courbes présentées à la figure 3, illustrant la commande en temps réel, montrent une forte diminution du nombre d'arrêts (environ 50 %) par rapport à la commande à temps fixe. Cette baisse est due surtout au fait que la commande en temps réel est basée sur les fluctuations de la circulation (adaptée à tout moment à la demande changeante). En plus, elle permet de donner une certaine priorité à l'approche 1 à débit élevé (dans cet exemple) par rapport à l'approche 2 qui est à faible débit. Pour favoriser une approche à débit élevé, appelée approche critique du carrefour, l'algorithme calcule et alloue à la phase correspondante suffisamment de vert pour satisfaire la demande en diminuant ainsi le nombre d'arrêts inutiles au carrefour.

Pour ce qui est des retards, la commande en temps réel apporte un gain d'environ 50% par rapport à la méthode de calcul des feux à cycle fixe. La figure 4 illustre l'évolution des retards selon les deux méthodes. Dans cet exemple, il est à souligner que, pour la commande en temps réel, le gain (diminution du retard) est 3 fois plus important pour l'approche 1 à débit très élevé que pour l'approche 2 à faible débit. En effet, plus les débits au carrefour sont élevés, plus la méthode du calcul des feux en temps réel apporte des gains importants par rapport à la commande à temps fixe. Ceci s'explique par le fait que, pour calculer la durée du cycle avec la formule de Webster, on utilise la charge au carrefour comme paramètre essentiel et, quand sa valeur se rapproche de la capacité, le retard augmente de manière significative. Par contre, la commande en temps réel permet une détection continue des changements de la demande et réagit instantanément avec une nouvelle commande calculée en ligne.

Dans cet exemple, l'application de la méthode de calcul des feux en temps réel a permis de diminuer considérablement la longueur des files d'attente et le nombre d'arrêts et par conséquent, d'apporter une forte baisse des retards au carrefour. Ceci s'explique par le fait que les algorithmes de la commande en temps réel ne permettent pas que de longues files d'attente se forment au carrefour étant donné que le critère de commutation est basé sur les retards évalués par la longueur des files au carrefour. Si une longue file d'attente se forme sur l'approche où le feu est rouge, alors on procède à une commutation de la phase au rouge et pour la phase suivante on alloue suffisamment de vert pour cette approche afin de permettre une dissipation immédiate et complète de cette file.

Par contre, la commande à temps fixe est cyclique, avec une durée du vert déterminée d'avance à l'aide de calculs effectués hors ligne. Alors, pour cette méthode et dans le cas des arrivées aléatoires, il existe de fortes probabilités d'une répartition inadéquate des durées du vert pour chaque approche. D'ailleurs, on ne connaît vraiment pas la distribution des arrivées dans le temps étant donné que la méthode de la régulation des feux à cycle fixe ne nécessite pas l'utilisation des détecteurs des arrivées aux entrées des liens.

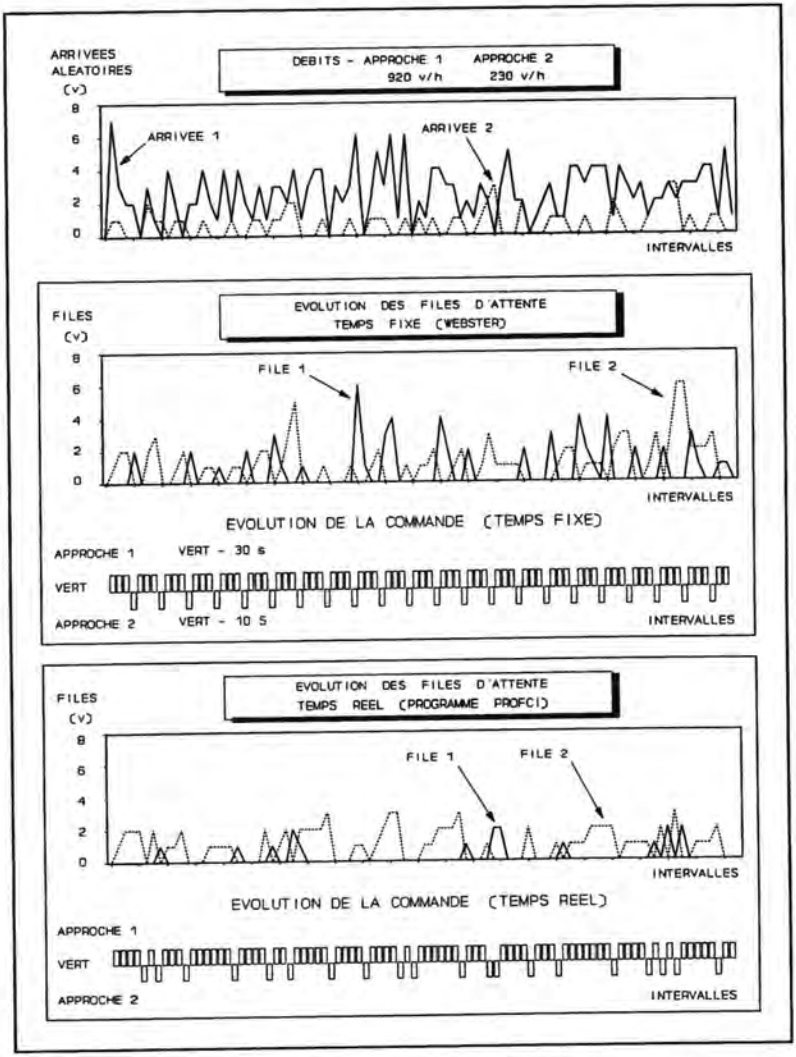


Figure 2 Evolution des files d'attente pour le carrefour isolé (Q1=920 v/h, Q2=230 v/h)

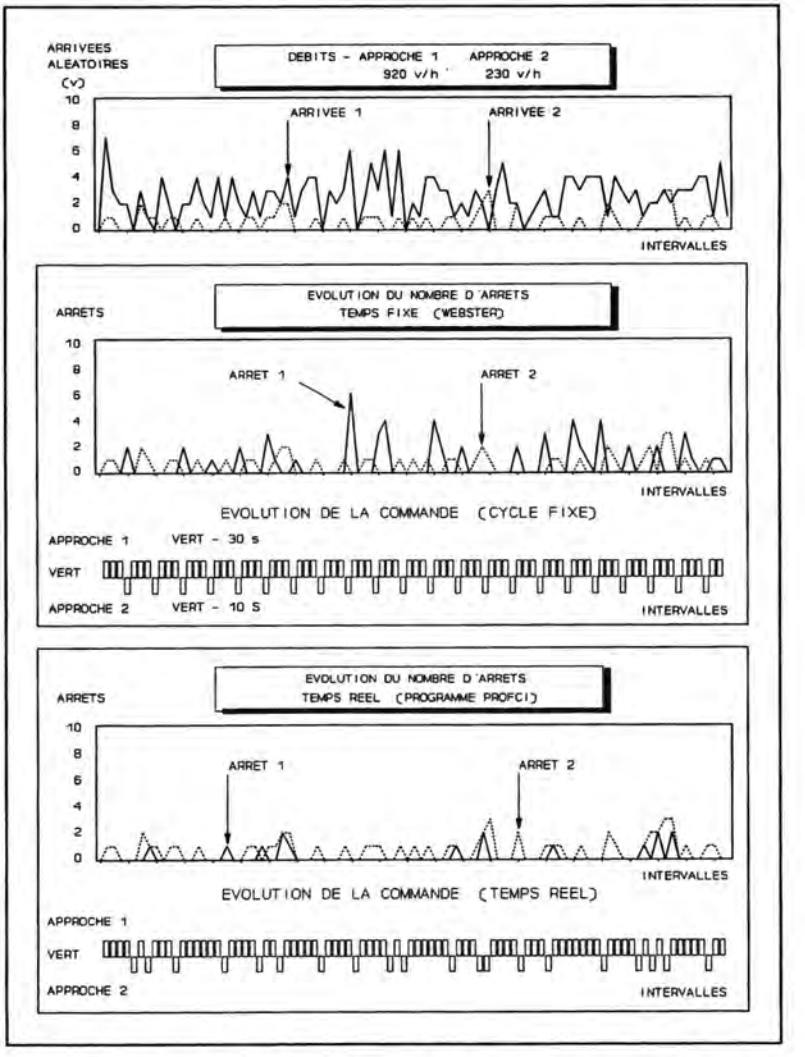


Figure 3 Evolution du nombre d'arrêts pour le carrefour isolé (Q1=920 v/h, Q2=230 v/h)

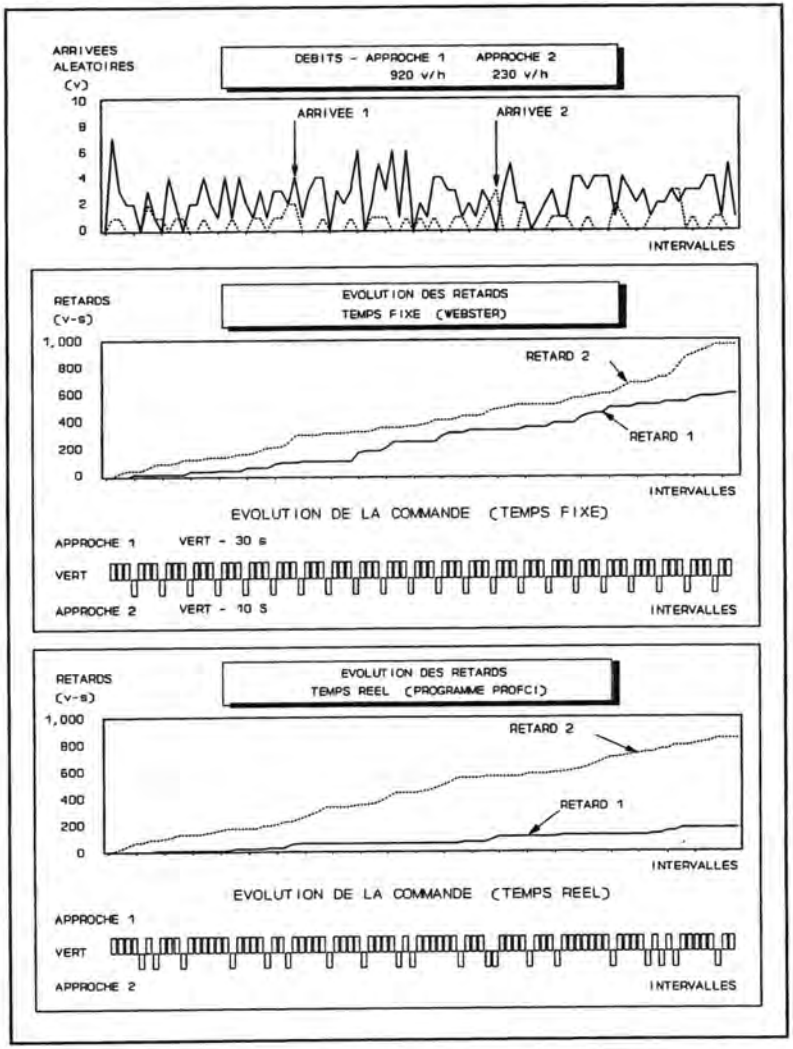


Figure 4 Evolution des retards pour le carrefour isolé (Q1=920 v/h, Q2=230 v/h)

Les figures 5, 6 et 7 donnent un résumé des différentes simulations effectuées. Dans ces figures, les indicateurs de performance sont donnés par rapport au débit total qui se présente au carrefour.

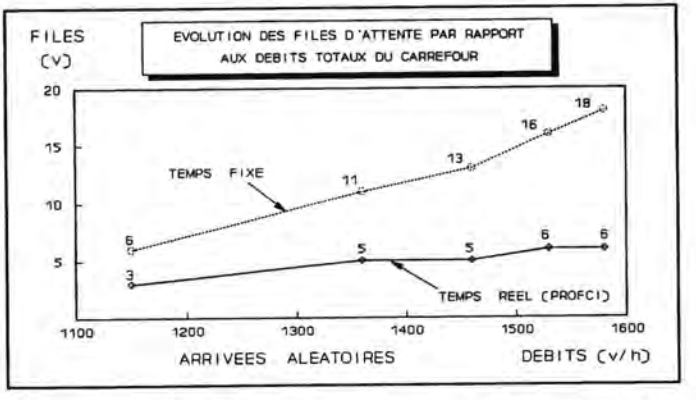


Figure 5 Evolution des files d'attente maximales (arrivées aléatoires)

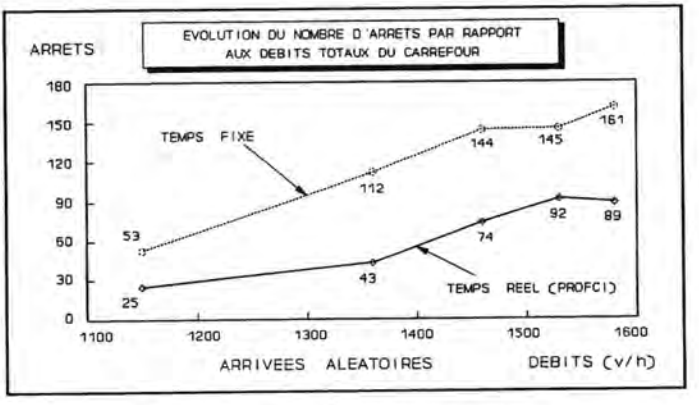


Figure 6 Evolution du nombre d'arrêts (arrivées aléatoires)

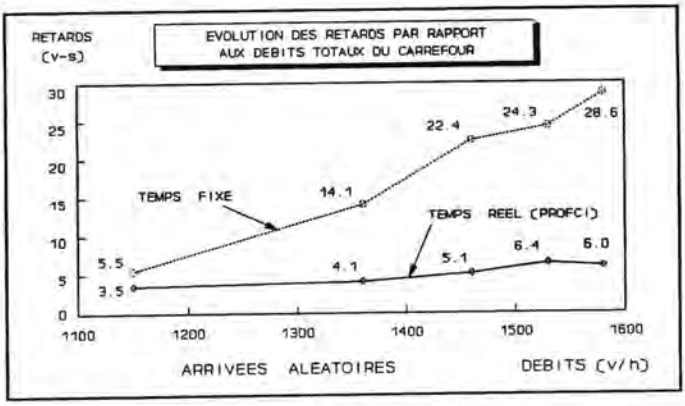


Figure 7 Evolution des retards (arrivées aléatoires)

Les avantages de la méthode en temps réel sont donc évidents et ceci même lorsque les débits s'approchent de la capacité, qui est de 1800 v/h. Il est cependant important de noter que ces avantages seront moindres dans le contexte d'un carrefour plus complexe comportant des liens à deux sens, des piétons, plusieurs voies par sens et d'autres contraintes. On peut cependant s'attendre, et ceci a été prouvé par des applications réalistes, à des avantages allant jusqu'à 10% par rapport aux plans de feux à cycle fixe calculés avec des programmes reconnus comme efficaces, tels que TRANSYT.

SYSTÈMES EXISTANTS DE RÉGULATION DES FEUX EN TEMPS RÉEL

Vers la fin des années 70, en Grande Bretagne, Robertson (1977) a développé la première méthode heuristique de régulation des feux d'un réseau de carrefours en temps réel, appelée SCOOT (Split, Cycle and Offset Optimization Technique). Cette méthode consiste à faire varier par de petits incréments de quelques secondes la durée du cycle, le vert et les décalages sous le contrôle d'un ordinateur central. Elle représente un modèle complexe du trafic qui fonctionne en régime fluide plutôt qu'en régime saturé tout en intégrant les interactions entre les carrefours. Le modèle fonctionne de façon à ce que le carrefour le plus chargé ne soit pas saturé à plus de 90%. L'optimisation de la durée du cycle, du partage du vert et des décalages est faite séparément pour chaque carrefour en ne considérant que ses voisins (en amont et à l'aval) et en supposant que les interactions entre les carrefours soient les mêmes que celles au cycle précédent.

Une autre méthode heuristique de régulation des feux d'un réseau de carrefours en temps réel est celle du système SCATS (Sidney Coordinated Adaptive Traffic System), développée par Sims (1979). Son principe de base, à peu près pareil à celui de la méthode SCOOT, permet de varier et d'ajuster la durée du cycle, le partage du vert et les décalages en réponse immédiate aux fluctuations de la demande. Par contre, dans la méthode SCATS, on a introduit les notions de décentralisation des calculs vers des ordinateurs régionaux et vers les contrôleurs locaux des carrefours. L'ordinateur central n'est utilisé que pour la collecte, la visualisation et l'impression des données sur l'état et les performances du système et pour un contrôle automatique en cas de panne. La durée du cycle est calculée par le modèle en fonction du degré de saturation et les optimisateurs du vert et du décalage fonctionnent séparément pour chaque intersection d'un sous-système formé de plusieurs carrefours.

Le principe de la programmation dynamique récursive (Nemhauser, 1966), utilisé par Gartner (1982) dans les algorithmes de la méthode OPAC (Optimized Policies for Adaptive Control), a permis de déterminer la régulation optimale pour un carrefour isolé tout en estimant les arrivées et les départs sur un horizon d'optimisation. L'horizon est divisé en un nombre entier d'intervalles de 5 secondes où chaque intervalle représente un niveau d'optimisation qui est défini par une valeur de la longueur de la file d'atente et l'état des feux (la phase au vert et la phase au rouge) et ceci pour chaque entrée du carrefour. L'objectif du modèle est de minimiser le retard total au carrefour, estimé par la longueur des files d'attente aux entrées.

Les techniques de la programmation dynamique directe (Bellman, 1962) ont été utilisées par Tuffal (1981) et Henry (1983) pour optimiser les feux d'un carrefour en temps réel. Cette méthode, nommée PRODYN (PROgrammation DYNamique), a connu un développement très rapide. En se basant sur les échanges entre les divers sous-systèmes formés par chaque carrefour du réseau, Farges (1983) et Barrière (1984) introduisent les notions de procédures de calcul hiérarchisées et de commande décentralisée qui permettent la diminution de la grandeur de mémoire d'ordinateur et du temps de calcul. Le problème global est décomposé en sous-problèmes d'optimisation des carrefours et en un problème de coordination entre eux. Le critère à minimiser est le retard total sur tout le réseau.

La première expérimentation de la méthode PRODYN a été réalisée en 1987 sur un carrefour isolé de la Zone expérimentale et laboratoire de Toulouse (ZELT). Les résultats ont été encourageants et ont conduit au développement d'un contrôleur incorporant le programme PRODYN. Ce contrôleur a été testé en 1989 sur un autre carrefour isolé.

Les résultats étant positifs, les concepteurs de la méthode PRODYN ont poursuivi leur expérimentation au début de 1990 sur un petit réseau formé de 7 carrefours de la ZELT. L'expérimentation a consisté à comparer la méthode PRODYN aux calculs des plans de feux à cycle fixe par le programme THEBES (la version française correspondant au programme de calcul des plans de feux à cycle fixe TRANSYT). Les résultats obtenus lors des expérimentations effectuées tant sur un carrefour isolé que sur un réseau sont présentés dans le tableau 1.

L'utilisation de la méthode en temps réel PRODYN (dont les principes ont été utilisés dans le programme PROFCI) pour la régulation des feux à un carrefour isolé a amené une diminution des retards au carrefour d'environ 8% par rapport à une application de l'algorithme adaptatif "intervalle-véhicule". Les tests statistiques effectués montrent que cette diminution est significative à 93%.

Pour ce qui est de l'expérimentation sur un réseau de 7 carrefours, la méthode PRODYN a permis une diminution d'environ 10% des retards par rapport aux plans de feux à cycle fixe calculés à l'aide du programme THEBES, et ceci a été significatif à 99%.

TABLEAU 1 Résultats des expérimentations de la méthode PRODYN

	Gain PRODYN sur intervalle-véhicule pour un carrefour isolé	Gain PRODYN sur cycle fixe - THEBES pour un réseau
Retards (véh-h/h)	8 %	10 %
Significatif à	93 %	99 %

CONCLUSION

La présente recherche a permis de mettre en évidence les avantages d'une régulation des feux en temps réel. Dans le cas d'un carrefour isolé simple à sens unique, les économies en temps et en nombre d'arrêts produites par une commande en temps réel sont considérables comparativement à un feu à temps fixe dont le fonctionnement cyclique et immuable devient inefficace lorsqu'il y a des fluctuations importantes de la demande.

Des applications récentes de cette nouvelle méthode à des réseaux de carrefours ont produit des résultats encourageants et il est à prévoir dans un avenir proche que de plus en plus de feux de circulation seront gérés selon le principe du temps réel suivant de prés l'évolution de la demande.

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TRANSPORTATION DEMAND IN THE TORONTO CENTRAL AREA

INTRODUCTION

Over the past couple of decades, there have been very significant changes in urban activity patterns which have taken place in North America. These patterns of change signify that the traditional "many to one" commuting pattern is gradually being replaced by the "many to many" travel patterns. These changes reflect that there is a continual process of decentralization of jobs, as well as the continuing dispersion of the resident labour force.

A recent research (1) based on Canadian census data found that "*overall commuting flows still tend to be dominated by the widespread dispersal of employment through the suburbs and by the continued attraction of the central core in terms of long distance commuting*". In spite of the policy of the 1976 Central Area Plan for the City of Toronto that encouraged decentralization, Soberman (9) concluded in the 1989 Forum on the future of the City of Toronto that "*there is a common perception that congestion within the downtown has reached unacceptable levels from the standpoint of users, businesses, negative community impacts, and air quality. ...for many years to come, the Central Area of Toronto is likely to remain the focus of increasing work trips generated throughout the entire Greater Toronto Area.*".

Nowlan and Stewart (7) proposed a hypothesis which argued that "*urban land use policy, in the form of housing and population intensification, can be used as a tool to shape transportation developments in downtown Toronto.*" This hypothesis was the result of a study of the present imbalance which exists in the development of the Toronto Central Area between available transportation facilities and the rapid growth in employment particularly in the office sector. Based on one of the relationships derived Nowlan and Stewart (7) concluded, "*past changes in population and housing have had on inbound trips: 70 fewer trips for each 1000 increase in population in the Central Area, or 120 fewer trips for each addition of 100 dwelling units*". When simply stated, the annual change in inbound person trips crossing the Central Area cordon can be explained by three independent variables, namely, mid-year occupied office floor space, Central Area population and Central Area dwelling units.

However, a recent study by Sarsan (9) who analyzed the Nowlan-Stewart hypothesis concluded that *"the Nowlan-Stewart formula would, most likely, overestimate the effect of Central Area population growth on reducing the inbound commuting trips"*. This could be very important as there has to be a "match" between the skill levels of the Central Area residents and the type of jobs being offered in the Central Area. Otherwise, it would undermine the belief that the Central Area residents will work in the Central Area. It is in this context that this study intends to clarify, revise, and refine both the Nowlan-Stewart and the Sarsan interpretations. It could prove to be a very valuable tool in managing growth and development.

STUDY OBJECTIVES

The principal purpose of this study is to analyze and to measure the effects and impacts of population and housing intensification in the Toronto Central Area on travel demand to the Toronto Central Area for the period 1975-89. As such, the objectives of this study are to:

i) perform time series analysis of travel demand trends associated with the Central Area,
ii) review and verify the Nowlan-Stewart hypothesis and the Saran analysis which attempted to relate travel demand, population and employment in the Central Area of Toronto through the use of available data,
iii) perform a cross-sectional analysis using the 1987 Travel Diary Survey data, and
iv) evaluate the Cordon Count data using the result of the cross-sectional analysis and a model derived from the Sarsan analysis.

Geographical Context

The geographical context of this study is the Toronto Central Area (C.A.). When dealing with Cordon Count data the Central Area Cordon was used. The screen lines which define the C.A. Cordon are Bathurst Street to the west, the C.P.R. North rail line to the north, the Don Valley to the east and the waterfront to the south. In the analysis concerning census linkages and origin-destination 24 hour work trips, the Greater Toronto Area (G.T.A.) and Metropolitan Toronto were also reviewed.

Time Period of 1975 -1989

A 14-year time period between 1975 and 1989 has been chosen for the study. It was 1976 when the Central Area plan went into effect in Toronto affecting housing, employment and transportation. A period of 14 years was considered to be reasonable to reflect any significant structural changes in the time series analysis.

THE 1976 CENTRAL AREA PLAN OF TORONTO

Deconcentration was the major objective in the Central Area Plan which was designed to establish a balanced distribution of employment growth within the Central Core, the Central Area and the Toronto region. In order to achieve the deconcentration policy, the City of Toronto recognized that the largest and fastest growing employment sector was located in the Central Area which also generated the highest peak-hour travel demand on the transportation system. Thus, in order to limit office space growth in the Central Area, the Plan called for no significant improvements on the transportation system that might improve the accessibility to the Central Area. Therefore, a principal task was to strike a balance between the capacity of the existing transportation infrastructures and a desirable office space growth rate. These factors combined with the allocation of office space prescribed a predominantly transit-oriented transportation system.

Toronto has faced considerable changes over the years since the 1976 Central Area Plan was originally implemented. A significant amount of office space has been built in the Central Area, the Central Area residentship has gone up, employment has become more office oriented, and travel demand into the Central Area has also grown. In many aspects, the 1976 Central Area Plan indicated the beginning of many structural changes in the Toronto Central Area. It has started a development process which has significant impacts on economic, social and physical terms. However, some of the changes might not have been intended changes by the Plan. TABLE 1 summarizes the evaluation of the 1976 Central Area Plan.

TABLE 1: GOALS AND EVALUATION OF THE 1976 C.A.PLAN (3)

C.A. Plan Goals	Evaluation	
	Where Plan has been successful	Comments
Housing • Promote Mixed-Use and new housing in the Central Area and Central Core • Affordable Housing for all resident and target income group	• Over 17,000 new units built • Further 11,000 approved • C.A. population is growing • Housing price have soared	• Social housing production failed to meet target • Need to increase affordable housing production
Office Deconcentration • Control rate growth in Core to permit transportation investment and growth in planned subcentres • Promote a deconcentrated Metro urban structure	• Rate of growth is within limits • From 1976-85 Core share of growth declines from 68% to 55% • Office space suburbanization	• Economic factors have affected the relationship between office and employment growth • Complete C.A. employment studies • Establish relationship between employment and transportation • Monitoring
Transportation • Discourage private auto for commuting • In short term, no major transit improvements serving the Core • Balance transportation and development capacities	• Plan has been successful in postponing the need for transportation improvements for 10 - 15 years	• A long term imbalance between transportation and development capacities emerging • Identify roads and transit improvements • Incremental approach to transportation planning recommended

The historical trends in the journey to work in terms of the spatial distribution of these trips and the mode choice distribution would help to give a better understanding of commuting trips destined to as well as originating in the Central Area. The following section presents the findings of travel demand associated with the Central Area.

ANALYSIS OF TRAVEL PATTERNS IN THE CENTRAL AREA

The focus of this section is the assessment of travel patterns related to the central area. Detailed examination of travel demand factors such as Place-of-Residence and Place-of-Work (POR-POW) linkages, 24-hour work trips, as well as mode choice were beyond the scope of the Nowlan-Stewart analysis. In this section the analysis utilized data gathered in the past 14 years for a more detailed analysis to understand the role of the Central Area as a trip attraction centre. The data used to support this analysis were as follows:

i) 1971, 81 and 86 census POR-POW Linkages.
ii) 1979 Metro Travel Survey (MTS) and 1986 Transportation Tomorrow Survey (TTS) 24 hours work trip tabulations.
iii) Time series Central Area Cordon Count data (1975-1989)

THE POR TO POW LINKAGES ANALYSIS

In order to get a general understanding of the travel patterns regarding the Central Area, the POR-POW linkages were used for this analysis. Travel pattern was examined using a very simple two zone designation. The Central Area zone was designated as the internal zone, whereas the G.T.A. was designated as the external zone. Three types of travel patterns were investigated, namely, internal to internal, external to internal and internal to external linkages. TABLE 2 summarized these travel patterns from the three census sources.

TABLE 2: POR-POW LINKAGES BY ZONE

YEAR	INT - INT	EXT - INT	INT - EXT
1971	32,760	241,980	14,175
1981	39,575	321,205	17,270
1986	45,147	343,097	24,789
% GROWTH,71-81*	20.8 (2.08)	32.7 (3.27)	21.8 (2.18)
% GROWTH,81-86*	14.1 (2.82)	6.8 (1.36)	43.5 (8.78)

*Number in brackets represent average annual growth rate.

The volumes of the three zonal pairs have grown over time at substantially different rates. Most significant was the growth rate of more than 40 percent shown by the internal to external linkages between 1981 - 86. The rate of growth of these internal to external linkages or "reverse commuting" had accelerated between 1981 and 1986 with an average annual growth rate of 8.8 percent. The external to internal linkages experienced the lowest growth of the O-D pairs between 1981 and 1986, at an average annual rate of 1.4 percent.

ASSESSMENT OF 24 HOUR WORK TRIPS

The POR-POW tabulations only recorded where people lived and worked. For a more detailed analysis investigating the mode choice used by these workers, the use of 24-hour work trip was required. The primary sources for this assessment came from the 1979 Metro Travel Survey (MTS) and the 1986 Transportation Tomorrow Survey (TTS). However, the 1979 MTS did not include data from areas outside Metro Toronto, therefore in order to make these survey results more compatible and consistent, the analysis was limited to the examination of the spatial distribution of work trips by mode in the Metro Toronto Region in the 1986 TTS. TABLE 3 summarized the finding between the internal and external zones.

TABLE 3: SPATIAL DISTRIBUTION OF WORK TRIP BY MODE

MODE	INT - EXT		EXT - INT		INT - EXT	
	79MTS	86TTS	79MTS	86TTS	79MTS	86TTS
AUTO[1]	26%	19%	35%	34%	51%	48%
TRANSIT[2]	37%	37%	64%	64%	47%	49%
WALK/OTHER	37%	44%	1%	2%	2%	3%

1 Auto work trips include taxi
2 Transit work trips include GO-Rail

The work trips that occur within the Central Area (internal-internal) showed that the walk/other mode dominated and was consistent with other research (4). The proportion of the walk/other mode had grown from 37 percent to 44 percent between 1979 and 1986, and was apparently growing at the expense of auto trips. The Metro to Central Area (external-internal) commuting was dominated by the transit mode, and showed little change over the period of 1979 to 1986. This model split of one-third auto trips and two-thirds transit trips had perhaps reached an equilibrium. It was unlikely to change unless new transport facilities were provided (11). The mode split was found to be fifty to fifty for the "reverse commuting" trips i.e., C.A. to Metro and this ratio was found to be similar to the mode split for inbound commuting trips during the 1960's (11).

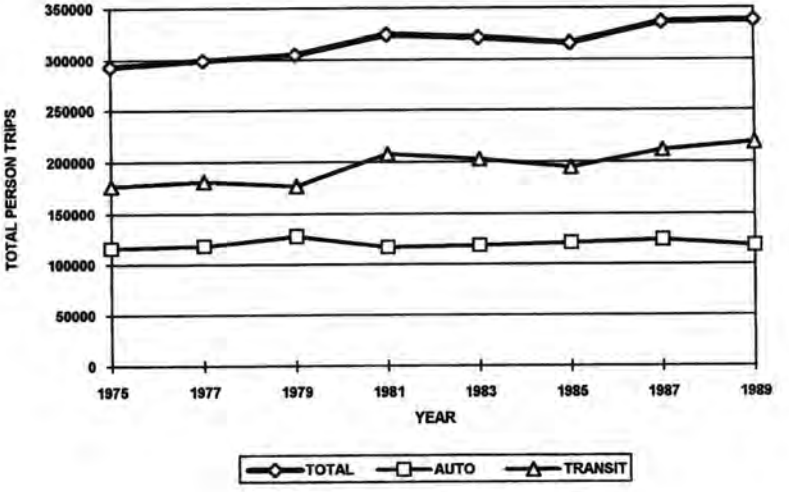
REVIEW OF THE METRO CORDON COUNT

The Metro Cordon Count program provided detailed person and vehicle counts, permitting a more detailed assessment of mode choice and the distribution of trips associated with the Central Area. The Central Area Cordon was used for the purpose of this analysis. The peak period used in the analysis referred to 6:30 a.m. to 9:30 a.m. for all trip purposes and modes.

Passenger Trips

The overall inbound person trips during the morning peak period entering the Central Area has grown by 15.2 percent between 1975 and 1989. Approximately 340,000 passengers were entering the Central Area between 6:30 a.m. and 9:30 a.m. in 1989. The number of person arriving in automobile had seen little growth, and the net effect was the decline in auto-occupancy rate as discussed in the next section. On the contrary, for passengers using transit to enter the Central Area, the historic trends showed significant growth during the study period. FIGURE 1 illustrated the number of total person trips, auto person trips and transit person trips crossing the Central Area Cordon in both directions during the morning peak.

FIGURE 1: INBOUND PERSON TRIPS 1975 - 1989

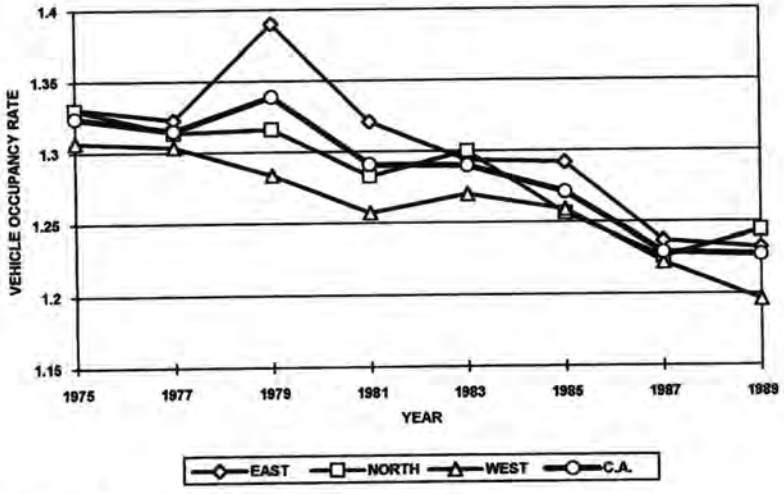


Auto Vehicle Trips and Vehicle Occupancy Rate

The number of automobiles (including taxis) entering and leaving the Central Area between 1975 and 1989 exhibited a steady increase. However, as illustrated in the previous section, auto person trips in both directions remained relatively stable over this period. The result is that the auto-occupancy rate must have fallen.

FIGURE 2 showed the auto-occupancy rate for inbound traffic between 1975 and 1989. The occupancy rate had decreased significantly from 1.32 person per automobile to 1.23 person per automobile over 14 years and averaged to be nearly 0.5 percent annually in the decline.

FIGURE 2: VARIATION OF VEHICLE OCCUPANCY, 1975 - 89
INBOUND TRAFFIC

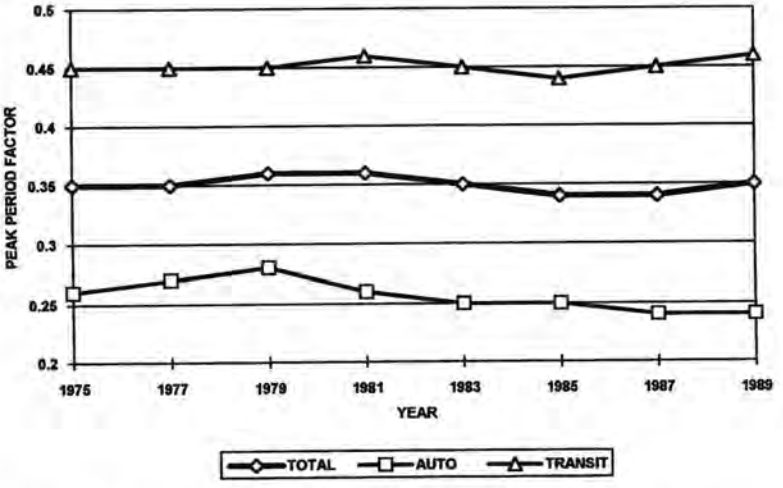


The Peak Period Factor

Theoretically speaking, as the number of passenger trips entering the Central Area increases during the peak period, it causes the peak hour to spread. This phenomenon of peak period spreading is the result of "*travel demand into the Central Area reaching or exceeding available capacity over a longer period*" (5). In order to explain the imbalance between travel demand growth into the Central Area and downtown development, it was important to examine if a greater number of commuting trips were being made outside the conventional three-hour morning peak period.

The peak period factor is defined as the ratio of the number of person trips by mode during the morning peak period (6:30 a.m. - 9:30 a.m.) to the total number of person trips by mode between 6:30 a.m. to 11:30 p.m. For transit person trips, the peak period factor had remained quite stable at 45 percent over the years. The peak period factor for auto users behaved quite differently. The net effect clearly showed that auto person trips were shifting away from the conventional morning peak period, i.e., the peak period factor was declining. This indicated that the roadway capacity of major roadways into the C.A. has reached or exceeded their capacities. However, the overall result, by combining all modes, indicated that the peak period factor remains quite flat as illustrated in FIGURE 3.

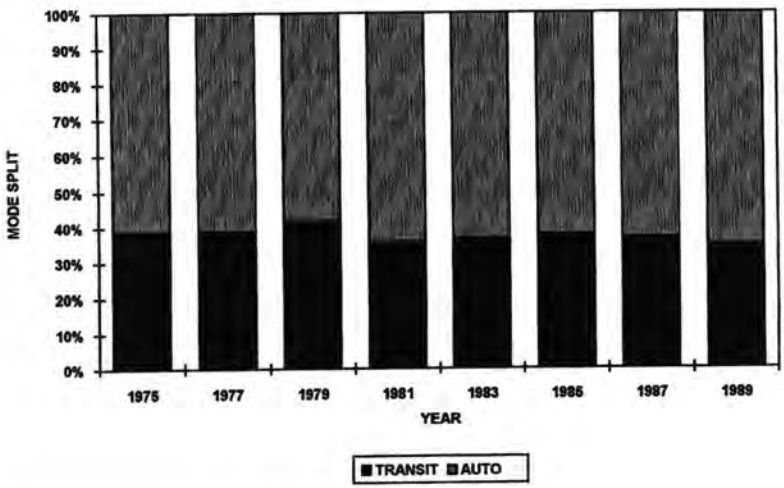
FIGURE 3: VARIATION OF PEAK PERIOD FACTOR, 1975 - 89
INBOUND PERSON TRIPS



MODAL SPLIT

Given the detailed information from the Cordon Count data, the mode split was also analyzed. FIGURE 4 illustrated the historical trends in the percentage of transit and auto usage for the Central Area Cordon. In 1989, the automobile carried 35 percent of the inbound passengers into the Central Area, and this ratio correlated well with the travel survey results. The ratio of automobile trips were declining, and have seemed to reached an equilibrium. However, any improvements on the road or transit systems would shift the equilibrium depending on the improvement policies implemented. For example, by building additional highway infrastructures, the share of automobile is expected to increase.

FIGURE 4: MODAL SPLIT OF INBOUND TRIPS, 1975 - 1989



THE NOWLAN-STEWART HYPOTHESIS

The hypothesis which argued that the growing residential population in the Central Area had impeded the growth in inbound commuting trips into the Central Area was first put forward by Nowlan (6), and finalized by Nowlan and Stewart (7). Based upon the population and housing changes from 1975 to 1989, the analysis concluded that there will be "*70 fewer trips for each 1000 increase in population in the Central Area, or 129 fewer trips for each addition of 100 dwelling units*" (7). The hypothesis implied that with further housing development and population intensification in the Central Area, further growth of downtown office space could be allowed without the provision of additional commuting infrastructure into the Central Area.

One of the two basic equations derived in the Nowlan and Stewart study (7) was:

TRIPS = 179,000 + 0.04*SPACE - 0.7*POPULATION.....eqn.1

where,

TRIPS = The number of inbound person trips crossing the Central Area Cordon by all modes between 7:00 to 10:00 a.m.
SPACE = The amount of mid-year occupied office floor space within the Central Area Cordon in square metres.
POPULATION = The size of the residential population living with the Central Area Cordon.

For the purpose of this study only equation 1 was examined. The Nowlan-Stewart hypothesis could prove to be very appealing to planners. By implementing a single policy, that is, increasing the number of Central Area residents, several benefits could be anticipated. These benefits include a more "livable, balanced" Central Area; the accommodation of Core office development without the provision of any new transportation facilities; and an increase in the amount of walk-to-work trips.

THE SARSAN MODEL

Some of the short-comings in the Nowlan-Stewart hypothesis were addressed by Sarsan (8). The Sarsan analysis concentrated on equation 1. The basic equation which Sarsan developed was of the form:

TRIPS = K + 0.9*(0.04*SPACE - L*POPULATION).....eqn.2

where,

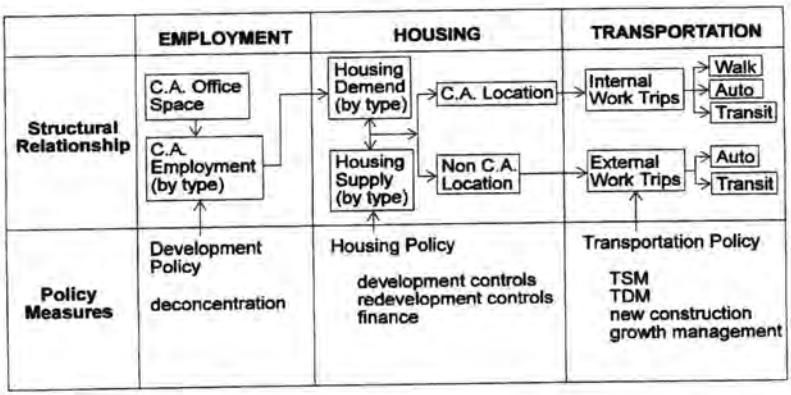
L = The percentage of Central Area population working full-time office job in the Central Area
K = Background trips such as non-work trips, through trips, non-office work trips and part-time office trips

A 10 percent absenteeism rate was included which was reflected by the 0.9 coefficient on the right hand side of equation 2. The floor space per worker ratio was assumed to be constant at 25 square metres per worker over the study period in the Nowlan-Stewart hypothesis, the K and L coefficients were assumed to be constant K, the amount of background travel, was estimated to be 179,000, i.e., the constant term in equation 1. L was calculated to be 70 percent, i.e., 70 percent of the Central Area population worked in full-time office job in the Central Area, without taking absenteeism into account. However, the Sarsan study pointed out that there did not exist any time series data to analyze the variation of both the K and L coefficients between 1976 and 1988 to be able to derive a valid relationship. The background travel into the Central Area might have been decreasing over time. Without knowing how it varied in the 1976-88 period, it was not feasible to project any future impact of the Central Area population had on reducing the morning peak hour inbound traffic.

The L coefficient calculated by the Nowlan-Stewart hypothesis appeared to be overestimated. The 1989 Central Area Residents' Survey (CARS) indicated that L could not have been anything higher than 35 - 40 percent (8). Thus, surveys similar to CARS should be conducted on a regular basis to monitor the structural changes in the Central Area in order to determine the L coefficient. Given that the L coefficient was known over a reasonable length of time, it was then possible to derive meaningful relationship between travel demand and land use in the Central Area.

The Nowlan-Stewart hypothesis as well as the Sarsan model basically tried to link the relationship between transportation and land use in the Toronto Central Area through a simple, time series, linear format. Housing and employment were used as the two major inputs in the land use context. The development of Central Area office space would attract the location of businesses which in turn generate a demand for new housing in the Central Area. Those who worked and lived in the Central Area would only create travel demand that was internal to the Central Area during the peak period. Those who chose to live outside the Central Area would generate additional commuting trips to the Central Area, thus putting additional burden on the already heavy-loaded transportation system. FIGURE 5 illustrated the relationship between employment, housing and transportation as well as their policy measures.

FIGURE 5: POLICY MEASURES AND THEIR EFFECTS



There are limitations to the use of the Nowlan-Stewart and the Sarsan models when use to project future implications on the Central Area using housing, population, office development and transportation changes. Both models used past demographics as predictors of the future. The pitfall was implicit in these relationships, which assumed that all other factors and relationships affecting travel demand into the Central Area would remain unchanged over time. Therefore, it must be used cautiously as a planning tool to assess impacts of alternative strategies.

The Nowlan-Stewart hypothesis also appeared to be too simple to assess the impact of Central Area population growth on morning peak hour inbound traffic entering the Central Area because the estimated structural change in the Central area population proved to be unrealistically high. This in turn overestimated its offset on the generation of additional inbound commuting trips into the Central Area during the morning rush hours.

For the downtown population to have the desired effect of decreasing travel demand into the Central Area, the Central Area residents must be "self-contained". "Self-Containment" dictates that the jobs created in the Central Area must be filled by Central Area resident labour force.

In the period between 1976 to 1989, the imbalance in growth between Central Area Travel demand and Core Area office floor space or employment was more likely to be caused by a number of factors including the growth of Central Area population as suggested in the Nowlan-Stewart hypothesis. These factors are summarized as follows (10):

i) Additional housing was provided in the Central Area, accommodating part of the Central Area workers. In other word , the Central Area is becoming increasingly more "self-contained".
ii) An increase in a less structured workday or workweek for Central Area workers. As the Central Area was turning more executive in nature with higher proportions of managerial and professional workers, some of the commuting might have occurred outside the traditional morning peak hours.
iii) A decline in non-work trips and through trips entering the Central Area during the morning peak hours.
iv) A decreasing proportion of office clerical workers making the commuting trip into the Central Area. Again, along with the increasing executive nature of the Central Area, a lot of "back office work" mainly done by clerical workers was moved outside the Central Area where rents were less expensive. These clerical workers tended to have rigid commuting schedule to travel inside the morning peak hours.

TRAVEL DEMAND MODELLING

In order to explore the implications of the Nowlan-Stewart hypothesis for future transportation planning associated with the Central Area, a more in-depth analysis at a given point in time (cross-sectional analysis) was performed in order to develop a simple travel demand model. The purpose of this model was to explain the Central Area's role as a work trip attraction centre, as well as the effect of Central Area population on the morning commuting trip. This part of the analysis attempted to establish the basic equation for use in the general assessment of various policy options in the future.

MODELLING APPROACH

The modelling approach was based on the Nowlan-Stewart hypothesis. It was assumed that the amount of passenger flow into the Central Area during the morning peak period was associated with selected land use and demographic variables in the Central Area. The level of analysis was highly aggregated, and the Greater Toronto Area was considered as one external zone. Inevitably, because of this level of aggregation, some of the variation which existed in the independent variables would be masked. However, due to the nature of the Cordon Count data, there was little choice. The 1987 Travel Diary Survey (TDS) data was used for the cross-sectional analysis in which the L coefficient could be estimated.

The volume of inbound passenger trips during this period was defined to be the dependent variable TRIPS. SPACE was defined as the mid-year occupied office floor space in square metres, and POPULATION was defined as the number of Central Area residents. Both SPACE and POPULATION figures were extracted from Nowlan and Stewart (7). Based on equation 2, once the L coefficient is determined from the TDS analysis, the K coefficient can be determined by substituting the TRIPS, POPULATION, and SPACE values collected in 1987. Hence, the 1987 TDS data was analyzed in the following section to determine the travel demand pattern in 1987.

THE APPLICATION OF THE 1987 TRAVEL DIARY SURVEY (TDS)

The TDS provided socio-economic characteristics (occupation and employment status), land use (place of residence and place of work), trip purpose and trip end times information which was not available from any other source.

The primary focus of the analysis was the pattern of peak period, home-based work trips associated with the Central Area. The analysis of peak period work trips concentrated on workers who specified their trip end times during the morning peak period between 6:30 a.m. and 9:30 a.m.. The trip characteristics examined in this cross-sectional analysis were summarized in TABLE 4.

TABLE 4: SUMMARY OF TRIP CHARACTERISTICS

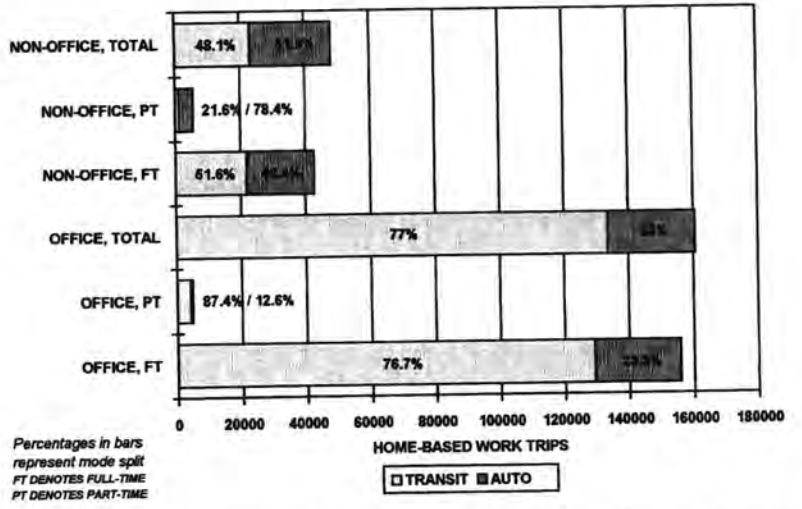
TRIP CHARACTERISTICS	CATEGORIES
Origin/Destination Pairs	External - Internal
Work Site and Use	Office Building Non-Office Building
Trip Purpose	Home-Based Work, Full-Time Home-Based Work, Part-Time Other
Employment Status	Full-Time Part-Time
Travel Mode	Auto Transit

ANALYSIS OF WORK TRIPS BY LAND USE

This part of the analysis was focused on the place of work for the peak period, home-based trips. By examining the volume of work trips that arrived at various work site destinations, it provided a reasonable check on the Nowlan-Stewart hypothesis because one of the independent variables was occupied office space (SPACE).

FIGURE 6 illustrated the modal variation by work site and employment status for external to internal trips. The full-time office-bound category clearly made up the bulk of the volume of home-based work trips made by full-time employees that entered the Central Area during the morning peak period, nearly 80 percent were destined to office buildings. Home-based part-time work consisted of only 4.7 percent of all home-based work trips made to the Central Area.

FIGURE 6: MODAL VARIATION BY WORK SITE LAND USE AND EMPLOYMENT STATUS



The non-office sector exhibited a near fifty to fifty mode split. However, the office sector showed a mode split of 23.3 percent auto and 76.7 percent transit, making the overall mode split to be near 30 percent to 70 percent for auto and transit users respectively. Part of the reason for the high percentage of overall transit usage when compared to the Cordon Count could be the fact that the "background" trips that entered the Central Area Cordon had a high percentage of auto users. The net result was the percentage of mode split as exhibited by the Central Area Cordon count.

ANALYSIS OF EXTERNAL TO INTERNAL TRIPS BY TRIP PURPOSE

In order to understand the peak period inbound travel demand better, the overall volume of trips recorded during the morning peak period was examined by trip purpose. Home-based full-time work trips overshadowed the rest. It consisted of 81.6 percent of all trips entering the Central Area during the peak by all modes. Trip purposes other than work only made up 14.4 percent of the trips that were made into the Central Area during the peak period.

COMPARISON WITH 24 HOUR WORK TRIPS

In previous sections, the possibility that some of the work trips were traveling in the off-peak hours was discussed. The TDS data base provides information for this kind of comparison.

It was found that 77 percent of all workers arrived at the Central Area during the morning peak period. Most of the transit users (80.3 percent) arrived at work during the peak period, whereas the percentage of auto users (71 percent) that arrived at work during the peak period was comparatively lower. This implied that some of the home-based work trips were actually occurring outside the traditional peak period for auto-users. The total number of home-based work (all modes) amounted to approximately 90,000. This further indicated that the Nowlan-Stewart hypothesis overestimated the effect of Central Area population growth.

LINEAR REGRESSION MODEL

The employed labour force in the Central Area was 85,198 (7). The 1987 TDS indicated that during the peak period, 22,943 home-based work trips for internal to internal travel was recorded for full-time and part-time workers. However, the 1987 TDS also indicated there were 35,693 24 hour home-based work trips that occurred internally (10). First, only 64 percent of the "internal" work trips occurred during the peak period. Second, if the employed labour force and 24 hour work trips were compared directly, 42 percent of the Central Area employed labour force were also working in the Central Area. This compared favourably with the 1989 CARS result of 35 percent to 40 percent (8).

From the TDS result, it can be deduced that the number of peak period full-time office-building-bound work trips using either the auto or transit mode was 168,573 trips. For the purpose of this discussion, assume that this figure reflects the actual number of trips made in 1987. Recalling equation 2, the percentage of workers living and working in the Central Area (L coefficient) could be calculated.

In this case:

T = 336,706 trips (1987 Cordon count data)
S = 5,825,906 trips (Nowlan-Stewart (7))
K = 336,706 - 168,573 = 168,133 background trips
P = 132,090 people (Nowlan-Stewart (7))

and,

TRIPS = K + 0.9*(0.04*SPACE - L*POPULATION).....eqn.2

therefore, **L** = 35 percent

Hence, it can be deduced that if the Sarsan model held true, the following characteristics may be used for further analysis:

i) The TDS data base reflects a reasonably accurate 168,600 work trips crossing the Central area Cordon during peak period.
ii) The number of background trip in 1987 was 168,000. This represented an approximate 50 to 50 split between work trips and background trips entering the Central Area.
iii) The K coefficient of 35 percent estimated from the modified Sarsan model is reasonable (compared with 1989 CARS figure of 35-40 percent)
iv) The final format of the Sarsan model is best described as:

TRIPS = 168,000 + 0.9*(0.04*SPACE - 0.35*POPULATION).....eqn.3

This cross-sectional analysis provided an insight of the composition of traffic entering the Central Area Cordon during the peak period using equation 3. Half of the inbound trips entering the Central Area were home-based work trips. If this relationship holds true for the future, Cordon Count data could be used to a better extent. By applying equation 3, the number of inbound trips during the peak period can be determined for any given year given that the variables S and P are known. However, this relationship will change and regular surveys such as the TDS should be conducted to monitor any changes to the relationship described in equation 3.

FUTURE TRANSPORTATION PLANNING IMPLICATIONS AND CONCLUSIONS

Based on the results of the previous findings, it is possible to look at a reasonable growth scenario for the Central Area. Equation 3 implies that the impact of Central Area population on inbound trips is such that for each 100 increase in population in the Central Area there would be 32 fewer trips. Therefore, if the number of inbound trips entering the Central Area must stay constant in the future, office development and Central Area housing must be planned hand in hand.

The office space in the Central Area has an average annual rate of just 3 percent over the past 15 years. Assuming that this trend continues in the near future, then by 1993 the office space in the Toronto Central Area would have grown to 7 million m^2. For the amount of inbound trips to remain at the 340,000 level, the Central Area population has to be approximately a quarter of a million to accommodate the extra 1,000,000 m^2 office space. This means an additional 120,000 people living in the Central Area by 1993.

Hence, in order for a healthy growth of office development the Central Area without any change in transportation policy, only by increasing the number of people living in the Central Area would not be feasible when the growth of the Central Are population have been approximately 2,000 people annually in the past decade (2).

The traditional way to accommodate increased travel is to construct new transportation facilities. However, in view of the present economic conditions , as well as the growing concern over the environment, this alternative does not appear to be attractive.

Transportation Demand Management (TDM) appears to be an attractive alternative, to partially ease the burden on the existing transportation system associated with the Central Area. By developing and implementing TDM programs, it is possible to alleviate traffic congestion through improved management of person and vehicle trip demand, thus accommodating future commercial development in the Central Area.

As indicated in the 1987 cross-section analysis, only half of the number of inbound trips entering the Central Area Cordon was associated with full-time work travel. The rest of the inbound trips entering the Central Area possessed different trip purposes. Home-based part-time peak period work trips only accounted for approximately 10,000 trips. Home-based school peak period trips, home-based other peak period trips and non-home based peak period trips were estimated in the 1987 TDS to be about 80,000. This suggested that the amount of trips going through the Central Area amounted to about 75,000 trips.

The discrepancy exhibited in the TDS auto occupancy rate and the Central Area Cordon Count data could be explained by the possibility that the background travelers preferred to drive alone or with very few passengers. As indicated in the Cordon Count data, the number of inbound auto person trips was 124,714 in 1987, whereas the number of inbound transit trips was 211,992. If the number of auto and transit trips from the TDS full-time office work trips were subtracted from these figures, it gives a mode split of 51 percent auto and 49 percent transit for the "background" trips during the peak period. Hence, about 80,000 auto trips that entered the Central Area were not full-time office work trips.

In view of the results, it pointed towards TDM as the ideal tool to ease travel demand entering the Central Area during the peak period. Programs such as road pricing or restriction of traffic entering the Central Area should be considered by the City of Toronto . By limiting the number of background trips entering the Central Area during the peak period, there would be room for office growth in the Central Area without the provision of new transportation facilities. TDM programs such as the Singapore Area License Scheme have proven to be very successful , as well as profitable, for reducing the number of automobile entering the downtown area during the peak periods (12).

By implementing TDM programs the background travel could be reduced, and using equation 4 to 6 , the following scenarios might be possible using TRIPS (T) = 340,000 and POPULATON (P) = 130,000:

% reduction of K coefficient		Office Space (million m^2)
20%	T = 134,000 + 0.036*S-0.315*P eqn.4	6.9
40%	T = 100,800 + 0.036*S-0.315*P.....eqn.5	7.8
60%	T = 67,200 + 0.036*S-0.315*P.....eqn.6	8.7

As discussed before, the addition of Central Area population also helped to reduce the amount of inbound traffic going the Central Area. However, this effect should be geared towards a more "self-contained" population in the Central Area. The L coefficient estimated for 1987 turned out to be 35 percent. If measures could be taken to increase the proportion of Central Area jobs filled by local residents, it would also serve to further reduce peak period inbound trips to the Central Area associated with full-time work travel.

By increasing the proportion of workers that worked and lived in the Central Area, and using equations 7 to 9 using TRIPS (T) = 340,000 and POPULATION (P) = 130,000, the following scenarios were examined:

L coefficient		Office Space (million m^2)
35%	T = 168,000 + 0.036*S-0.315*P.....eqn.7	6.0
50%	T = 168,000 + 0.036*S-0.450*P.....eqn.8	6.4
75%	T = 168,000 + 0.036*S-0.675*P.....eqn.9	7.2

When TDM programs are considered along with the policy of increasing the "self-containment" of the Central Area residents, office growth in the Central Area can be further encouraged without the provision of new transportation facilities. The following scenarios were provided using a L coefficient of 55 percent TRIPS (T) = 340,000 and POPULATION (P) = 130,000:

% reduction of K coefficient		Office Space (million m^2)
20%	T = 134,000 + 0.036*S-0.5*P.....eqn.10	7.5
40%	T = 100,800 + 0.036*S-0.5*P.....eqn.11	8.5
60%	T = 67,200 + 0.036*S-0.5*P.....eqn.12	9.4

Since the development of the Central Area of Toronto is important to economic growth in the Toronto region, it is recommended that TDM programs that limited the access of the Central Area to non-work related travel should be implemented. Polices that would increase the proportion of workers living and working in the Central Area should also be encouraged. Hence, affordable housing geared towards the average full-time office worker should be developed in the Central Area.

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Market Structure, Regulatory Externalities and the Overloading of Trucks: An Industry Perspective.[1]

[1] Introduction to the Problem.

The overweighting of trucks can do considerable damage to the man-made environment. By causing degradation to the pavement surface, overladen trucks impose costs on other road-users in terms of increased travel times, and decreased comfort and road-safety. By increasing the amount of money which must be spent on road repairs the behaviour also imposes a burden on the public purse and thence upon society in general.

The economic incentive for an operator to overload his truck is clear - his revenue will (in general) be linearly increasing in the weight of produce which he hauls, whilst his operating costs increase only nominally. Much of the extra cost of excessive loading is, then, external to the operator, taking the form of increased infrastructural damage. Because of the externality imposed by trucks which are overloaded weight limits are set. The enforcement component of regulation is of unusual importance, in this context, because of the potential for 'outliers' to do disproportionate amounts damage. A 'rule of thumb' commonly used by civil engineers is that the severity of the pavement damage caused by the transit of a truck increases with the fourth power of gross axle weight (Stiglitz and Arnott (1988: 33)) - one severely overweighted truck can do the damage of hundreds of compliant ones.

One study estimates that overloaded trucks in Saskatchewan (which constitute 13% of loaded trucks and, therefore, significantly less than 13% of total truck movements in that province) are responsible for 98% of all damage to highways (Wyatt and Hassan (1984: 70)). Thus, according to Saskatchewan Highways and Transportation, the practice of overweighting accounted for some $1.8 m of pavement damage in that province in 1984. Barron (1985) calculates that pavement damage attributable to overweight trucks in New Jersey could exceed US$ 20 m per annum. Similar conclusions regarding the disproportionate impacts of violators of weight regulators have been reached for other jurisdictions. It should be noted that these estimates often understate the true damage done to infrastructure because studies (including that by Wyatt and Hussan (1984)) ignore damage done to bridges and other roadside structures. More general estimates of the potential effects of heavy trucks have been provided by the U.S. General Accounting Office (1979) and the Organisation for Economic Cooperation and Development, Environment and Transport Divisions (OECD, 1983). What is clear is that the damage associated with the antisocial activity of overloading lorries is considerable.

In this paper we assess the regulatory problem surrounding the enforcement of weight limits. In particular, the scope for industry self-regulation is considered. Regulation is assumed to comprise a weight limit and a level of enforcement effort which depends upon the compliance performance of the industry. In Canada, weight regulations vary between provinces, and between States in the US. Maximum loads are defined for each axle and for gross

combination weight (GCW) by class of truck. Setting standards is not enough, in itself, however, to protect the road system from excessively heavy lorries. It cannot be assumed that operators will be uniformly scrupulous in complying with the regulatory requirements unless an adequate enforcement régime is installed. In this paper we concentrate on the problem of enforcing existing regulations, rather than that of at what stringency regulations should be set in the first place. In the context of a 'responsive' regulatory agency, we demonstrate that there are potential gains to be reaped by the industry from establishing a self-regulatory system to ensure a higher rate of compliance than would be the case if each firm acted independently.

The story which our model tells is, essentially, a simple one. Consider a trucking duopoly. On a particular route Firm A overloads some fraction of it's trucks, inducing an increase in the regulatory effort of the government on that route. This reduces the expected profits of Firm B, the other duopolist. Firm A can be said to inflict a 'regulatory externality' on Firm B. At the same time, however, Firm B is inflicting an analogous regulatory externality on Firm A. We demonstrate that, in general, there will be benefit to both firms from agreeing to some kind of mutual restraint on their respective violation rates. Such cooperative action on the part of the members of the industry is what we will call 'self-regulation'. The new (cooperative) equilibrium will not be characterised by full compliance, but will involve less frequent violation than in the non-cooperative equilibrium. For this reason the government regulatory agency should encourage this class of cartelisation by the industry.

The focus of this study is the problem faced by firms in the industry, and regulatory framework is to some extent 'black boxed', though we will motivate the external characteristics of that black box in several ways. In Section 2 we develop and solve a simple model of the loading problem faced by the individual truck operator. In Section 3 we consider the role of market structure on the compliance behaviour of the industry. It is shown that a less concentrated industry will, in aggregate, violate the weight standards more often than a more concentrated one. In Section 4 the scope for, and practicability of, self-regulation is examined. It is argued that the gains from industry self-regulation may be considerable, though empirical determination of those gains is likely to be hampered by the problem of adequately defining the boundaries of the market (how far is the industry segmented - both geographically and by the characteristics of the vehicle population). Suggestive examples taken from the North American industry are used throughout.

[2] A Stylised Model of the Truck-Loading Decision.

Weight regulation in a particular jurisdiction is based upon a weight limit, denoted W, which must not be exceeded. Loading a truck is a discrete choice problem: comply or overweight. The revenues and costs associated with complying or overweighting are, respectively, R_C, C_C, R_O, C_O. It is assumed that $R_C<R_O$ and $C_C<C_O$, but $(R_C-C_C)<(R_O-C_O)$. This last condition ensures that, in the absence of any regulatory enforcement, the operator faces an incentive to overweight - in not satisfied the problem is trivial.

An increase in cargo weight from 10 to 20 tons can cause the total cost of haulage to increase by only a few percent. The incremental incentive to overweight (net of penalties incurred), then, depends upon the going rate per

pound on the route being travelled (see Tables 1 and 2 for some typical figures). Data on these rates is easily available and varies according to origin-destination combinations and the nature of the cargo. The incentive to overweight depends, then, upon what is being hauled and on which route.

The regulatory agency conducts random inspection of trucks in transit, in which permenant weigh-stations or patrol cars equipped with mobile scales are used to verify the truck's compliance status. The probability that a given truck on a given journey will be inspected in this manner will be denoted μ, and if the truck is found to be in violation of the weight limit its owner faces a fine of monetary value f. The proportion of the ith firm's trucks which are overweighted is denoted β_i. The enforcement effort of the regulator, on any particular route or in any particular jurisdiction, is assumed to be an decreasing function of the propensity of the truck population to comply. If the industry in that segment is comprised of n firms indexed by lower case subscripts, with respective market shares denoted s_i, then $\mu=\mu(\Sigma\beta_i.s_i)$ where it is supposed that $\mu'>0$, $\mu''<0$. Increased disobeyance of the regulations on any particular routeway (or in any particular market segment) induces, ceteris paribus, increases in the intensity with which that routeway is policed. Such a relationship can be generated by variations on a variety of 'familiar' models of enforcement strategy from the literatures on environmental protection, income tax collection and others. These will be outlined more fully in Section 3. For now we wish to focus on the problem from the point of view of the industry and treat the function $\mu=\mu(\Sigma\beta_i.s_i)$ descriptively.

The trucking firm chooses a mixed strategy, described by the parameter β which dictates the probability that the operator will dispatch an overweighted truck. Through time β will come to be the proportion of truck-journeys which involve excessive loads. The term Ω will be used to denote the average rate of violation in the truck population as a whole. The problem faced by the ith firm, then, is to specify a mixed strategy (ie a β such that $0\leq\beta_i\leq1$) to maximise expected profit P_i.

$$\textbf{(1)}\quad \underset{0\leq\beta_i\leq1}{\textbf{Maximise}}\ P_i=\{[1-\beta_i].[R_c-C_c]+\beta_i.[R_o-C_o]-\beta_i.\mu(\Sigma s_i.\beta_i).f\}$$

The first and second terms represent expected net operating surplus from compliant and overweighted trucks respectively, whilst the third term is the expected penalties to be paid. In the case of an interior solution and assuming Nash conjectures (ie that $(\partial\beta_j/\partial\beta_i)=0$ for all $i\neq j$, the firm takes the actions of it's competitors as given), the first-order and second-order conditions (where the latter is assumed to be satisfied) associated with the ith firms problem are

$$\textbf{(2)}\quad (\partial P_i(\beta_i^*)/\partial\beta_i) = G-\mu(\Sigma s_i.\beta_i^*).f-\beta_i^*.\mu'(\Sigma s_i.\beta_i^*).f.s_i = 0,$$

and

Cargo Weight (tons)	Line-Haul Cost Per Mile	Line-Haul Cost Per Ton-Mile
10	0.891	0.089
15	0.895	0.060
20	0.903	0.045
25	0.905	0.036

Table 1: US Estimates of line-haul costs as function of cargo weight (in 1982 dollars). Notice how slowly per-mile costs rise and, thence, how rapidly costs per ton-mile decline as cargo weight is increased. (Source: Paxson and Glickert (1982: 34))

Vehicle Weight (lbs)	Cargo Weight (lbs)	Rate Per Pound (1982 US $)	Total Rate (1982 US $)
73 000	45 000	0.056	2520
75 000	47 000	0.054	2540
80 000	52 000	0.052	2700
90 000	62 000	0.050	3100

Table 2: Impact of cargo weight on operator revenue, US Estimates. Notice that revenue rises rapidly with cargo weight. Recalling from Table 1 that total operating costs rise only nominally as truck rate increases, this implies that there are significant incentives for operators to overload their trucks (a typical GCW weight limit would be 60 000 lbs). (Source: Paxson and Glickert (1982: 34).

(3) $\partial P_i^2(\beta_i^*)/\partial \beta_i^2 = -f.s_i.\{2.\mu'(\sum s_i.\beta_i^*) + \beta_i^*.s_i.\mu''(\sum s_i.\beta_i^*)\} < 0$

respectively, where the asterisk denotes the solution value and

$$G = [R_o - C_o] - [R_c - C_c] > 0,$$

is the increase in gross operating profit (ie abstracting from regulatory penalty considerations) generated by overweighting a truck which would otherwise be in compliance.

The first-order condition dictates that the firm will go on increasing the proportion of its trucks that it overweights upto the point at which the expected increase in gross profit from so doing equals the increase in expected penalties. The increase in penalties has a direct and an indirect component. There is an increased likelihood that if one of that firms trucks is inspected (which will be the case with probability μ) it will turn out to be overweight and thus draw a fine (of size f). In addition, the simultaneous increase in the proportion of non-compliant trucks on the road will lead to an increase in the enforcement effort of the regulator and thus increase the risk of detection of all of that firms (and, incidentally, every other firm's) overweight trucks. There is evidence that truck-operaters do trade-off the costs and benefits from breaching weight requirements in this way when travelling on any particular routeway. One study records that ".....truckers often have substantial experience to aid them in calculating the probability of being apprehended. Based on this probability they can calculate the expected costs (in fines) of overweighting", (Paxson and Glickert (1982: 34)).

Assuming that the optimal mixed strategy for firm i is described by an interior solution for ß (that is, the firm dispatches some, but not all, of it's trucks overweight) application of the implicit function to the first-order condition (equation 2) yields several comparative static results: $(\partial \beta_i^*/\partial R_c) < 0$, $(\partial \beta_i^*/\partial R_o) > 0$, $(\partial \beta_i^*/\partial C_c) > 0$, $(\partial \beta_i^*/\partial C_o) < 0$, $(\partial \beta_i^*/\partial f) < 0$, $(\partial \beta_i^*/\partial \mu) < 0$ and $(\partial \beta_i^*/\partial \beta_j) < 0$, all of which have straight-forward interpretation and are strongly intuitive. A particular firm is more likely to violate when G (the gross gain associated with violation) is large, fines are small, inspection frequencies are low and/or it's competitors are violating relatively infrequently.

[3] Market Share and Overweighting.

The vector of n first-order conditions (or, where appropriate, corner solutions), one for each firm in the market segment which we are examining, implicitly serve to define the compliance behaviour of each individual firm, and thence the environmental performance of the industry as a whole. It is of some interest to consider both the impact of a particular firm's market share upon that firm's respect for the weight regulations and, more generally, the impact of market structure upon the compliance of the industry in aggregate. This is of particular interest in considering the possible impact of industry deregulation

upon the integrity of the road network.

The inter-city road-haulage industry in Canada (as in most other developed economies) contains firms of many different sizes - from corporations with over a thousand trailers to independent operators with a small handful. Transport Canada data can be used to estimate four-firm concentration ratios for road-haulage services in the Canadian provinces (see Hirshorn (1981: 51)). The total figures range from 15% (for Quebec and Ontario) to as high as 46 and 52% for Manitoba and Saskatchewan respectively. The licences granted to firms are, in most cases, highly specific with regards to the types of vehicles and the precise routes which the operator can utilise.[2] The market structure for freight-haulage on any given routeway can, therefore, be significantly more concentrated than this.[3] The hypothesis of this paper is that operators in a particular market segment (ie on a given routeway) are engaged in a non-cooperative game. Larger firms will take account of the effect which their compliance decisions will have upon the regulatory enforcement effort and thus upon the profitability of their whole fleet of trucks. The operator of a single truck has no incentive to do this and will be more prone, according to our analysis, to overload.

[3.1] Market Share and Overweighting.

Consider the case of a symmetric, n-firm Nash equilibrium. In this case the market share of the representative ith firm is (1/n). Defining Ω to be the industry non-compliance rate (that is, $\Omega = \sum s_i.\beta_i$) the first-order condition associated with an interior solution to the ith firm's truck-loading problem is

$$(4)\quad \partial P_i(\beta_i^*)/\partial \beta_i = G - \mu([\beta_i^* + \sum \beta_h]/n).f - \beta_i^*.\mu'([\beta_i^* + \sum \beta_h]/n).f/n = 0.$$

The assumption that the ith firm has Nash conjectures regarding the reactions of rival firms to changes in his actions means that $(\partial \beta_h/\partial \beta_i)=0$, such that $(\partial \Omega/\partial \beta_i)=s_i=(1/n)$. It will be assumed, again, that the requisite sufficiency condition is satisfied. In equilibrium, symmetry requires that $\beta_i=\beta_h$, such that the subscripts which distinguish between firms can be dropped and the representative first-order condition becomes:

$$(5)\quad G - \mu(\beta^*).f - \beta^*.\mu'(\beta^*).f/n = 0.$$

To examine the impact of market structure upon the propensity of the industry to overload it's trucks, the implicit function theorem can be applied to this equation to show that,

$$(6)\quad \partial \beta^*/\partial n = -(1/J).\{\beta^*.f.\mu'(\beta^*)/n^2\}$$

where **J** represents the second-order condition associated with the representative firms problem and, as such, is assumed to be negative in the vicinity of β^*. The term in braces is unambiguously positive, thus $(\partial\beta^*/\partial n)>0$ - an increase in the number of constituent firms in a symmetric, n-firm Nash equilibrium industry will be associated with an increase in the proportion of trucks which each firm (and, thence, the industry as a whole) dispatch in violation of the weight regulations.

Subject to certain constraints upon the form of the regulatory reaction function, $\mu(\Omega)$, there will exist some N_{min} and N_{max} such that $\beta^*=0$ when $n<N_{min}$ and $\beta^*=1$ when $n>N_{max}$. That is, when the number of firms in the industry is sufficiently small there will be no overweighting in equilibrium (unless N_{min} turns out to be less than one, in which case this possibility is eliminated). When the number of firms in the industry is sufficiently large all trucks will be overweighted. Notice that N_{max} will be finite only if $G>\mu(1).f$, (ie if $\mu(1)$ is sufficiently small).

The most 'general' case, with both N_{max} and N_{min} being finite and greater than unity, is illustrated in Figure 1.

When one firm overweights one of it's trucks it induces, by increasing the fraction the industry population which is overweighted, an increase in the intensity of regulation. By so doing it inflicts a 'regulatory externality' on it's rivals. Increasing the number of firms in the industry increases the portion of costs due to the regulatory tightening which constitute external costs. As it's share of the industry-wide regulatory costs of overweighting decreases (ie as the industry becomes less concentrated) the firm disregards an increasing portion of those costs and thence overweights more frequently.

In the symmetric case the market share of each firm equals (1/n). Thus more overweighting is associated with firms with smaller market share. This result can be generalised to an asymetric case, in which the industry is populated by firms of different sizes. The analytic result that propensity to overweight is a decreasing function of the size (market share) of the carrier conforms to the evidence that it is the small, independent operator who is prone to frequent violations. Walton and Yu (1983) provide empirical and anecdotal evidence of this in a study of road-haulage in Texas: "Common carriers.....have low rates of violation. These data correspond well to comments rendered by DPS personnel with respect to their observation that independent (small) truck operaters are the significant challenge to License and Weight officers", (Walton and Yu (1983: 28)).

[3.2] Compliance Performance and Enforcement Effort.

Crucial to our model is the supposition that the enforcement efforts of the regulatory agency are 'reactive' in the sense that a change in the proportion of trucks not obeying the weight regulations will induce a change in the inspection rate. We have made the supplementary asssumption that the relationship is positive and concave, such that the 'reaction function' of the regulatory agency is as assumed in the last section.

It is not the aim of this paper to build-in any kind of model of optimal

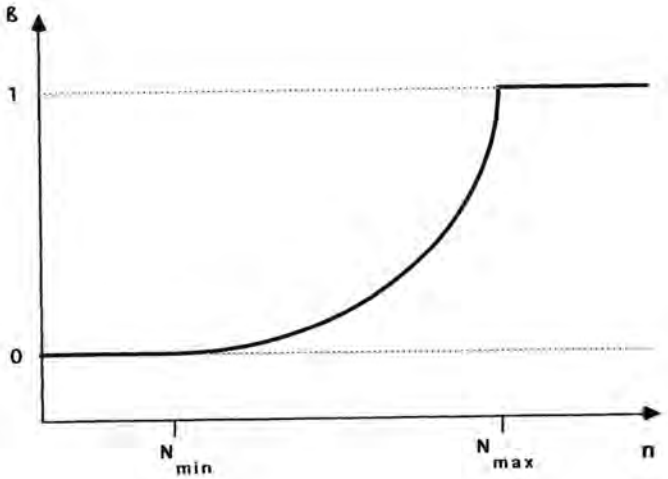


Figure 1: Derived relationship between number of symetric Nash competitors in the industry (n) and the equilibrium propensity of the representative firm to violate weight regulations (ß).

regulatory behaviour (ie to derive the reaction function). Though the regulatory problem has not, to our knowledge, been treated to rigorous economic examination a variety of familiar models could, we assert, be used to derive a reaction function with the requisite characteristics. These include; (i) simple 'crime and punishment' models in which the increased presence of non-compliers in the regulated population increases the productivity of the marginal dollar spent on inspection, thus causing more to be spent upon it, (ii) 'segmented market' models in which a national or provincial agency allocates some fixed budget across a set of market segments (ie different routeways) to maximise number of violators caught or some other objective function, (iii) models of a budget-constrained agency in which penalty income is 'recycled' (either directly or indirectly) into the agency's operating budget, (iv) 'transport planning' models, in which a central planning department (such as a Provincial Highway Commission) with overall control of maintaining the integrity of the road network finds it cost-effecive to respond to increased non-compliance rates by redirecting funds from its maintenance budget (ie damage repair) to its enforcement budget (ie damage prevention), (v) 'behavioural models' in which for (often ill-defined) bureaucratic reasons some desired compliance rate has been targetted by administrative or legislative mandate, and (vi) various 'political economy' models in which increased 'crime' rates and diminishing road quality standards increase public and political awareness of the problem, and thus the efficacity of the various automobile, environmental and other interested pressure groups.

This list of 'stories' which could be told to generate a functional form for $\mu(.)$ of the type assumed in our analysis is suggestive rather than exhaustive. Furthermore, they are not mutually exclusive - two or more effects could work at the same time. It should be straightforward, conceptually at least, to use time-series methods to estimate the relationship between non-compliance and enforcement effort.

[4] On the Benefits From Industry Self-Regulation.

There exist, in general, gains to the industry from self-regulation. Recall that P_i is the expected profit of the representative firm. Consider a small chage in Ω, generated by each firm's simultaneously changing its choice of β by the same arbitrarily small amount. In the vicinity of the (non-cooperative) Nash equilibrium,

$$(7)\quad dP_i(\Omega^*)/d\Omega \;=\; \underset{(+)}{(\partial P_i(\Omega^*)/\partial\Omega)} \;+\; \underset{(-)}{(\partial P_i(\Omega^*)/\partial\mu)}.\underset{(+)}{\mu_\Omega(\Omega^*)}$$

The full impact of the change upon the expected profits of the ith firm is the sum of two components. The first is the 'direct effect', holding the level of regulatory enforcement constant. It is obvious that this term is negative, except in the case of n=1 (a monopolised industry) in which case the envelope theorem dictates that it should equal zero. The second term is the effect on expected profitability of the change in regulatory stringency induced by the change in the

proportion of violators on the road. This effect will be unambiguously negative, as marked. It can be shown that the indirect effect always outweighs the direct effect by re-expressing Equation 7 (the substitution for the 'direct effect' can be made from the firm's first-order condition, Equation 2) as

$$(8)\quad dP_i(\Omega^*)/d\Omega = (1-s_i).\Omega.f.\mu_\Omega(\Omega^*) - \Omega.f.\mu_\Omega(\Omega^*)$$

$$= -s_i.\Omega.f.\mu_\Omega(\Omega^*) < 0$$

or, in the n-firm symmetric Nash case considered throughout this paper,

$$(9)\quad dP_i(\Omega^*)/d\Omega = -(1/n).\beta^*.f.\mu'(\beta^*) < 0$$

The implication is that an agreement by all firm's in the industry to reduce (each by an equal amount) the frequency with which they overweight their trucks would increase the expected profit of all firms. The result is a variation on the well known Pareto inferiority of Nash equilibria. In the non-cooperative context examined, no firm has an incentive to take account of the 'regulatory externality' which it imposes upon the other firm's in the industry. Thus, every firm overweights more frequently than it would if it were to take account of (or be liable for) the external costs it generates. The result is that the industry ends up in a 'frequent violation/high enforcement' equilibrium.

[4.1] Diagrammatic Exposition: The Duopoly Case.

It is easiest to illustrate the potential gains from self-regulation for the case of an industry comprised of two (symmetric) Nash competitors. In $\{\beta_1,\beta_2\}$-space it is possible to characterise a reaction function for each firm, of the form $\beta^*_1=f(\beta^*_2)$ and $\beta^*_2=f(\beta^*_1)$. It is straightforward to demonstrate that each of these will be downward sloping, as is the case in Figure 2, and truncated at $\beta=1$. There is, of course, no reason to suppose that the reaction functions will be linear - further characteristaion requires that functional forms be imposed.

An iso-expected profit contour for each firm is also sketched in in Figure 2. In each case the expected profit at each point on the contour is the level associated with the Nash equilibrium. The shaded area constitutes a core of $\{\beta_1,\beta_2\}$ pairs which ensure greater expected profits to both of the firms than the Nash equilibrium. Within the constraints of our analysis (ie that we only consider the welfare of the members of the industry) such a solution Pareto dominates the Nash equilibrium. There is, however, a third group whose interests have been suppressed in our analysis, namely the general public - in whose interest regulations are supposedly framed in the first place. It is reasonable to suppose, however, that this third group also prefer the new solution over the Nash equilibrium, since it is associated with a lower rate of violation (and thus road damage) and/or a lower rate of enforcement expenditure. The points in the 'core' can, then, be said to Pareto-dominate the Nash

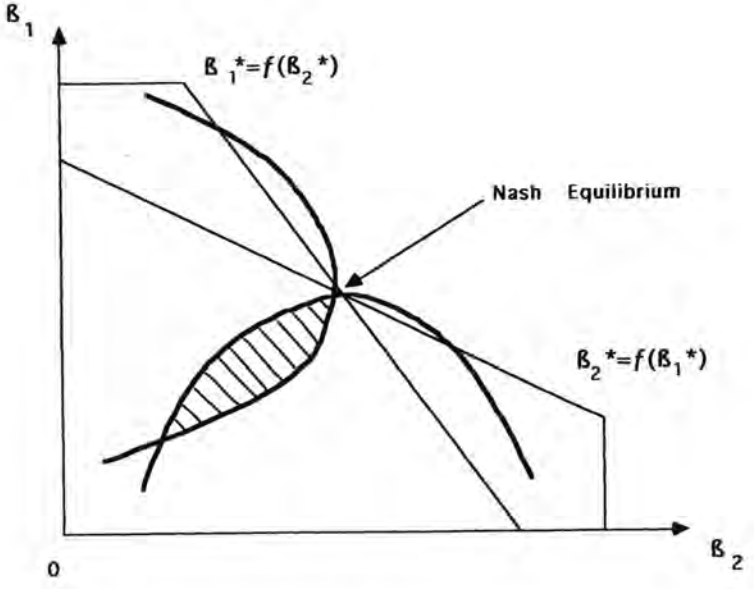


Figure 2: Simplified diagram illustrating the industry gains to self-regulation in the duopoly case. Areas in the core of points Pareto dominate the non-cooperative Nash solution. Representative iso-profit contours are marked (the inverted U-shaped one belonging to Firm 2).

equilibrium.

[4.2] Implementation and Sustainability of a Self-Regulatory Accord.

It is not enough to identify potential gains from cooperative action, in any given context. It is also necessary to examine the extent to which those gains can be reaped. The practical problems associated with implementation of the requisite cooperation may turn out to be formidable.

The procedure whereby the firms in the industry attempt to implement a point in the 'core' (rather than reverting to the non-cooperative Nash solution) is what we will term 'self regulation'. Some convention must be arrived at whereby all operators in the particular geographic market segment agree to comply with the weight regulations more frequently than would be the case in the absence of self-regulation. By how much each firm would be required to raise its own, particular compliance rate cannot be determined uniquely. This reflects the fact that there are a multiplicity of possible solutions involving self-regulation - each associated with a single point in the core marked (for the duopoly case) in Figure 2. Which of the possible points in the core will be 'chosen' by the industry to constitute the solution will depend on, amongst other things, the institutional structure of the industry and the internal framework set-up to facilitate inter-firm bargaining over the terms of self-regulation.

The self-regulated outcome will be associated with less frequent violation and lower enforcement intensity than the non-cooperative Nash solution. In effect, the self regulatory programme has displaced some part of the external regulatory programme and, in this sense, self regulation by the industry can be considered a legitimate (partial) substitute for administrative regulation. The potential Paretian improvements generated by replacing some part of the latter with the former have rested, so far, on the implicit asssumption that enforcement within in the industry would be costless, whereas enforcement from outside is costly. The case can clearly be made, however, whenever internal enforcement is less costly than external enforcement (though not necessarily costless).

The central problem associated with implementing an industry equilibrium with self-regulation is the familiar issue of sustainability (see Shubik (1975) for a classic textbook treatment). It is straightforward to see, from Figure 2 for instance, that from any point in the core every firm stands to increase it's expected profits by unilaterally defecting from that point. More generally, this is true for any point within the area bounded by the reaction functions and the axes. in $\{\beta_1,\beta_2\}$-space with the exception of that associated with the Nash equilibrium. Unless a more cogent story is told as to why the representative firm would not 'cheat' on any industry agreement it is unclear why any solution point other than the Nash equilibrium should be seriously considered. Even if the firms in the industry did agree to some mutual reduction in violation rates it would not be sustainable - we would soon expect to find operaters breaking the terms of the agreement and the self-regulatory system breaking down.

It is, then, necessary that we 'tack on' some additional tool whereby the firms in the industry will be able to sustain mutually beneficial cooperation. Our recommendation is the establishment of 'cartel fines'. Whenever the truck of a particular operator is fined for overweighting (news of such prosecutions are in the public domain) that operator would, as well as the f dollars paid to the formal

regulatory agency, pay an additional 'cartel fine' equal to f_c dollars to the internal regulator. The funds thus generated would be paid to the the local truckers association or other nominated self-regulatory body.

The cartel fine which would implement the optimal (ie joint profit maximising) solution would be equal to

$$(10)\quad f_c = [(1-s_i)/s_i].f.\mu'(\Omega^*).\Sigma_{-i}\beta_i \ .$$

Where the summation in the expression is done across all of the firms in the industry except for the ith. In the symmetric case this becomes

$$(11)\quad f_c = (n-1).f.\mu'(\beta^*).\beta^*$$

The cartel fine, f_c, constitutes a standard Pigovian corrective penalty and serves to internalise the regulatory externality which each firm would otherwise be visiting upon it's competitors. Notice, from equation 11, that the appropriate f_c is everywhere positive and increasing in n. As a particular firm's market share increases the magnitude of f_c diminishes - capturing the notion that a large firm generates a smaller externality. The biggest cartel fine would, for this reason, be payable by the small operator with a single trailer. It is questionable that a 'regressive' system would sit well with advocates of deregulation - seeming, as it does, to penalise the small firm disproportionately. The best we might hope for would be flat-rate cartel fines, though the distinction is, of sourse, trivial in the symmetric market structure case which was the focus of the earlier analysis. When n=1 (ie s_i=1) the industry is monopolised and the appropriate cartel fine would be zero - the monopolist generates no 'regulatory externality' because there is no other firm in the industry upon which such an externality could be incident.

Whether this type of self-regulation proved workable would depend, to a large extent, on institutional considerations. Implementability would vary among jurisdictions. There is an implicit assumption that some channel exists whereby each firm can be coerced into paying the requisite cartel fine - that by failing to do so it would be expelled from the Association and that expulsion losing the other benefits from membership. These other benefits may, in some cases, be too small to permit expulsion to constitute a serious enough sanction to, and this could hinder workability. One way around this might be to require each operator to deposit some fee with it's association, which would be forfeited if the operator failed to honour the terms of the self-regulatory agreement.

Economic theory predicts that implementation of 'cooperative' equilibria in a non-cooperative setting is likely to be particularly difficult when there are many players involved. It is also likely to be difficult to sustain cooperative action when the jurisdiction is host to a large number of 'transient' trucks which may use the routeways but are not party to the local self-regulatory accord. In examining the feasibility of a self-regulatory régime, then, it is important that the market be adequately delineated.

At a provincial or regional level the appropriate institutions for administering a self-regulatory framework (based on cartel fines or some other mechanism) would be the relevant trucking Associations.[4] One province in which cooperative action be the trucking industry could be expected to be practicable is Newfoundland. This is particularly true following the recent evolution of the market's structure there. Previously, the industry was highly fragmented with many small firms providing service which was not always efficient. With the emergence of of larger firms and a considerable reduction in the number of one-man carriers, a group of twelve carriers has now captured almost all of the trucking market in Newfoundland (the Sullivan Commission noted the rapid rate of small firm consolidations and the subsequent rise to predominance of "10 to 12 large carriers"). This relatively small 'club' of operators, along with the lack of any 'through' traffic (for obvious geographical reasons) of trucks belonging to operators outside of the jurisdiction of the local industry federation makes it particularly likely that a mutually advantageous self-regulatory accord (based, perhaps, on 'cartel fines') could be implemented in that province.

It may be, however, that the natural level of aggregation for such self-regulatory agreements is not at the provincial or regional level. The detailed restrictions on routes to be travelled on a given operators licence means that the industry can be treated as a highly segmented one, and it may be that agreements could be drawn-up at the segmental level. Thus, it is conceivable that the six competing firms on the Sault St. Marie to Sudbury route, mentioned earlier, could arrive at some agreement regarding overweighting on that route (ie in that market segment). In response to these cuts in violation frequency the government regulator would (rationally) cut the enforcement effort which he exerts on that routeway and, as our analysis has demonstrated, all of the six firms could expect to gain.

Cooperative action in any given market segment is also likely to be easier to sustain when the gains to the various parties from cooperation are well-defined. It would, we contend, be in the interests of the government agency to facilitate self-regulatory agreement by making the linkage between observed violation rates, on any given routeway, and future rates of inspection on that routeway more explicit. This would involve commitment to an announced enforcement policy which would serve, analytically, to render the μ-function common knowledge and, in so doing, make the gains to the industry from self-regulation more transparent.

[5] Conclusions.

In this paper we have shown that, in general, there are gains to be had by the trucking industry to (atleast partial) self-regulation of truck weight. As such, our results back-up those of Hildebrand, Prentice and Lipnowski (1990). In our model, however, these arise because of the existence of regulatory externalities.

Local feasibility of a self-regulatory programme is likely to depend upon local institutional factors. Case-study analysis of implementability by region (or even by well defined routeway) is an important next step, and one which we intend to pursue in future research. The main contribution of this paper has been to use economic theory to demonstrate that there are, in all but the most trivial cases, gains to be reaped by the industry from self-imposed regulatory programmes. These can be expected, in general, to take the form of 'codes of

practice' and should be backed-up by credible monetary sanctions. We have also argued that such programmes will be socially beneficial and, as such, should be encouraged by government regulatory bureaux.

Endnotes:

(1) I would like to thank Robert Cairns, Christopher Green and Catherine Liston for comments on an earlier version of this paper. This paper was written whilst I was a graduate student in the Department of Economics at McGill University.

(2) See, for instance, Boucher (1981) for details of the limitations on the permits issued to hauliers on the principal Montreal to Quebec City route.

(3) Hirschorn (1981: 53) records the number of competitors on various different routeways in Canada. For one example amongst many, from Sault St. Marie to Sudbury there were six competing firms: four were large (with more than 600 trailers), one medium (300 to 600) and one small (less than 300) firm. On the primary Toronto to Ottawa route there were nine: two large, four medium and three small.

(4) In Canada there are seven of these (the Manitoba, Atlantic Provinces, Ontario and Saskatchewan Trucking Associations, the British Columbia and Alberta Motor Transport Associations and L' Association du Cammionage du Quebec), each affiliated to the Canadian Trucking Association. The position of smaller National organisations which represent smaller sections of the truck population (eg the Canadian Association of Movers or the Private Motor Truck Council of Canada) in a self-regulatory agreement is less clear - comprehensivity, or near comprehensivity, would be vital to the success of such a scheme.

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The Effects of Airline Acquisitions in the Canadian Airline Industry

Introduction

Since airline deregulation in 1988, several acquisition announcements and mergers have occurred within the Canadian airline industry. Critics of airline deregulation argue airline consolidations result in anti-competitive activity in the form of higher fares and reduced quality of service. If this proposition is valid, the financial market would expect monopoly gains from airline consolidation. Furthermore, there should be positive intra-industry valuation effects in response to these acquisition bids. That is, share prices of listed carriers should be positively related to expected increases in concentration.

Alternatively, proponents of deregulation argue airline consolidations have no effect on prices and service quality; hence, consolidation does not create market power. The absence of market power supports either the contestability theory or the Bertrand game concept. If this is the case, financial market efficiency implies that share prices of the airlines involved in an acquisition are not related to changes in the concentration of the industry.

Airlines argue that consolidations allow them to produce more efficiently by realizing cost advantages through economies of density, scope, and scale. If this argument is valid, there should be positive valuation effects for the airlines involved in response to acquisition bids. It is ambiguous whether prices increase, decrease or stay the same. Critics argue that the price increases while proponents argue price will not increase if the airline industry is contestable or in a Bertrand game. A priori, the appropriate models to describe the airline industry are outlined in section I. With the appropriate model, the effects of consolidation are theoretically analyzed in section II and empirically analyzed in section III.

I Contestability Verses Bertrand

As defined by Baumol, Panzar, and Willig (1982) a perfectly contestable market is one that is accessible to potential entrants and satisfies the following properties: First, the potential entrants can serve the same market demands and use the same productive techniques as those available to the incumbent firms. Second, the potential entrants evaluate the profitability of entry at the incumbent firms' pre-entry prices. That is, the entrants assume that if they undercut the incumbents' prices they can sell as much of the corresponding good as demanded at their own prices.

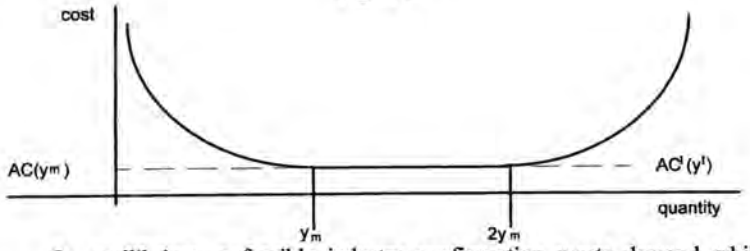
The first property ensures the ease of entry and implicitly ensures the ease of exit. It implies entrants and incumbent's have the same cost function; hence, there is no cost disadvantage for the entrant. To evaluate the costs of entering, firms must distinguish between fixed costs and sunk costs. Fixed costs are not reduced in the long run but they can be eliminated by total cessation of operation. For each period of operation fixed costs represent an opportunity cost for both the incumbents and the entrants; thus, they do not constitute barriers to entry. Whereas, sunk costs cannot be eliminated by total cessation of operation. Once committed, sunk costs are no longer a portion of the opportunity cost of production. However, they are an opportunity cost for a potential entrant; hence, constituting an entry barrier. Entry barriers are anything that requires an expenditure by a new entrant but imposes no equivalent cost upon an incumbent, thereby creating a cost disadvantage for the entrant. If no entry barriers exist, entry and exit are costless and the first property of contestability holds.

The second property holds if the price adjustment lag faced by the incumbent exceeds the entry and exit lag of the potential entrant or the price adjustment costs are substantial. Brock (1983) points out that if the second property is not satisfied, contestability still holds as long as there is a period where the new entrant earns positive profits.

The optimal structure of an industry is determined by the unique point of average cost minimization which establishes the efficient size of a firm as given by y_m in figure 1. To ensure that a sustainable equilibrium exists, Baumol et al. assume that the average cost curve (AC(y)) is flat within the interval $[y_m, 2y_m]$.[1] If all firms incur the same average cost $AC(y_m)$, the structure of the industry can be determined. If the industry output y^I is less than y_m, only one firm exists. When y^I is greater than y_m, at least m firms exist where $m \geq y^I/2y_m$ and at most M firms exist where $M \leq y^I/y_m$.

[1]The assumption that the average cost curve is flat-bottomed is consistent with empirical evidence accumulated over the last 40 years.

Figure 1



In equilibrium, a feasible industry configuration meets demand while covering costs: $\sum y_i=Q(p)$ and $py_i-C(y_i)\geq 0$. Within the context of contestable markets, this equilibrium is sustainable if there are no opportunities for profitable entry. This implies that $p^e y^e \leq C(y^e)$ $\forall$ $p^e \leq p$ and $y^e \leq Q(p^e)$ for all entrants. Also, the equilibrium is sustainable when industry output is produced at the minimum total cost. This ensures no alternative number of firms, size distribution of firms, quantity of output, or productive techniques can provide industry's output at a lower total cost. Otherwise, any industry inefficiencies will make the industry vulnerable to entry.

With the threat of potential entry only one sustainable equilibrium emerges. An industry with two or more firms must price such that price equals marginal cost; thus, $py_i=C(y_i)$ and profits are zero. Hence, the industry achieves a first best pareto optimum consistent with the outcome of perfect competition. An industry that consists of a natural monopoly must price according to second best pareto optimum rules (p=AC) and profits are zero. Therefore, the ability to contest a market eliminates production inefficiencies, excessive prices, and maximizes consumer welfare.

Alternatively, the airline industry may be within the setting of an infinitely repeated Bertrand game. Using one city-pair to illustrate the game, the theory can realistically be applied to all city-pairs consisting of two or more airlines. Canadian Airlines International Ltd. (CAIL) and Air Canada (AirC) both provide scheduled services on the Vancouver-Toronto route. The product CAIL and AirC offer is non differentiated except for price. Charter airlines also provide services along this route, however their services are differentiated from those provided by CAIL and AirC in the sense that they do not operate as frequently

and they are often delayed. For this reason it is assumed that CAIL and AirC split the market.[2]

In an infinitely repeated Bertrand game any price between marginal cost and the monopoly price can potentially be supported as a subgame perfect equilibrium. If both airlines price according to the monopoly price each time period, AirC and CAIL receive profits

$$\frac{k\prod(p^m)}{1-\delta} \quad \text{and} \quad \frac{(1-k)\prod(p^m)}{1-\delta}$$

respectively, where k represents the proportion of the market provided by AirC, $\Pi(p^m)$ is the total monopoly profits, and δ represents the firms' discount factors. When a firm deviates the punishment involves marginal cost pricing forever (Trigger Strategies). Price = p^m is a subgame perfect equilibrium if the following conditions are met:

$$\prod(p^m) \le \frac{k\prod(p^m)}{1-\delta} \quad \text{and} \quad \prod(p^m) \le \frac{(1-k)\prod(p^m)}{1-\delta}$$

When these conditions are met, neither firm has an incentive to deviate by under cutting p^m and gaining the entire market because the gain from deviating is less than the loss. Theoretically, the discount factor is directly related to the frequency of interaction between the two airlines. As the airlines interact on a daily basis, the discount factor δ should be close to one, implying that future profits are as important as current profits. This should be sufficient to make $p=p^m$ a sustainable equilibrium. Also, if one firm has a small proportion of the market, they have more incentive to deviate. In this case, k is approximately .5 which minimizes the incentive to deviate. It is also essential that an airline is able to monitor all past prices so they can easily detect a deviation.

However, in practice there is frequently one airline who practices price cutting behaviour which is emulated by its competitor shortly after. According to travel agents, reactions to price cutting actions are implemented within 4 days to 1 week of the initial price cut. Since there seem to be few potential entrants on this route, the price cutting behaviour is probably in response to a fluctuating demand. As the demand for airplane seats is dependent on price and the state of the economy, among other things, the price must adjust accordingly to attract more passengers rather than flying with empty seats.

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[2]In 1991, chartered airlines served 20% of the traffic on this route and CAIL and AirC served 80%. If chartered airlines are considered in the analysis, the results still remain valid.

An alternative explanation involves a series of finite Bertrand games. In this context, punishment for deviation from p^m involves marginal cost pricing for a finite period. At the end of this period, the firms return to p^m and play the game again. The unique subgame perfect equilibrium of this type of Bertrand game is also p=MC.

In either type of Bertrand game, mergers will not affect this outcome provided there are always two competing airlines on each route. In this case, the results are consistent with the results of the contestability theory. Contestability and the Bertrand game will prevent larger carriers from realizing an increase in profits from anti-competitive behaviour. However, if a merger creates a monopoly on a given route, the results of a Bertrand game and those of a perfectly contestable market diverge. As described in the context of contestable markets, airlines will price according to the second best pareto optimum because of the constant threat of potential entrants. Thus, consolidation has no negative impacts on consumer welfare. In the Bertrand setting, airlines on a monopoly route will price according to profit maximization ($p=p^m$) and consumer welfare declines.

II Qualitative Analysis of the Effects of Mergers

Consolidation Since Deregulation

In May 1984, the Ministry of Transport proposed a New Canadian Aviation Policy. It divided the country into two unequal parts labeled north and south. The airline market in the north was termed the designated area and required economic regulation. The airline market in the south was considered mature and ready for liberalization. Liberalization entailed government deregulation; thereby allowing free entry and egress of any domestic route. In 1986, the National Transportation Agency drafted the National Transportation Act (NTA) and fully implemented it on January 1, 1988.

Since full scale deregulation was implemented, there has been a trend of consolidations and mergers within the airline industry. Seven major carriers (AirC, CP Air, EPA, Nordair, Quebecair, PWA, Transair) merged into three level I carriers (AirC, CAIL, Wardair) by 1989. CAIL purchased Wardair Inc. in 1989 and acquired the remaining 54% of Time Air Corporation and the remaining 53% of Ontario Express Ltd. in 1991. AirC purchased Air Toronto and the remaining 51% interest in Air Nova in 1990. This year AirC purchased 29% equity interest in Continental and made formal merger offers to CAIL which were subsequently rejected. Meanwhile, CAIL is negotiating an equity alliance with American Airlines. Currently, there are two level I carriers (AirC, CAIL), four charter

airlines (3000 Airlines, Nationair, Bradley Air Services, Air Transat), twenty-three level II carriers, and 78 level III carriers.[3]

Characteristics of the Canadian Market

According to Statistics Canada, between the years 1989 and 1991, the domestic city-pairs served by one carrier had a lower proportion of discounted traffic than city pairs served by two or more carriers. Specifically, in 1991, 57.1% of passengers on monopoly routes traveled on a discounted ticket, 68.6% on duopolistic routes, and 58.7% on oligopolistic routes. There are conflicting explanations for the observed differentials: One, the market is contestable and the airlines on the monopoly routes are pricing according to the second best pareto optimum for a given demand. Two, the market is consistent with a Bertrand game and the airlines on monopoly routes are pricing to maximize profits given the demand. A qualitative analysis of the Canadian airline industry determines whether the industry fits into the contestability theory or the Bertrand model.

The NTA requires that any air carrier operating anywhere in Canada give public notice 120 days prior to a proposed discontinuance of domestic service or a reduction in the frequency of a domestic service to less than one flight a week. The NTA also allows carriers to implement new fares, rates or charges immediately. This requirement significantly hinders such actions as "hit-and-runs" involved in the contestability theory. Thus the entrant is required to compete at lower prices for at least 120 days. The profits generated through a low priced entry may not exceed the often negative profits generated through price wars, particularly if the incumbent follows a price cut immediately.

The validity of the contestability theory with respect to airlines has been argued by economists since its onset. Brenner (1988) notes that incumbents will normally match the lower fare immediately with a negligible time lag. Thereafter, the new carrier has the challenge of achieving a viable market share,

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[3]Level I carriers include every Canadian air carrier, that in each of the 2 calendar years immediately proceeding the report year, transported at least 1000 000 revenue passengers or at least 200 000 tonnes of revenue goods. Level II carriers include every Canadian air carrier that are not level I carriers and transported at least 50 000 revenue passengers or at least 10 000 tonnes of revenue goods. Level III air carriers include every Canadian air carrier that are not level I-II carriers and transported at least 5 000 revenue passengers or at least 1 000 tonnes of revenue goods.

against an equally-priced incumbent who has market advantages such as established market identity, working relationships with local travel agents, and local residents enrolled in its frequent flyer club. Brenner argues "hit-and-run" strategies are not typical and not credible threats.

Another requirement for the contestability theory to hold is sunk costs must be negligible, thereby making potential entry a credible threat to incumbents. Proponents of the contestability theory argue that the airline industry is typical of having low sunk costs, as those required to operate are borne by the government. The costs associated with the airline industry are airplanes, runways, ground facilities, and air navigational aids. Airplanes are easily sold or rented in alternative markets, thus not a sunk cost. The costs of runways, ground facilities and air navigational aids are generally incurred by governments and not airlines.

However, this argument may not be justified because entry barriers do exist. The most significant barrier to entry is the computer reservation system (CRS). Travel agents distribute 70% of airline tickets sold in Canada and 90% of the travel agents are connected to a CRS. There are two types of CRS, Gemini and Sabre. Gemini is owned in equal parts by AirC, CAIL, and Covia (the United Airlines CRS). Gemini accounts for 84% of the CRS market and Sabre accounts for the remaining 16%. For an entrant to be profitable they must have access to a CRS which is costly, effectively limiting the number of potential entrants. Another barrier to entry involves advertising costs but notably, airport time slots are not. In Canada, time slots are considered a public good; hence, all airlines are given access to slots through negotiations.

Likely Potential Entrants

The contestability theory requires all firms to incur the same average cost $AC(y_m)$. Much empirical work has validated that there are cost differentials with respect to size of airlines. In Canada, we have level I, II, and III carriers which, by definition, implies that the size of airlines differs considerably. Viton (1986) found that economies of scale exist. Caves, Christensen, and Trethway (1984) rejected the hypothesis of economies of scale but found there were sizable economies of density, particularly with smaller airlines. Roy and Crofsky (1985) also rejected the hypothesis of economies of scale. However, Caves et al. found that consolidations which create hubs reduce non stop service, allowing carriers to combine passengers with different origins and destinations, thus increasing load factor and reducing operating costs. These actions allow a carrier to seize economies of scale in aircraft. Although these results are not definitive, they do imply that a cost differential exists on the basis of carrier size.

Alternatively, Bailey, Graham, and Kaplan (1985) argue that smaller carriers have lower operating costs on the basis of significant wage differentials. According to the Aviation Statistics Centre the average wage for pilots and co-pilots is $103 386 and $80 864 for level I carriers and level II-III carriers respectively; the average wage for general management and administration is $49 790 and $40 160; and the total average wage for all employees is $44 145 and $42 225.[4] A differential of $1920 is not significant and the gap minimizes if the smaller carriers expand. Typically the expansion of a carrier is coupled with the growth of union power and wage demands.

It is apparent that larger airlines that have seized available economies of scale and density have lower costs than smaller airlines. It is assumed that level I carriers incur symmetric costs and level II-III carriers also incur symmetric costs but higher than those level I carriers incur. This cost differential violates the assumption that all firms incur the same average cost. However, small airlines act as commuter airlines for either AirC or CAIL and incur lower costs because they can free ride on AirC's or CAIL's advertising and CRS system as long as they remain commuters. If small airlines could not free ride, they would incur significantly higher costs. As a result, the market has settled into a system where smaller airlines generally serve traffic on short-haul routes (distances under 800km). They compete against each other and also make up the list of candidates for potential entrants on short-haul routes they do not already serve.

When Hurdle, Johnson, Joskow, Werden, William (1989) analyzed the contestability hypothesis in the American market, they identified likely potential entrants for a city-pair market on the basis of combined enplanement at the two endpoints. Non incumbent carriers with combined enplanement at the two endpoints of at least half the average enplanements of incumbents are considered likely potential entrants. Using this definition, the city-pair of Ottawa-London is analyzed to determine the number of likely potential entrants. Air Ontario has a monopoly on the non-stop route London-Ottawa offering 80 seats weekly. The candidates for likely potential entrants include Canadian Regional Airlines at the London endpoint and Canadian Frontier, Ontario Express, Skycraft and Pem Airlines at the Ottawa endpoint. American airlines operating out of the London and Ottawa airports are disqualified as potential entrants as they are American owned and cabotage does not exist in Canada.

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[4]All employees include: pilots, co-pilots, other flight personal, general management, administration, maintenance labour, aircraft and trafficking service, and other personal.

On the long-haul routes (distances over 800km) AirC and CAIL offer approximately 80% of the flights and charter airlines service the remaining 20% of the traffic. Again foreign airlines are disqualified as likely potential entrants because of the absence of cabotage. Also, smaller airlines are not credible as potential entrants because they all act as commuters for either AirC or CAIL. If a commuter attempts to compete on long-haul routes they lose their commuter status and all the cost advantages associated with being a commuter. Incumbents make competition difficult by lowering fares and eventually debilitate the entrant in price wars. This is illustrated by the fate of Time Air and Intair in their attempt of expansion (Canadian now owns Time Air and Intair went bankrupt). Thus the number of likely potential entrants on long-haul routes is zero.

Qualitative Results

In the short-haul market the notion of contestability is not rejected. There are no CRS expenses nor advertising costs that restrict entry and, as established, likely potential entrants exist. Although there is a minimal price adjustment lag and an exit lag of 120 days, entrants still can make positive profits when the opportunity arises, if only in the shortrun. Thus, consolidation should have no impact on consumer welfare as long as there remains at least one likely entrant on monopoly routes.

The qualitative evidence seems to reject the notion of contestability within the Canadian airline industry and support the Bertrand game for long-haul markets. In combination, the expense of the CRS and advertising costs implies that barriers to entry exist. Also the minimal price adjustment lag period and an exit lag of 120 days violate the requirements for contestable markets. It seems infeasible that the "hit-and-run" strategy is a credible threat since there are zero potential entrants. If the airline industry is within the Bertrand setting as hypothesized for the long-haul market, consolidation should not have a negative impact on consumer welfare as long as at least two competing airlines remain on a given route. If consolidation creates monopoly routes, consumer welfare may decline.

However, the National Transportation Agency has a policy that prevents airlines flying monopoly routes from charging profit maximizing prices. Consumers are able to complain to the Agency if it is felt a carrier operating a domestic service has imposed an unreasonable basic fare increase. The complaint must be in respect to a domestic service operating where there is no other alternative, effective, adequate and competitive transportation service. If the Agency finds the basic fare increase to be unreasonable, it can disallow the increase or direct the carrier to reduce the level of the basic fare by such amounts

and for such periods as the Agency finds reasonable and, when practicable, order the carrier to provide refunds as specified.

III Empirical Analysis of the Effects of Mergers

Sample and Method

A consolidation of airlines potentially has two effects: One, the remaining airlines engage in anti-competitive behaviour to increase their profits by increasing fares or lowering service quality. Second, the remaining airlines experience no change in profits. In the context of an infinitely repeated Bertrand game, the first effect proposes that the market shares for the remaining airlines are sufficiently high to support the strategy of price = p^m (the profit maximizing price) as a subgame perfect equilibrium generating positive profits. It also implies that the National Transportation Agency is not effective at monitoring unreasonable fares. The second effect proposes that the strategy of price = p^m is not an equilibrium because airlines will deviate by cutting prices. Thus in each game period, the Nash equilibrium of price = marginal cost is the outcome. It also implies that the National Transportation Agency is effective in monitoring unreasonable fares.

In the context of contestability, the second effect proposes that the strategy of price = p^m on any route is not sustainable because it presents an opportunity for an entrant to make positive profits. The only sustainable equilibrium is marginal cost pricing on routes flown by two or more airlines and average cost pricing on monopoly routes.

Consistent with these hypotheses, financial market efficiency implies that share prices of the airlines involved are positively related to increased concentrations of the airline industry if consolidation generates increased profits. Alternatively, share prices have no relation to changes in concentration if airlines are not expected to have a change in profits. Slovin, Sushka, and Hudson (1991) analyzed share price reactions to announcements of acquisitions in the United States. They found there were no positive effects on share prices in relation to increases in industry concentration. Their results support the hypothesis that consolidation does not change the remaining airlines' profits. It is not definitive whether these results rely on the contestable markets theory or the outcomes of a Bertrand game.

My intention is to perform a similar test using Canadian data. Since deregulation there has been one major acquisition; PWA (i.e. CAIL) bought Wardair for $248 000 000 in April 1989. The announcement of this acquisition occurred on January 19, 1988 and is subsequently labeled "event 1". During

1992 there was potential of a merger between CAIL and AirC. On January 8, 1992 it was announced that AirC and CAIL were negotiating a merger. On March 20, 1992 CAIL rejected AirC's offer. AirC and CAIL renewed negotiations on July 27, 1992 which disintegrated on August 17, 1992. On September 2, 1992 there was an announcement of further merger negotiations between AirC and CAIL which were terminated on November 3, 1992. This series of announcements is labeled "event 2".[5]

It is assumed that airlines involved in consolidation do not realize any cost advantages. Consistent with the assumptions in section I, all airlines involved in events 1 and 2 are level I carriers and have fully extracted any potential cost advantages associated with size. Therefore, any increase in profits resulting from a consolidation are attributed to anti-competitive behaviour.

I provide empirical evidence for the hypothesis of monopoly profits using time series regressions to examine the impact changes in concentration associated with proposed consolidations have on excess returns to carriers. Using stock returns from the Toronto Stock Exchange, I calculate the average prediction errors (APE) for portfolios of targets and bidders. The APE (excess returns) are daily stock returns adjusted for movements in the Toronto Stock Exchange daily market index (TSE). For event 1, the average returns are estimated over the pre-event period, t = -200 to -100, where t = 0 is the date of the first published bid announcement. These are subsequently used for the market adjustment of the APE from t = -100 to 100. For event 2, the average returns are estimated over the pre-event period t = -200 to -100 and t = 0, t = 141, and t = 167 are the dates of the published bid announcements. The bids were rejected at t = 52, t = 155, and t = 209. The average returns are used for the market adjustment of the APE from t = -100 to 248 (t = 248 is the last day of available data). Daily share prices and excess returns for CAIL, AirC, and Wardair for the relevant event periods are graphed in the Appendix A and B respectively.

Concentration is measured with the Herfindahl-Hirschman Index (HHI) for scheduled airlines using year-end data obtained from Statistics Canada . Market share is calculated as the ratio of an airline's domestic passenger kilometres to the industry's domestic passenger kilometres. The HHI is the sum of the squares of each airline's market share. The highest value for the index 1(1x1) applies to a market consisting of a single monopoly producer; a large number of carriers with small market shares drives the index toward zero. A market in which the index is between .1 and .18 is considered moderately

[5]These dates were obtained from the Globe and Mail Index and Financial Post Newscards.

concentrated, and highly concentrated at values over .18. The Canadian Airline Industry concentration has generally increased since deregulation, putting it in the highly concentrated range. The HHI, airline market share, and HHI adjusted for expected change in concentration resulting from an acquisition announcement are reported in Table 1.

Table 1

Market Shares of Level I-III Carriers and HHI before and after Acquisition Announcements for Events 1 and 2

Event 1	Before Announcement:				HHI
		Market Share			
		Level I		Level II-III	
	AirC	CAIL	Wardair		
	0.3919	0.3138	0.1418	0.1525	0.2722
After:	0.3919	0.4556	-	0.1525	0.3612
Event 2	Before Announcement:				HHI
		Market Share			
		Level I		Level II-III	
	AirC	CAIL			
	0.3798	0.3470		0.2712	0.2647
After:	0.7268	-		0.2712	0.5282

A time series regression is performed over the event period t = -100 to 100 for event 1 and t= -100 to 248 for event 2, where HHI and (time) are the independent variables and APE is the dependent variable. A second time series regression is performed over the same time periods where HHI, (time), and $(time)^2$ are the independent variables.

Empirical Results

I estimate time series regressions in which excess returns for targets and bidders are each specified as a function of a variable reflecting changes in concentration associated with bids and variables accounting for time. I use the change in the HHI based on carrier market shares to measure expected changes in industry concentration. The anti-competitive hypothesis implies fares will increase or service quality will fall relative to increases in industry concentration implied by horizontal merger bids. Excess returns to carriers should be positive functions of associated changes in concentration. This hypothesis implicitly implies that the National Transportation Agency does not prevent profit maximizing pricing. In contrast, if the airline is contestable or the Bertrand game

still applies after mergers, airlines cannot exercise monopoly power or earn supranormal profits regardless of the change in concentration. In this case, excess returns should not be a positive function of changes in concentration. This also indicates that the National Transportation Agency is successful in preventing monopoly pricing on monopoly routes.

Separate regressions are estimated for each event using the Cochrane-Orcutt iterative technique to correct for serial correlation. Given the nature of the hypothesis, I use one-tailed tests of statistical significance for the coefficient of HHI. The first set of cross-sectional regressions include (time) as another independent variable. The coefficient of (time) represents the trend of each particular airlines' stock relative to time. This coefficient can be positive, zero, or negative depending on whether the stock is improving, not changing, or declining in value over time. Thus, I use two-tailed tests of statistical significance for the coefficient of (time).

This set of regression results is reported in table E.1. For event 1 and event 2, the change in concentration has no systematic positive effect on excess returns to the target or bidder carriers; the estimated coefficients of the HHI are not significant and the R^2's are low. There is no evidence of gains from anti-competitiveness to carriers party to consolidations; thus, supporting the contestability or Bertrand hypothesis and implicitly supporting the effectiveness of the National Transportation Agency at monitoring unreasonable fares. In event 1, the coefficients of (time) are not significant indicating that the value of the stock is not changing over this time period. In event 2, the coefficients of (time) are statistically significant and illustrate that there is a negative effect of time on excess returns. That is, excess returns for the listed carriers are declining over time. Also, for both events serial correlation is rejected.

Table E.1

Cross-sectional regression results for airline industry concentration effects on targets and bidders, estimated as APE $= \alpha + \beta_1 HHI + \beta_2(time) + u$ over the relevant interval, where u is the random error term. The estimated coefficients β_1 and β_2 are reported with t-statistics in parentheses.[A] The Durbin Watson Statistics (d) are listed for each regression; the rejection of serial correlation is denoted by *.

Event 1	Target	Bidder
	Wardair	CAIL
β_1 (t-Statistic)	-0.4555 (-1.2283)	-0.0991 (-0.0530)
β_2 (t-Statistic)	-0.0013 (-.2355)	-0.0035 (-1.5689)
R^2	0.012	0.020
d.	2.162*	1.819*

Event 2	Target	Bidder
	CAIL	Air Canada
β_1 (t-Statistic)	-0.1321 (-1.1583)	-0.0106 (-0.0271)
β_2 (t-Statistic)	-0.0761 (-3.2980)***	-0.0385 (-8.8336)***
R^2	0.034	0.185
d.	2.087*	1.999*

A. The level of statistical significance of β_1 is assessed using a one-tailed test and β_2 is assessed using a two-tailed test. Statistical significance is denoted as : * significant at the 10% level; ** significant at the 5% level; *** significant at the 1% level.

The second set of regressions includes HHI, (time), and $(time)^2$ as independent variables. The $(time)^2$ variable is used for trend elimination and I use a two-tailed test of statistical significance for its coefficient. These regression results are reported in table E.2. For both events 1 and 2, the results are similar to the first regressions. The change in concentration has no significant positive effects on excess returns to the target and bidder carriers, thereby supporting the notion that there is no change in expected profits to carriers party to the consolidation. This reinforces the contestability/Bertrand hypothesis and implicitly supports the hypothesis that the National Transportation Agency is effective at monitoring unreasonable fares.

Table E.2

Cross-sectional regression results for airline industry concentration effects on targets and bidders, estimated as APE $= \alpha + \beta_1 HHI + \beta_2(time) + \beta_3(time)^2 + u$ over the relevant interval, where u is the random error term. The estimated coefficients β_1, β_2, and β_3 are reported with t-statistics in parentheses.[A] The Durbin Watson Statistics (d) are listed for each regression; the rejection of serial correlation is denoted by *.

Event 1	Target	Bidder
	Wardair	CAIL
β_1 (t-Statistic)	-0.3128 (-0.9520)	-0.0213 (-0.1134)
β_2 (t-Statistic)	-0.0490 (-4.8012)***	0.0012 (0.1350)
β_3 (t-Statistic)	0.0002 (4.7371)***	0.0001 (-0.5932)
R^2	0.139	0.022
d.	2.052*	1.820*

Event 2	Target	Bidder
	CAIL	Air Canada
β_1 (t-Statistic)	-0.1427 (-1.2739)	-0.0416 (-0.1080)
β_2 (t-Statistic)	0.3408 (6.7270)***	0.0830 (5.3130)***
β_3 (t-Statistic)	-0.0004 (-6.8258)***	-0.0001 (-5.5438)***
R^2	0.291	0.612
d.	2.045*	1.943*

A. The level of statistical significance of β_1 is assessed using a one-tailed test; β_2 and β_3 are assessed using a two-tailed test. Statistical significance is denoted as: * significant at the 10% level; ** significant at the 5% level; *** significant at the 1% level.

For Wardair in event 1, the coefficient of (time) is significantly negative and the coefficient of $(time)^2$ is significantly positive. For CAIL in event 1, neither of the coefficients on (time) nor $(time)^2$ are significant. For event 2, the coefficients of (time) are significantly positive and the coefficients of $(time)^2$ are significantly negative. Serial correlation was rejected for all regressions.

To choose which regression is superior an F-test must be performed. The first regression is restricted and the second is unrestricted. The computed F values are 22.44 and 0.35 for event 1, Wardair and CAIL, respectfully; 30.73 and 46.59 for event 2, AirC and CAIL, respectfully. In all cases except for CAIL in event 1, the computed F value exceeds the critical F value at a 5% level of significance; thus rejecting the restricted regression. Therefore, it is assumed that the results of the second set of regressions are valid for all events except for CAIL in event 1 where the first set of regressions are used. These regressions support the hypothesis that mergers do not result in anti-competitive behaviour for either event.

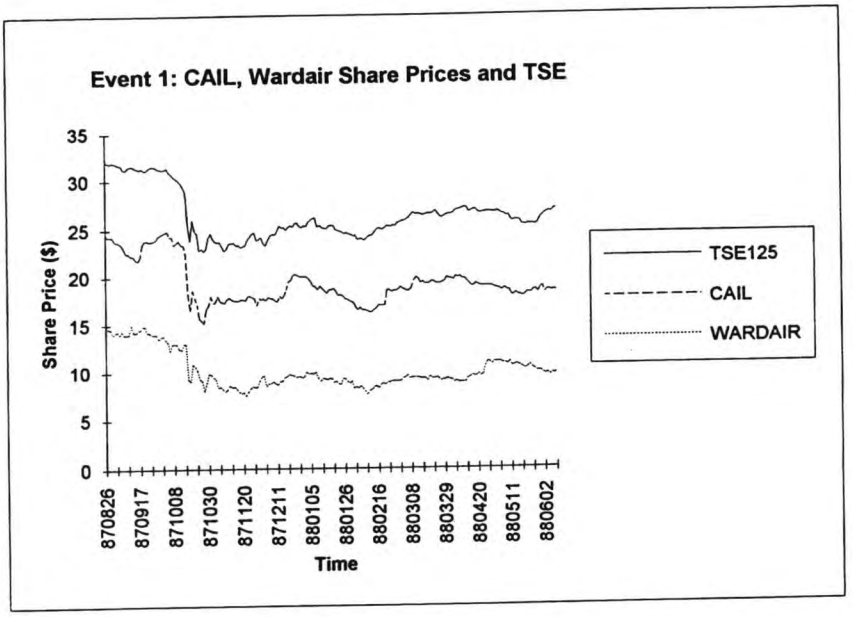
It is particularly surprising that the potential merger between CAIL and AirC produces no positive intra-industry valuation effects. As this merger would create a highly concentrated industry with the merged CAIL-AirC serving approximately 80% of the domestic traffic, one would expect positive profits. It was previously established that the long-haul market did not meet the conditions for contestability but seemed to be in the context of a Bertrand game. Given that many long-haul routes would be served by this one airline, the infinite Bertrand game would unquestionably support the profit maximizing price as an equilibrium. However, this equilibrium may not be sustainable for three reasons: One, the National Transportation Agency effectively prevents profit maximizing pricing. Two, charter airlines may be sufficient competition to ensure the Bertrand outcome, price = marginal cost. Three, the high level of concentration in the Canadian industry may galvanize the government to further liberalize international air treaties to include cabotage. However, cabotage does not seem to be an option at the moment, so this explanation is eliminated.

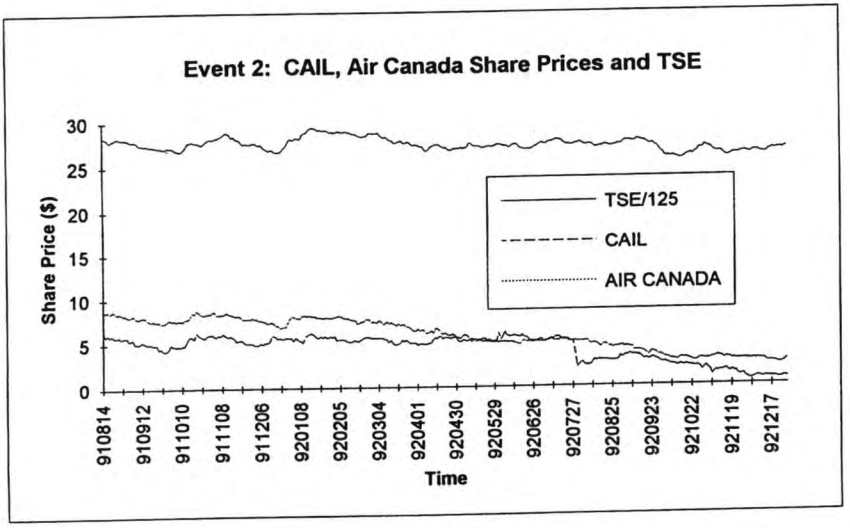
Conclusion

A qualitative analysis illustrates that the contestable markets theory is appropriate for the short-haul market and the Bertrand theory is more appropriate for the long-haul market. The empirical results show that increasing the concentration has no positive effect on excess returns to the target and bidder carriers; hence, there are no positive gains from anti-competitiveness. This evidence supports the theories of both contestability and Bertrand. In the context of Bertrand, it suggests that the National Transportation Agency prevents

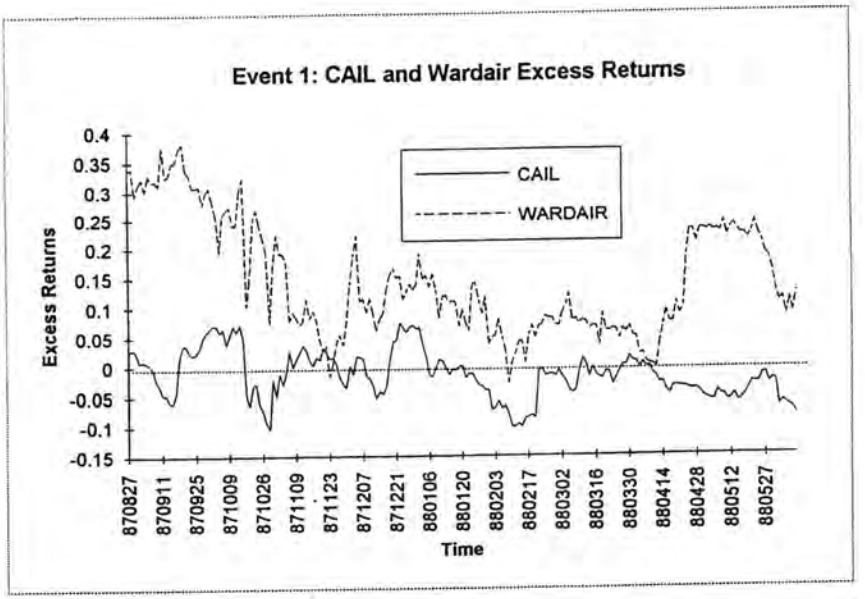
excessive fares and the remaining carriers have incentives to price cut. These results imply that consolidation has no negative impact on fares, service quality, or consumer welfare. If these results seem reasonable, they indicate that the current structure of the Canadian airline industry maximizes consumer welfare. With the assumption that there are no further cost advantages to creating larger airlines, there is no need to further liberalize international air treaties with respect to improving consumer welfare.

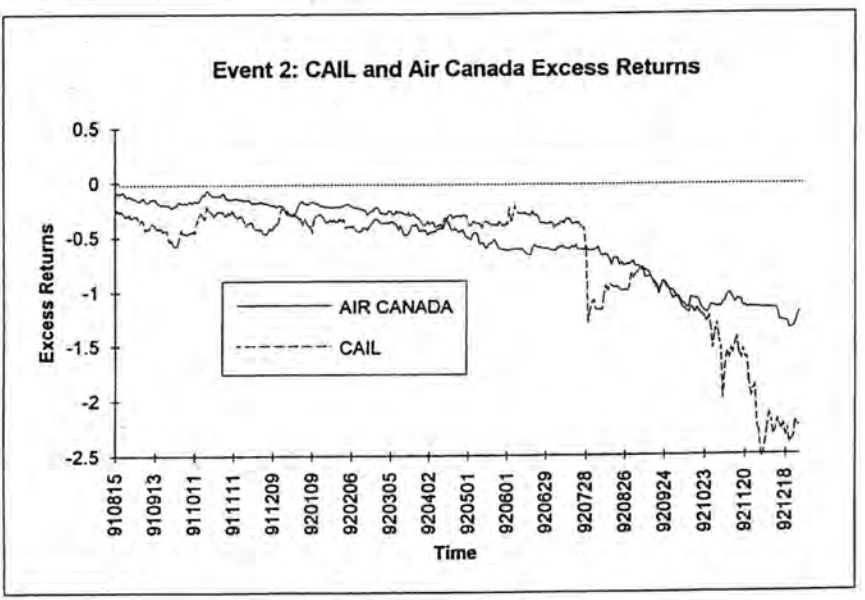
APPENDIX A


Event 1: CAIL, Wardair Share Prices and TSE
Share Price ($)
35
30
25
20
15
10
5
0
870826
870917
871008
871030
871120
871211
880105
880126
880216
880308
880329
880420
880511
880602
Time
TSE125
CAIL
WARDAIR


Event 2: CAIL, Air Canada Share Prices and TSE
Share Price ($)
30
25
20
15
10
5
0
910814
910912
911010
911108
911206
920108
920205
920304
920401
920430
920529
920626
920727
920825
920923
921022
921119
921217
Time
TSE/125
CAIL
AIR CANADA

APPENDIX B


Event 1: CAIL and Wardair Excess Returns
Excess Returns
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
-0.05
-0.1
-0.15
CAIL
WARDAIR
870827
870911
870925
871009
871026
871109
871123
871207
871221
880106
880120
880203
880217
880302
880316
880330
880414
880428
880512
880527
Time


Event 2: CAIL and Air Canada Excess Returns
Excess Returns
0.5
0
-0.5
-1
-1.5
-2
-2.5
AIR CANADA
CAIL
910815
910913
911011
911111
911209
920109
920206
920305
920402
920501
920601
920629
920728
920826
920924
921023
921120
921218
Time

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POTENTIAL FOR PRIVATIZATION: HALIFAX INTERNATIONAL AIRPORT

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Introduction

It is generally accepted that an international airport is a lifeline to the world economy and a rapid conduit for buyers and sellers of, and investors in, a region's goods and services. Under the Federal Government's policy of withdrawing from the business of running transport businesses, it is preparing to transfer ownership and/or operating arrangements of Transport Canada's busiest international airports to Local Airport Authorities (LAA). These LAA are to be independent corporations, mandated by legislation and with a Board of Directors made up of local business and community leaders, with a primary focus on utilizing the airport resources to encourage local economic development.

This paper reviews recent trends in air passenger traffic, both in general terms for airports across Canada, and more specifically for Halifax International Airport (HIA). The future management structure for Transport Canada's 138 airports recommended by the Airport Task Force is reviewed, together with its suggested next steps. Canada has not been alone in seeking to 'privatize' its airports and the recent and on-going experience in Britain and the United States is analyzed to draw out lessons for the process ahead in Canada. The success or failure of the transition to LAA will largely depend on future traffic growth, more proactive management, the price put on the airport's assets by the Federal Government and the financial instruments used; each of these factors is addressed. The experience of one of the newly privatized airports is reviewed, together with a breakdown of the perceived economic benefits for the region, and the implications of all this for HIA. Recommendations are provided concerning the potential for privatization at HIA together with a view of the way ahead for the Airport Study Group.

Trends in Canadian Air Passenger Traffic

Halifax International Airport is regarded as a positive influence in the quest for regional economic development, but like many airports across the country its traffic has declined in recent years. The reasons are self evident, certainly in the recent past. In 1991 for instance, the last year for which figures are available, a continuing recession and the adverse effect on passenger confidence of the Gulf War were two obvious and powerful influences. Statistics Canada's 1991 air passenger surveys illustrate the problems.

Domestic Routes[1]

Statistics Canada 1991 Domestic Survey highlights the following trends in passenger traffic on domestic routes:

- the total number of passengers travelling on domestic scheduled

services totalled 13.0 million in 1991, a drop of 12.9% from 1990; this was the third successive annual decrease;

- the number of passengers with a domestic portion in their international journey totalled 1.6 million in 1991, down 13.8% compared to 1990; this marked the end of a continuous growth period which began in 1988;
- in 1991, the top ten city-pairs represented 40.6% of the total domestic market, slightly down on 1990; Halifax-Toronto was seventh in 1991 with 2.63% of the total; Montreal-Toronto topped the list with a 9.87% share.

Scheduled Domestic Air Passenger Origin and Destination (O&D) Statistics are displayed in graphical form at Appendix 1 (Appendix 1 is not available for these *Proceedings*). Amongst the most significant factors which affected the airline industry in the 12 year period from 1980 to 1991 were: two economic recessions (1981-83 and 1990-91); deregulation of the air transport industry (1988); and the Gulf War in 1991.

- between 1980 and 1983, which encompasses the first recession in the period, domestic passenger traffic dropped nearly 20%, reaching a level of 11.2 million passengers in 1983, the lowest level in the period;
- a steady recovery followed but by the end of 1987 the total number of domestic passengers stood just 4% above the low of 1983;
- the National Transportation Act , 1987, (NTA), came into effect on January 1, 1988. This Act removed the bulk of economic restrictions on routes in Southern Canada, reduced regulation in the North and left the international routes untouched;
- part of the phenomenal growth recorded in 1988 was down to the inclusion of Time Air and Air BC in the O&D survey for the first time (both airlines, partners of Canadian Airlines International and Air Canada respectively, reached the 300,000 passenger level which required them to take part in the O&D survey);
- during 1988 the number of scheduled domestic passengers reached 13.6 million, up 16% from 1987;
- in terms of total numbers of outbound and inbound passengers, Halifax ranked eighth in 1991 (the same as in 1990) with 960,000 passengers, or 4.23% of the total: in comparison, Toronto was first with 21.77% of the total, Vancouver second with 12.75% and Montreal third with 9.40%.

Canada–United States[2]

The transborder passenger trends for 1991 were similar to those already noted for journeys within Canada. However, over the longer term there were also significant differences:

- Scheduled Air Passenger Origin And Destination data showed that 8.3 million passengers travelled between the two countries in 1991, down 8.3% on 1990;
- in the period 1987-1991, the number of passengers travelling between Halifax and Boston increased by nearly 40%, while over the same period on the New York route it decreased 8.6%; details are shown at

Appendix 2 (Appendix 2 is not available for these *Proceedings*).

- a graph of scheduled transborder air traffic for the twelve year period 1980 to 1991 is shown at Appendix 3 (Appendix 3 is not available for these *Proceedings*):
  - while the effect of the recession is clearly visible in the early 80's, by 1990 the transborder traffic had reached 9.1 million passengers, an increase of 32.4% compared to 1984;
  - in 1991 this figure decreased 8.3% to 8.3 million for the reasons already discussed;
- the annual distribution of transborder passengers for 1990 and 1991 by province and territory are shown in the table at Appendix 4 (Appendix 4 is not available for these *Proceedings*):
  - the largest proportion of transborder passengers are concentrated in four provinces—Ontario, Quebec, British Columbia and Alberta—which account for 93% of the total;
  - Nova Scotia experienced an 8.9% decrease year on year;
  - Halifax International Airport (HIA) ranked twentieth in terms of the total number of transborder passengers, accounting for just 0.92% of the total traffic in 1991: this compares with Toronto in top position which accounted for 20.77%.

International And Charter Passengers

Statistics Canada counts international and charter traffic using numbers of Enplaned and Deplaned (E&D) passengers; as such these figures are not readily comparable with the O&D statistics already shown. However, the trends are broadly the same and in 1990 the number of international passengers was exactly half the number of transborder passengers; in terms of charter flights, the figure was some 59% of the transborder figure.[3]

As can be seen from the statistics, the trend of the past few years has been for a reduction in domestic and international journeys. In addition, HIA has a small proportion of the total traffic. However, Transport Canada has estimated that traffic will grow by 9.5% from 1990 to 1993 and by another 9.8% between 1993 and 1995.[4] These forecasts are significant factors in the predictions of the future health of the airport.

Future Of Canadian Airport Management

The Airports Task Force

In the mid-1980s the outlook for air transport looked bright. During this period, the Minister of Transport was responsible for the development and regulation of aeronautics in Canada. In particular, the Minister regulated all aspects of aeronautics from a safety perspective and provided Air Navigation Services; these functions were performed by the Aviation Group within Transport Canada. In 1985 the Airports Authority Group was involved with 301 aerodromes, of which 138 were owned by Transport Canada and 77 operated and managed directly.

In the Federal Government's 1985 Budget there was reference to the need to consider a new management structure for Canada's airports, one that would provide for a self-sustaining system and allow for autonomous local control.

Before then, the effectiveness of Canada's 1300 airports as instruments of economic development—allowing the efficient movement of people and goods across a country the size of Canada—was largely taken for granted. However, this was not without cost and in the period 1980 to 1985 the Auditor General estimated that cost-recovery had dropped from 49% to 44%; systems costs had increased 51% in the same period with only a 35% increase in offsetting revenues.

The overly centralized system of management in place at the time was seen as a brake on the effective exploitation of facilities and a lack of responsiveness to local needs. The Federal bureaucracy was seen as a counterweight to proper accountability (not only financial), and an impediment to proper management incentive, responsiveness and flexibility. Such conditions led to revenue and cost structures which bore little relevance to a commercial enterprise and the bureaucracy made it difficult to attract and retain commercially oriented staff. These factors led, in 1985, to the establishment of a Task Force, comprised of people from industry, government and business, to examine the options for the future management of Canadian airports.

The objectives of the Task Force, as set out in its report, were to:

- improve the accountability, effectiveness and efficiency in airport management , while meeting the required levels of safety and security;
- work towards the commercial viability of as many commercial airports as possible; and
- develop the potential of the airports as instruments of local economic development.[5]

In the course of its deliberations, the Task Force identified four organizational alternatives which were consistent with its objectives. These were:

- A Modified Transport Canada Arrangement. This option would be a streamlined and decentralized organization based on the extant Transport Canada structure;
- Crown Corporation. Envisioned as a lean holding company with wholly owned subsidiaries, each with its own Board of Directors. Although not spelled out in the report this implied that the Crown Corporation would operate under Schedule D of the Finance Act;
- Independent Airport Authorities. Autonomous local entities set up to own, operate and finance airport(s) in a community; and
- Private Sector Operators. Airports owned and operated by a private sector enterprise.

The Task Force developed criteria under five generic headings to evaluate each of the four organizational models:

- **Management Practices**: the nature of the decision making process. The process should involve a minimum of management levels and reduce unnecessary checks and balances; clearly, any government involvement which includes public financing will need checks and balances but these need to be reduced and the lines of communication shortened for them to be effective and not burdensome and a disincentive to proper authority and accountability; appropriate flexibility in labour/management practices.
- **Relationship with Local Economy**: the responsiveness to local

circumstances, recognizing the particular needs and aspirations of the local economy, and the interrelationship with local economic development.

- **Efficiency of Asset Management**: the setting of commercial objectives for airports (adequate financial returns, agreed risk, etc.); the visibility of loss in operations; and the existence of efficiency performance targets linked to a proper management incentive structure tying compensation to performance.
- **Relationship with Federal Government**: the potential for cross-subsidization between profitable and unprofitable airports; and the adherence to federal government policies and objectives, such as increased decentralization, employment equity, etc.
- **Potential for Productivity Improvements**: improving accountability, effectiveness and efficiency in the management of federally owned airports; and the possibility of improving revenues, decreasing operating and overhead costs, and thereby improving margins.

The Task Force's final report was published in September 1986. It concluded that the Airport Authority model significantly beat the others when evaluated against these criteria. It thus recommended that this model be adopted as the preferred solution. However, it also recognized that the transition to Airport Authority status would not be possible in all cases and that a Crown Corporation form of management might be a better alternative. For some airports that had the potential to become profitable, this would be an interim arrangement to prepare them for final disposal, but for the rest this would be their permanent form of organization.

The advantages to be gained in adopting the Airport Authority model can be summarized as follows:

- airport management would have the ability to deal directly with the primary customer—the airlines—and meet their needs in a timely manner;
- similarly, management would be closer to, and deal directly with, its main user groups;
- LAA would have the authority to set fees, rates and charges that are appropriate for the local area;
- management would be conducted along clear commercial lines—business goals would be set and the best staff hired to make the airport a viable entity; those who do not contribute will be let go (although there were to be safe guards for public servants transferring to the new authorities);
- airports would be financially self-sufficient;
- priorities would be set for planning, expansion, construction and terminal operation to give a competitive edge;
- land usage, within zoning constraints, would be maximized for aviation and non-aviation related activities, such as business park development; and
- strategic planning would be carried out locally and overseen by of a Board of Directors drawn from the local community.

In addition, the Task Force considered it vital that a data base of current and forecast traffic trends be developed before its recommendations be

implemented. The information required included:

- the development of airport revenue forecasts, including forecasts of traffic growth, the implications of regulatory reforms, and the potential for revenue enhancement (landing fees, concession leases, etc.).
- the establishment of a baseline for transfer to a commercial operation (the 'Base Case'). This would include: the development of airport accounts, including a 10-year profitability forecast; the valuation of capital assets and revenue streams to ensure an equitable price for those airports transferred to LAA control; and the development of appropriate financial and managerial incentives.[6]

Transport Canada announced a new initiative building on this report, but also put some caveats on the proposed sale:

- Initiation. Transport Canada would not seek out potential owner/operators, and the initiative would be left entirely with eligible parties;
- Federal Funding. Government would not increase its funding requirements in the long term as a result of the transfers. Any incremental start-up assistance would expect to be recovered within a period of about ten years;
- Fair Commercial Value. The facilities would be transferred at a price, either by outright sale or long term lease, which reflected the commercial value of the property and facilities;
- Employee Transfer. Transport Canada would look to negotiate an equitable employee package which would include pay, pensions, benefits, continuity of service and other conditions of employment;
- Airport Operations. The potential owners/operators would have to honour all national and international air transport agreements and obligations negotiated by the Government of Canada as well as meeting the essential requirements of safety and security, and in conformance with the operating licence. This would include open access to the airport facility and services for existing and new airlines;
- Existing Federal Initiatives and Licences/Leases. The new operators would conform to all federal initiatives, such as access for the disabled and language rights, as well as honouring existing leases/licences;
- Future Financial Arrangements. The Federal Government would retain all revenues from federal taxation, including the Air Transport Tax. In the case of unprofitable airports, the Federal Government would be prepared to consider some cost-sharing agreements.[7]

As a result of the report, Transport Canada formed its own Task Force to oversee the creation of LAA. This Group's report envisaged Airport Authorities which were financially self-sufficient and not draw upon municipal tax revenues for support. Specific powers could vary from site to site, but a number of common factors were identified.[8]

- to plan, establish, acquire, construct, improve and operate one or more airports;
- to acquire/dispose of real estate;
- to arrange long-term and short-term financing;
- to have the power to establish and collect fees, rentals, rates and other charges;

- to provide local security and emergency services;
- to contract with carriers for the landing, accommodation and servicing of aircraft and the handling of cargoes and passengers;
- to contract for the provision of goods and services for the use of employees and passengers; and
- to conduct the affairs of the authority to ensure that the annual revenues were sufficient to meet operating costs and debt service.

As has already been intimated the Federal Government was not alone in seeking an alternative form of structure for the management of its airports. Similar pressures existed in the UK and United States, and it is of value to review their experiences.

Change Of Airport Management—The Experience In Britain And The United States

Privatization Of The British Airports Authority

In Britain, the Conservative Government of Margaret Thatcher privatized the state run airports, which include two of the busiest in the world, London Heathrow and Gatwick, by the issuing of shares. The British Airports Authority plc (BAA) was created as a result. BAA was privatized in 1987, although the UK government kept a 'golden share' which gave it the right to veto a change of ownership, reflecting in part the strategic nature of the entity's virtual monopoly of airports in the south-east of the country. BAA is unique in that it is the only publicly-quoted enterprise in the world owning and managing airports.

The Airport's Act, 1986, which privatized the BAA, imposed on the Authority conditions on the charges that it could levy. The Act also provided for a review after five years of operation. That review took place in 1991 and BAA highlighted one aspect of the regulation of utilities in the UK which it finds counter productive; this is the problem of reconciling a regulatory system, which is essentially short-term in focus, with the need to provide incentives to invest in projects that are capital intensive and dependent on revenues over a long period of time.[9] This is one of a number of problems which need to be addressed in the context of the move to 'privatize' Transport Canada's airports.

Experience In The United States—Move To Local Airport Authorities

The Airport Authority Concept in the United States is similar to that proposed in Canada. One basic difference is that most airports in the US are owned and managed at the State or Metropolitan Area level. In Nashville, the airport has been transferred from Metropolitan control to the Metropolitan Nashville Airport Authority (MNAA) with some success.

The initial spark for the evolution of the Authority was provided by a task force appointed by the local Chamber of Commerce. Its conclusion was that the Authority concept was financially viable, and this view was endorsed by the Metropolitan Government and, subsequently, by the Tennessee State Legislature which had to enact enabling legislation. The powers and limitations of the proposed MNAA were to be:

- title to, and responsibility for, all airport property and operations;
- no taxing authority—the MNAA would be dependent solely on revenue generated; and

- tax equivalents paid to local government for all non-aviation activities, such as retail leases.

The legal framework established to support the transfer included the following principles:

- MNAA was established as a separate public corporation, with no zoning or taxing powers, but was also tax exempt;
- the Authority does not have the equivalent of Crown immunity: it can sue and be sued;
- it is a financially independent vehicle;
- the creating municipalities have the power to hire and fire the Board members; and
- the President and COO are employed by the Board.

One interesting part of the operating arrangement is the 'use agreement' reached with the airlines. This agreement covers such items as the periodic adjustment of rental and fees (every six months for landing fees and every three years for others) but it also gives the airlines the right to review the Operating Budget prepared by the Authority. Moreover, there is a Right of Appeal if the budget exceeds the pervious year's by 10% or the previous three years' by more than 25%. In addition, the airlines have thirty days to review the Authority's Annual Capital Budget which must be approved by the 'majority-in-interest' of airlines.

For many people in the industry, the creation of Local Airport Authorities was only seen as an interim step and they have pushed for full privatization. President Bush signed an executive order on April 30, 1992 which allowed for the privatization of airports in the United States. However, most analysts believe that rather than fully privately-owned airports, the most likely outcome will be a complex mix of quasi-public entities in which contractual arrangements with private companies for many services are common. Even this has been attacked as inadequate as it tends to move the profits from the airport into a number of corporate pockets and off the airport site. Lockheed has argued that it is better to form a joint partnership between the municipal or state authority and a private corporation to manage all operations. This one to one rather than one to many relationship is seen in some quarters as more efficient and more responsive to the needs of an airport's principal customers and users.[10]

The benefit of the sale to the state government is that it would get an immediate infusion of funds. In the longer term it would also be spared the need to raise taxes or incur debt-finance to complete necessary capital improvements to the terminal and runway extensions.

Whoever gets to bid on the airports in Canada is likely to find that they are being offered a GOCO—Government Owned Contractor Operated—arrangement. To date no major airport in the United States is privately owned and Lockheed's recent moves to buy the Albany, NY, airport it already operates was blocked by the Federal Aviation Administration (FAA). The FAA rationalized its position by stating that it had financed a large portion of the improvements to the airport and these could not be sold. However, the Federal Government also believes that private airports would be harder to regulate and this was undoubtedly taken into account in reaching this decision. There is thus a tension between the espoused policy of the Administration and how this is being implemented by the regulatory authority.

Privatization In Canada—Financial Implications

The Transport Minister's announcement in 1987 concerning the new policy towards the airports, made it very clear that he was willing to look at ownership and operating alternatives in 'privatizing' Transport Canada's airports; interested parties could either buy outright or negotiate long-term leases to the facilities. This position may have been modified somewhat by the terms agreed for the creation of the first four LAA, which were all granted sixty year leases with a review after five years which may lead to the sale of assets.[11]

The available options impinge directly on the type and quality of the financial instruments that the airport could use. The government's expectation of a reasonable 'return' will also be critical in deciding if the project is viable. Purchasers' ability to pay will be influenced by the projected operating profits, capital expenditure requirements and debt load assumed by the Authority. The government may need to be flexible in this regard and provide financing at a mutually agreed rate of return, perhaps tying into future revenues, although again the evidence so far is that the government will only act as a guarantor of commercial loans.

Any outside funding agency will need to be assured of a number of points:

- if the facilities are to be leased, the term must meet or exceed—with renewal—the term required to pay back any funds borrowed;
- the projected income and balance sheet performance must meet normal commercial financial coverage tests; and
- there must be a competent management and sound organizational structure in prospect.

Undoubtedly, lenders will apply normal commercial criteria to their decision making process: they will want to see a stable and reliable revenue picture sufficient to service the debt, and a realistic valuation of the assets as collateral against the loan. Again the government has a part to play in ensuring realistic values are placed on these assets at the time of transfer. Possible sources of funds include:

- pension funds: although a relatively new phenomenon in Canada, aggressive pension fund managers in the US and UK have bought significant equity positions in airports in their respective countries;
- banks: in that the banks tend to have a short-term horizon, the funds available from banks are probably more useful as sources of working capital;
- government loan or guarantee: in times of economic stringency, the likelihood of government at any level providing direct finance is remote. However, the Federal Government could help the process by setting a realistic value for the airport—especially as the facilities will remain in the 'quasi-public' sector—and assuming some of the debt load which may come with the transfer; and
- direct equity issues: although at present true privatization (à la BAA model) is not seriously being considered.

In terms of HIA, pension funds may be interested in buying bonds issued by the LAA, if backed by government guarantee. The guarantee would also lower the cost of capital to the Authority, with concomitant lowering of the breakeven point. Also given a government guarantee the banks could be

encouraged to take a longer term view. However, at present a straight federal or provincial loan is unlikely.

Experience Of Privatization At Canada's Airports

In considering the formation of a LAA for Halifax International, it is important to tap into the very recent experience of the four authorities already formed. Calgary was one of the first airports to be privatized, and moves to that end started soon after the 1985 budget announcement. An economic impact study carried out in 1986 reached some interesting conclusions concerning employment and the economic impact of the airport on the region.[12]

The effect on jobs fell into two categories. The first was direct, on-airport jobs in support of the airlines, airline related business, tenants, concessions and airport staff. Some 1,990 people were in this category with a total annual payroll of $40 million. The second category contained jobs created in the community by the presence of the airport. Some of these jobs would be directly related to the air travel industry, while a larger number would feed off the combined spending power of the airport related businesses. This category totaled nearly 19,000 jobs —ten times the number of direct airport employees.

When the economic impact of the activity surrounding the airport was considered, the following aspects emerged:

- direct airport expenditures, including salaries, taxes, goods and services totalled $152 million per annum;
- indirect expenditures by people and business that rely on the airport for income was $310 million p.a.; and
- a 'respending' multiplier of 2-4 times direct spending was found to be the norm.

The overall effect on Calgary's economy in 1986 was a contribution to the community of approximately $1.3 billion.

Calgary and Vancouver were the first two airports handed over to local authority control in July 1992. They were followed a month later by Edmonton and Montreal (Dorval and Mirabel). Of particular importance to Montreal was the high level of Origin and Destination (O&D) traffic. This has been estimated as high as 80% and was seen as an important tool of economic development.

Financing the required upgrading of airport infrastructure will need some imaginative solutions. Transport Canada does not have the resources to finance the expansion in capacity to meet its own projected traffic forecasts. Local authorities too are cash-tight and will probably have to leverage the development rights making use of the taxpayer-provided assets.[13]

The on-off marriage between Air Canada and Canadian Airlines International is causing some concern to the Airport Authority Groups as they try to plan their long term capacity needs. For instance, at the time of the move from Transport Canada control, the Calgary Airport Authority announced plans to spend $3 million on upgrading facilities but these have since been put on hold. In Montreal the effect of a merger on Dorval is an expected 25% decrease in the number of take-offs and landings with a concomitant drop in revenue of between 4 and 5%.[14] Inevitably, there will some effect at HIA, and this will need to be factored into any future economic plan.

Halifax International Airport

Six airports have already been privatized while at seven others, excluding Halifax, local groups have formally expressed an interest in following this route. These airports include Victoria, Kamloops, Windsor, Quebec, and Moncton. In the light of the experience so far, what are the prospects for HIA to move successfully to LAA control?

At the most fundamental level, what benefits will flow from the process? Is it a question of having more say in the transportation infrastructure of the region and its development, or is it to maximize the economic contribution to the local community? In the latter case, should the LAA be allowed to operate at a loss if greater regional economic spin-offs are envisaged?

The financial viability of the entity must clearly be understood. For instance, is the capital-debt load that is likely to be transferred too high to allow the airport to be financially viable? Could the airport post an operating profit, given the right combination of revenue increases and cost reduction? Are there acceptable alternative, more profitable uses for the property, land and buildings?

The unaudited financials for HIA[15] show that the net loss increased in 1991 and the return on assets and invested capital were down 6% and 22% respectively. Similarly, loss on net revenue increased some 10% year on year. In addition, the current ratio is down a significant 28% over the same period. On the positive side, invested capital is being made to work harder, turnover having increased some 10%. Likewise inventory turnover has increased by just over 3%. Some of these changes may be due to changes in accounting arrangements over the period, or one-time write downs to prepare the airport for transfer.

However, the net loss of $7.6 million in 1991, which is considered the bottom of the airport's business cycle, turns into a small operating profit if Terminal Charges ($5.6 million) and Departmental Overhead ($2.3 million) are removed. It is understood that the LAA would not be charged the former and should be able to contain its overhead considerably below Transport Canada's figure. Together with potential improvements in revenues—by providing more and better services reflecting local needs and better understanding what the market will take, for instance in concession fees—the airport should be able to make an operating profit.

The Halifax Airport Study Group has been incorporated as a not-for-profit organization to consider the prospect of forming an Airport Authority to take control of Halifax International. The Base Case Study already referred to is being prepared on behalf of Transport Canada and should be available in January, 1993 at which time the Group will move on to consider the projections provided by Transport Canada and commission its own study.

Until recently it appeared that the Federal Government would not provide or guarantee loans to the LAAs. However, this position seems to have softened somewhat during negotiations for the transfer of the first five airports. While the government has achieved its stated aim of moving the burden of funding development to the commercial sector, it would appeared to have done so by underwriting the loans. This could, of course, turn into a double-edged sword in that the main advantage of seeking local control of the airports was to cut down the number of management levels involved in decision making and make the airports more responsive to customer needs. In the past the unwieldy Transport

Canada bureaucracy has had the effect of slowing down the decision making process, particularly in respect of capital projects. If the Federal Government insists on the same sort of controls because of its latent involvement by way of loan guarantees, then the LAA will be off to an uncertain start. This is clearly something that the Group will need to clarify as its own study develops.

The agreements for the four LAA so far established were achieved in concurrent negotiations. These agreements will provide the starting point for all future transfers. As has been shown, HIA is marginally profitable when Departmental Overhead and Terminal Service charges are factored out. The Federal Government accepted as a principle early on in the process that an unprofitable airport could still be transferred. In doing so it has assumed that an entrepreneurial and responsive local organization could at least reduce losses if not produce a profit. In all this the guiding principle has been that the Crown must be no worse off in the process. With the Federal Government keen to get out of the business of running airports, given the right conditions it would seem a reasonable prospect that the Halifax Airport Authority could become a reality in the not too distant future.

Conclusions

Passenger traffic during the past 12 years has proved to be cyclical, with period lows recorded in 1983 at the end of the last recession, and peaking in 1990.

The general trend for an increase in the total number of passengers over the period has been encouraged by deregulation in the industry and the intense price wars that have followed. Over the last decade, air travel has become very much more affordable and, with a considerable investment in new aircraft and attention to customer service, more comfortable for most people.

In terms of Domestic Origin and Destination Passengers, Halifax ranked eighth in 1990 and 1991 with 960,000 passengers, 4.23% of the total. The airport experienced approximately a 9% decrease in air traffic in 1991 and ranked 20th, accounting for under 1% of the total.

The 1986 Airport Task Force concluded that the Airport Authority structure was the most appropriate form of management for the future but recognized that some airports would still be run by the Federal Government. It was proposed that these airports become part of a separate Crown corporation.

The UK privatized its airports in one step, but it is unlikely that such an initiative would be successful in Canada. However, even in this arrangement there have been tensions created between the regulatory and commercial entities and Transport Canada should note this experience.

The United States' experience to date has been closer to the model proposed for Canada, and the Nashville Metropolitan Airport Authority has been seen to have made the transfer successfully. Even so, moves to full privatization are being advocated by many in the industry. Of particular interest here has been the involvement of the airlines in the process, something which has been rejected at this stage by the Halifax Airport Study Group.

The lease or buy options, and the price set by the Federal Government in negotiations with the prospective LAA, will critically affect the type of financial instruments available to fund the deal. It is unlikely that any level of government will be prepared to grant direct loans to the LAA, but the Federal Government will likely act as guarantor for commercial loans. Pension funds and

other commercial lenders should be willing to invest in bonds backed by government guarantee, providing a reasonable rate of return can be envisioned, given the relatively low risk of default.

Historically, airports have had a significant impact on local economies in three ways: first, by direct airport expenditures in the community; second, by indirect economic effects which could be up to four times as great as the direct effects; and third, a more general effect of allowing local people and business to access national and international opportunities to the benefit of the local economy, while at the same time allowing people from outside the region to have ready access to the region and its products and services.

Financially, a privatized Halifax International Airport looks marginally viable from an operating profit perspective. Whether it can, or should, aim to make a profit is a moot point. However, given a more entrepreneurial style of management, together with a more responsive approach to its customers, it should reduce any losses that it would otherwise make. And even in a loss situation it may still be appropriate to revert to local management and control; the Federal Government has accepted the principle of transferring unprofitable airports - to which it, presumably, would provide an operating subsidy - so long as the Crown is no worse off in the long run.

Recommendations

Overall, the prospect for the successful transition of Halifax International Airport to Local Airport Authority control appears positive. Accordingly, it is recommended that the Halifax Airport Study Group continue with its initiative to study the possibility of moving to a LAA type of management structure. In that LAA have been proposed to be more responsive to the needs of its local customers, the Study Group should involve its principle customers at an early stage.

Endnotes

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