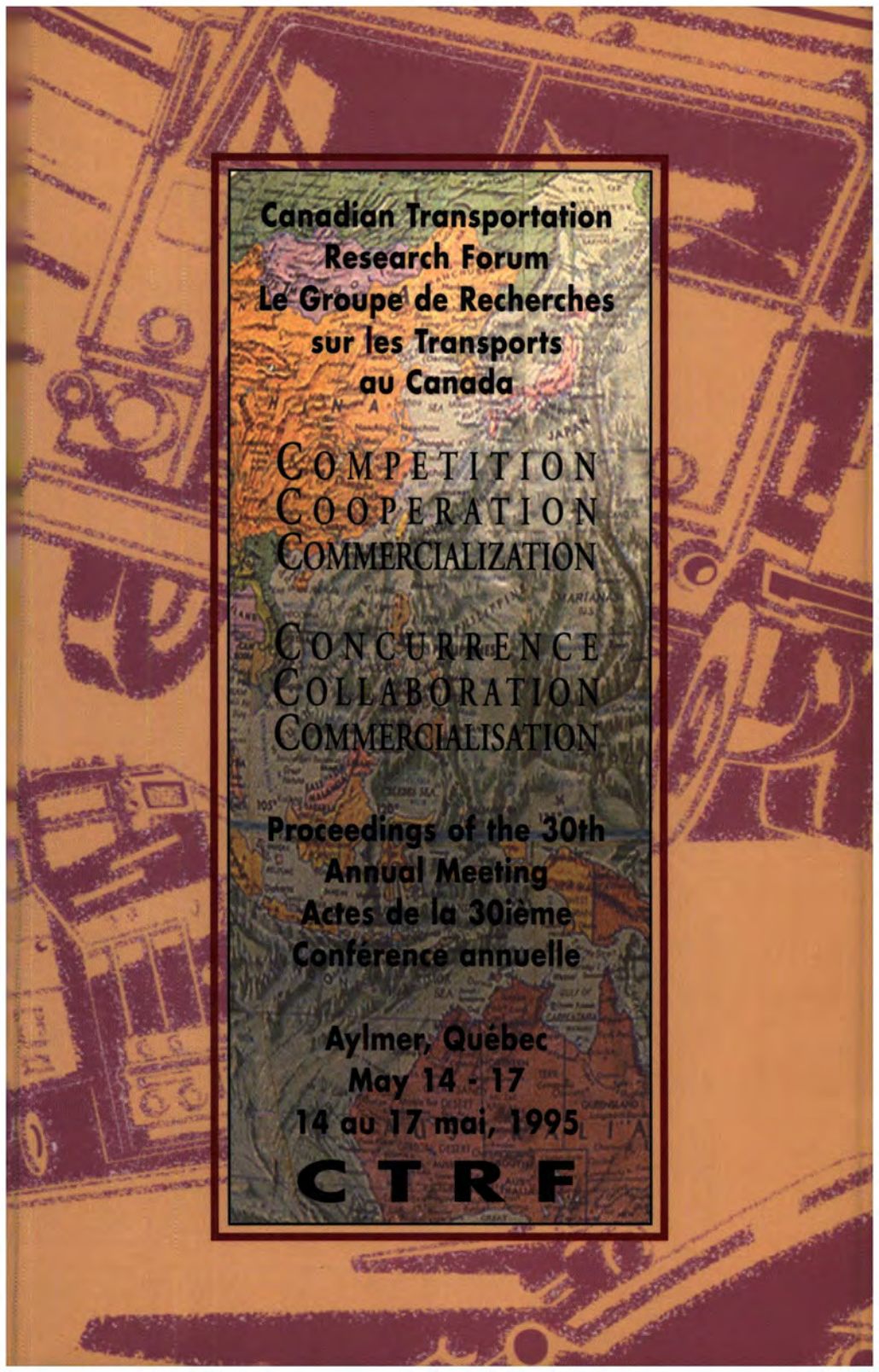

Canadian Transportation
Research Forum
Le Groupe de Recherches
sur les Transports
au Canada
COMPETITION
COOPERATION
COMMERCIALIZATION
CONCURRENCE
COLLABORATION
COMMERCIALISATION
Proceedings of the 30th
Annual Meeting
Actes de la 30ième
Conférence annuelle
Aylmer, Québec
May 14 - 17
14 au 17 mai, 1995
CTRF

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

PROCEEDINGS
of the 30th Annual Conference

ACTES
de la 30ième Conférence annuelle

COOPERATION - COMPETITION - COMMERCIALIZATION
COLLABORATION - CONCURRENCE - COMMERCIALISATION

Aylmer, Que. / Qué.
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President's Message
Welcome to CTRF's 30th Annual Conference

For the Canadian Transportation Research Forum, a thirtieth annual conference corresponds to an important step. Thirty years of well attended annual conference is indicative of the dynamism of the Board and the members of the CTRF which, year in and year out, place at the forefront the key transport related questions.

This thirtieth conference also corresponds to a new era in transportation captured by the theme of the conference: the era of "Cooperation, Competition and Commercialization". This new era changes the transport research needs. Those who have followed the activities of the CTRF over the years will note this change as they read through the Proceedings of this CTRF conference. In fact, the Proceedings give a life to the issues addressed at the conference, a life which is a function of the complexity and importance of the issue.

I would like, finally, to thank the organizers of the conference, David Dodds and Louis-Paul Tardif, their collaborators, as well as every active participants at the conference.

Roger Roy
President



Message du Président
Bienvenue à la 30ième Conférence annuelle

Pour le Groupe de recherche sur les transports au Canada, une trentième conférence annuelle représente une étape importante. Une telle étape témoigne du dynamisme du conseil d'administration et des membres du GRTC qui placent chaque année à l'ordre du jour les questions de l'heure dans les transports.

Cette trentième conférence correspond aussi à une nouvelle ère dans les services de transports captée par le thème même de la conférence: une ère de "collaboration, concurrence et commercialisation". Cette nouvelle ère transforme les besoins de recherche dans le domaine des transports. Ceux et celles qui auront suivi le GRTC au cours des ans, noteront ce changement à la lecture des Actes de cette conférence du GRTC. D'ailleurs ces Actes donnent une vie aux questions traîtées lors de la conférence, une vie dont la durée est liée à la complexité et à l'importance des questions abordées.

J'aimerais, en terminant, remercier les organisateurs de la conférence David Dodds et Louis-Paul Tardif, leurs collaborateurs(trices), ainsi que tous ceux et celles qui ont participé activement à cette conférence.

Roger Roy
Président

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CTRF's objectives are ...
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- 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 ...
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- 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.
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- de réunir les personnes intéressées au système canadien de transport.

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- la promotion et le parrainage de colloques régionaux avec d'autres organismes.
- un concours annuel de textes d'étudiants(es).
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- un bulletin de nouvelles publié cinq fois l'an.

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LE CHEMIN DE FER D'INTÉRÊT LOCAL : OPTION À CONSIDÉRER POUR LE TRANSPORT DES VOYAGEURS

Louis Doyle
Analyste en transports
Ministère des Transports du Québec

I. INTRODUCTION

Le thème général de ce congrès est «Concurrence, coopération et commercialisation». Mon propos sera d'exposer une possible commercialisation des services ferroviaires locaux de voyageurs.

Devant la nécessité pour la société Via Rail de diminuer de façon significative sa dépendance à l'égard des subventions fédérales, soit 100 millions de dollars d'ici le 31 mars 1997, des coupures de service sont inévitables. En effet, les subventions à Via Rail doivent être graduellement réduites de 295 millions $ en 1995 à 246 millions $ en 1996 pour atteindre 234 millions $ en 1997 et 204 millions $ en 1998. Ainsi, en octobre dernier, Via Rail a procédé à la mise à pied de 478 employés, soit 10 % de son personnel. Dans le même esprit de rationalisation, la société américaine AMTRAK a décidé de congédier plus de 600 employés, soit 20 % de son personnel en plus de mettre un terme à certains services déficitaires dont la liaison quotidienne Montréal-Washington, le *Montrealer*.

Dans un tel contexte, les services ferroviaires voyageurs en régions éloignées pourraient être la victime des prochaines coupures budgétaires. Ainsi, le ministre des Finances, M. Paul Martin, a annoncé dans son budget du 27 février 1995 une coupure d'une trentaine de millions $ au budget de Via Rail, ce qui réduit la subvention à 288 millions $ pour l'année budgétaire 1995-1996. La déclaration de M. Paul Raynor, conseiller principal, Communications externes, chez Via Rail, est très claire sur l'avenir des services ferroviaires voyageurs en régions éloignées :

> *«Mr. Raynor emphasized that yesterday's cuts were just one part of a process to put Via back on economic track. The next steps are to renegociate union contracts that provide lifetime job security and to realign passenger service. The company hopes these steps will*

> *improve service in some profitable areas, such as the Windsor-Quebec City corridor. But the changes could also lead to cuts on less travelled routes in remote regions of the country*[1].»

Devant le danger à moyen terme de perdre certains services ferroviaires en régions éloignées, il faut donc trouver des solutions innovatrices pour réduire le coût de ces services. Dans le texte portant sur l'avenir des services ferroviaires voyageurs en régions éloignées[2], nous avions esquissé différentes options susceptibles d'assurer le service ferroviaire de passagers aux régions éloignées (contribution d'autorités publiques, examen des services par l'Office national des transports (O.N.T.), exploitation de ces services par Via Rail à titre de service public). Cependant, nous estimons qu'une autre option est possible, soit celle d'un chemin de fer d'intérêt local (CFIL) à vocation voyageurs.

II. L'OPTION D'UN CHEMIN DE FER D'INTÉRÊT LOCAL À VOCATION VOYAGEURS

Nous croyons fermement que la création de CFIL à vocation voyageurs serait une option intéressante au même titre que les CFIL de marchandises qui sont présentement un succès au Canada. Ainsi, plus de six CFIL de marchandises sont en exploitation au Canada dont deux au Québec.

La raison de leur réussite est la réduction des coûts d'exploitation et un meilleur service à la clientèle :

> «Premièrement, les chemins de fer d'intérêt local peuvent rapidement réduire leurs dépenses en raison de leurs frais généraux moindres, de classifications plus flexibles sur le plan de la main-d'oeuvre et de la possibilité d'un meilleur équilibre entre le niveau d'exploitation et l'entretien du réseau.
>
> «Deuxièmement, en raison de leur taille, les transporteurs régionaux peuvent mieux utiliser le matériel et accroître par un service personnalisé, leur intégration au milieu et leur aptitude à attirer de petits et moyens expéditeurs hors de la portée d'un transporteur majeur[3].»

Les raisons énumérées du succès des CFIL de marchandises nous convainquent de l'utilité d'y avoir recours pour le transport des voyageurs.

L'option que nous proposons à Transports Canada consiste à confier à un CFIL la responsabilité d'exploiter un service ferroviaire local pour voyageurs, particulièrement en régions éloignées des grands centres. Il va de soi que la

société Via Rail continuerait à offrir un service ferroviaire pancanadien de base, c'est-à-dire de Halifax à Vancouver.

L'option de confier à des CFIL l'exploitation des services ferroviaires locaux s'inspire de la nouvelle approche des principaux chemins de fer tant américains que canadiens de céder à des chemins de fer secondaires ou CFIL le transport local ou régional ferroviaire des marchandises dans certaines régions. Cette nouvelle approche est elle aussi présente depuis de nombreuses années dans le secteur aérien.

Au Canada, nous devons suivre avec attention l'expérience de l'entreprise Great Canadian Rail Tours qui propose, par son train *Rocky Mountaineer* un trajet touristique en Alberta et en Colombie-Britannique.

Le président de cette entreprise, M. Peter Armstrong, présentait ainsi son point de vue sur l'avenir des services ferroviaires voyageurs à Transport 2000 :

> *«The time has come to look for new ways to operate our railroads. There are many Canadians outside of the Via bureaucracy with the know-how, enthusiasm and commitment to sustain and expand passenger rail. The government and Transport 2000 should look at alternatives to unprofitable, publicly-subsidized passenger rail service*[4]*.»*

Cependant, il faut souligner que le projet *Rocky Mountaineer*, en raison de son caractère touristique et saisonnier, est un exemple difficilement applicable aux régions éloignées qui veulent un service de base et ce, à longueur d'année.

Aux États-Unis, notre intérêt doit porter sur le projet novateur d'un groupe bénévole de citoyens (TrainRiders Northeast) qui veut relier la ville de Portland (Maine) à celle de Boston sur une distance de 114 milles. Ce projet financé par la Federal Transit Administration, au coût total de 58,6 millions $ (38,6 millions $ pour l'amélioration de la voie, 20 millions $ pour le matériel ferroviaire) qui a déjà reçu l'autorisation du gouvernement fédéral américain, permettrait aux citoyens de ces deux villes de se doter d'une liaison ferroviaire de moins de deux heures alors que les automobilistes font ce trajet en plus de 2 heures, 20 minutes. Le financement de l'exploitation de ce projet serait assuré en vertu de l'article 403 b) du *Rail Assistance Program* administré par la société AMTRAK. En effet, ce programme d'aide prévoit la prise en charge par AMTRAK pour la première année de 65 % des pertes d'exploitation. Pour la seconde, et ainsi que les trois années subséquentes, c'est l'État du Maine qui assumerait alors 65 % des pertes d'exploitation contre 35 % pour la société AMTRAK. Dans le cours de la cinquième année, le projet prévoit l'autofinancement en raison du fait que les revenus devraient couvrir le coût de l'exploitation de cet éventuel train.

À l'autre extrémité des États-Unis, il est prévu un projet d'une liaison ferroviaire internationale de voyageurs entre Seattle et Vancouver; cette liaison sera inaugurée le 26 mai 1995. Ce projet, permettant aux passagers de rejoindre ces deux villes en moins de quatre heures, est le fruit de la participation conjointe d'AMTRAK, du ministère des Transports de l'État de Washington ainsi que du chemin de fer Burlington Northern qui conviennent d'investir la somme de 27,2 millions $ pour des améliorations à la voie ferrée. Quant au financement de l'exploitation de ce projet, il serait assumé entièrement par l'État de Washington.

Dans le corridor Montréal-Washington, où la société AMTRAK a décidé de mettre fin le 1er avril 1995 à cette liaison, un groupe d'investisseurs et de consultants propose une liaison ferroviaire entre St. Albans, Vermont et New London, Connecticut. Ce groupe appelé Le chemin de fer Vermont et Connecticut propose de diminuer les coûts d'exploitation par l'engagement d'employés moins rémunérés, l'augmentation des tarifs ainsi que la disparition des services de *sleeper* et de *dining car*. Ce projet de train laisserait à AMTRAK, outre l'exploitation du seul matériel roulant, les dimensions «réservations» et «vente de billets».

En Argentine, les services ferroviaires voyageurs ont été confiés, en 1994, à des exploitants privés par le truchement de franchises d'exploitation. Ainsi, ces exploitants privés ont reçu une aide financière initiale pour débuter les opérations, cependant ils doivent assurer leurs services ferroviaires voyageurs sans aucune subvention d'exploitation pour l'avenir. Au Chili, le secrétaire adjoint aux Transports, M. Hohmann, a déclaré en janvier 1995 que sa priorité serait de privatiser les services ferroviaires passagers.

III. PROPOSITION D'UN PROJET-PILOTE EN GASPÉSIE

Dans le contexte actuel où les services ferroviaires voyageurs en régions éloignées sont en danger en raison des restrictions budgétaires, il nous apparaît intéressant de trouver des solutions innovatrices pour conserver ces services essentiels à certaines régions tout en réduisant le coût de ceux-là.

Dans cet esprit, nous proposons à Transports Canada d'initier un projet-pilote en Gaspésie pour le tronçon entre Gaspé et Matapédia, d'une longueur de 325 kilomètres. Rappelons que Transports Canada a déjà contribué pour plus de 2,7 millions $ à un projet-pilote permettant la création d'un premier chemin de fer d'intérêt local (marchandises) au Canada, le chemin de fer Central Western, en Alberta, en 1986.

Dans la même optique, nous croyons que Transports Canada pourrait mener le même projet-pilote dans l'Est, mais cette fois-ci pour la dimension «voyageurs», en partenariat (ou autre formule) avec des intérêts locaux.

A. La situation actuelle

Actuellement, la région de la péninsule gaspésienne est desservie par le train. En effet, depuis décembre dernier, le train Océan, en direction de Moncton, se divise à Matapédia où un groupe de wagons avec une locomotive se dirigent vers Gaspé, une distance de 325 kilomètres.

Il s'agit d'un service très achalandé puisque, en 1993, les 37 000 passagers représentaient la moitié de la population totale de cette région qui compte 80 000 habitants.

Les caractéristiques particulières de cette région justifient le maintien du train. En effet, ce service ferroviaire de passagers est d'une importance vitale pour l'ensemble des citoyens et citoyennes de la région. En outre, il faut souligner que cette population est en moyenne plus âgée que l'ensemble du Québec et que la Gaspésie est insuffisamment dotée de services de transport.

En effet, il faut signaler les failles des autres modes de transport. L'avion constitue un mode de transport très onéreux, tandis que l'automobile, en raison du caractère accidenté de la route entre Gaspé et Rimouski ainsi que des conditions climatiques rigoureuses de cette région, demeure un mode de transport qui n'est pas de tout repos. Quant à l'autocar, il effectue un long trajet de 14 heures (Gaspé-Montréal) dont le niveau minimum de confort laisse à désirer.

De plus, l'éloignement de cette région des grands centres de Québec et de Montréal ainsi que les conditions climatiques et économiques souvent difficiles, rendent impérieux le maintien de ce service ferroviaire de voyageurs.

B. Le processus

Le tronçon Matapédia-Gaspé est exploité par Via Rail pour le transport des personnes; la partie Matapédia-Chandler est exploitée par le CN (région des Maritimes) pour le transport des marchandises.

Sur le plan pratique, le CN pourrait procéder à la vente du tronçon Matapédia-Gaspé à un CFIL de marchandises qui prendrait la relève dans cette région.

L'article 158 de la *Loi de 1987 sur les transports nationaux* prévoit que la vente de tout tronçon est sujette à l'approbation de l'O.N.T. Le paragraphe 4 d) de cet article précise que si le cessionnaire ne relève pas de l'autorité fédérale et qu'il n'est pas tenu d'assurer le service de Via Rail à la date de la vente, la déclaration à l'effet que le tronçon est un ouvrage à l'avantage général du Canada cesse d'avoir effet.

Dans le cas qui nous occupe, le cessionnaire, en l'occurrence le CFIL, achèterait le tronçon sans obligation de garantir le service offert par Via Rail. Dans ce contexte, il ne relève plus de l'autorité fédérale et peut donc contracter avec Transports Canada pour l'exploitation d'un service ferroviaire de voyageurs.

Le rôle de Transports Canada serait donc dès la fin du service voyageur de Via Rail sur ce tronçon, de contracter avec le CFIL en vue d'exploiter, outre un service privé de marchandises, un service public de transport ferroviaire de voyageurs faisant le lien avec les trains de Via Rail à Matapédia. Rappelons que le gouvernement fédéral détient la responsabilité d'assurer des services ferroviaires de passagers aux différentes régions du pays conformément à l'article 92, paragraphe 10 a) de la *Loi constitutionnelle de 1867.*

Nous sommes convaincus que l'approche CFIL permettrait d'assurer cette desserte des voyageurs avec une réduction substantielle des coûts d'exploitation.

C. La description pratique du projet-pilote

Le projet-pilote sous-tend l'exploitation d'un service ferroviaire de voyageurs, jointe à l'opération principale d'un CFIL de marchandises. Comment le projet-pilote d'exploitation du service voyageur fonctionnerait-il concrètement? Voici quelques éléments permettant de saisir le fonctionnement pratique du futur CFIL.

1. Le matériel roulant

Le CFIL, administrant conjointement le transport des personnes et des marchandises, pourrait acquérir de Via Rail ou d'autres exploitants ferroviaires en Amérique du Nord des wagons de passagers. Quant aux locomotives, elles seraient celles qui sont utilisées pour le transport des marchandises.

2. L'infrastructure

L'exploitation du volet «voyageurs» serait complémentaire à celle du transport des marchandises. Le problème principal se pose lors de l'acquisition de cette ligne, celle-ci devant absolument être en bon état de circulation, spécialement les ponts. Un programme d'aide financière spécifique aux CFIL pour restaurer les voies ferrées dès l'acquisition serait surement l'outil indispensable pour le succès de tout CFIL.

3. Le financement

Le projet-pilote, soit le volet «voyageurs» du CFIL, serait financé par Transports Canada. Dans le but d'inciter les promoteurs du projet-pilote à s'autofinancer à long terme, la participation financière gouvernementale aux pertes d'exploitation serait décroissante (100 % la première année, 80 % la seconde année, 60 % la

troisième année, 40 % la quatrième année, 20 % la cinquième année). Après la cinquième année, le projet-pilote serait évalué de façon exhaustive par Transports Canada.

Nous croyons que le financement de ce projet-pilote par Transports Canada ne peut être, en aucun cas, plus élevé que ce qu'il est actuellement, soit, en 1993, pour le corridor Montréal-Gaspé, une subvention de 10,7 millions $[5]. Cette subvention est basée sur la répartition de tous les coûts reliés à l'infrastructure d'entretien, des gares, à la commercialisation ainsi qu'aux services à la clientèle. Si on applique la notion américaine à laquelle est soumise la société AMTRAK, soit celle des coûts évitables, la subvention serait alors de 4,6 millions $. Rappelons que les coûts évitables, tels que définis dans la loi sur AMTRAK, recouvrent les droits de circulation que le chemin de fer doit démontrer comme attribuables à l'opération ou au service fourni à AMTRAK, ce qui exclut donc les frais administratifs et généraux. N'y aurait-il pas lieu de s'inspirer, au Canada, de cette notion de coûts évitables qui nous paraît plus équitable pour les CFIL voyageurs et pour Via Rail?

Voici deux exemples de CFIL de marchandises qui ont réussi récemment à devenir rentables dès la première année. Le CFIL américain *St. Lawrence and Atlantic*, né de la vente par le CN de ce tronçon entre Portland, Maine, et Norton, Vermont, a réduit de plus de 30 % ses coûts d'exploitation par une réorganisation administrative (réduction du personnel, flexibilité des emplois).

En Nouvelle-Écosse, le CFIL *Cape Breton & Central Nova Scotia* couvrant le territoire entre Sydney et Truro, a terminé sa première année d'exploitation avec un profit. Le nombre d'employés a été réduit de 115 à 50. Le gérant de cette entreprise, M. Mark Westerfield déclare :

> *«The key to our success is flexibility. Engineers and trainmen oil their engines and change light bulbs and brake shoes. Mechanics drive shunting locomotives*[6].

Par ailleurs, en plus de la réduction du nombre d'employés et de la flexibilité des postes, le CFIL, en raison de son statut d'entreprise provinciale, n'a pas à rémunérer ses employés selon les conventions collectives de travail fort onéreuses prévues au niveau fédéral. En dernier lieu, la dimension touristique de ce trajet panoramique le long de la baie des Chaleurs pourrait être exploitée, permettant ainsi une augmentation substantielle des voyageurs. M. Carl Fowler, un réputé organisateur américain de voyages en train, déclarait l'an dernier que le trajet en Gaspésie constituait *«the grandest canadian rail scenery east of the Rockies*[7]».

Tous ces éléments militent en faveur de la viabilité d'un projet-pilote d'un CFIL de voyageurs dans cette région.

L'avantage de cette solution serait d'assurer la survie à long terme du service ferroviaire voyageur dans cette région tout en permettant des économies importantes pour les contribuables canadiens.

IV. CONCLUSION

Nous sommes d'avis que la création d'un CFIL de voyageurs dans le cadre d'un projet-pilote en Gaspésie serait une option intéressante à examiner au même titre que l'expérience pilote d'un CFIL de marchandises dans les années 80 en Alberta. Ce projet-pilote s'inscrit parfaitement dans la nouvelle philosophie de commercialisation développée par le ministre fédéral des Transports, M. Doug Young lors de récentes allocutions.

Le succès éventuel d'un tel projet-pilote serait des plus prometteurs pour d'autres régions du Québec et du Canada et aurait le grand avantage de décharger Via Rail du fardeau de desservir les zones isolées ou éloignées.

NOTES

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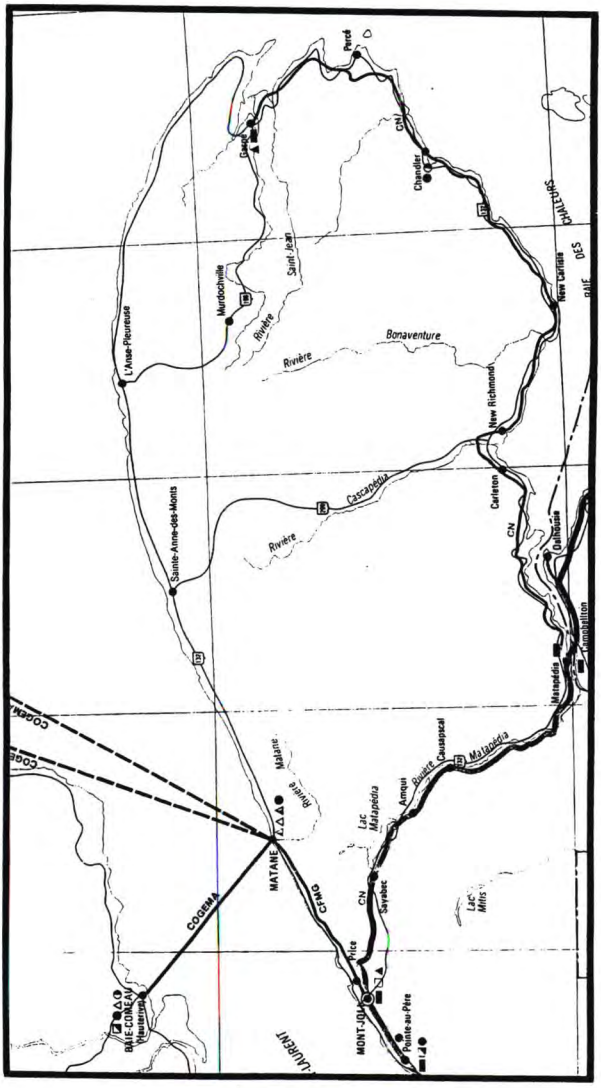
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Percé
Chandler
CN
Murdochville
Saint-Jean
Rivière
L'Anse-Pleureuse
Bonaventure
New Carlisle
CHALEURS
BAIE DES
New Richmond
Carleton
Cascapédia
Sainte-Anne-des-Monts
Québecia
Matapédia
Amqui
Rivière Causapscal
Lac Matapédia
Lac Mills
Sayabec
MATANE
COGEMA
CFMO
MONT-JOLI
Rimouski
LAURENT
Pointe-au-Père
BAIE-COMEAU
Manicouagan

MINIMIZING VIA RAIL'S DEPENDENCE ON GOVERNMENT

Gerry Kolaitis
Department Director
Corporate Planning and Financial Support
VIA Rail Canada Inc.

1. BACKGROUND ON VIA RAIL

- VIA carried 3.6 million passengers in 1994 and earned passenger revenues of $176 million. The revenues came from:

  - Corridor Services 69%
  - Eastern Services 11%
  - Western Services 17%
  - Remote and Regional Services 3%

- Operates 435 trains weekly serving 400 communities across Canada.

- The corporation has 3,500 employees (versus 4,000 in 1994 and 4,500 in 1992).

- There are five maintenance centers: Halifax, Montreal, Toronto, Winnipeg and Vancouver.

2. MARKETS

Passenger rail services can be classified into four service groups, each with its own markets.

- Corridor services (Quebec City-Windsor)
  - economy class is used primarily by non-business travelers,
  - first class caters to the business traveler (and tour operators in the summer).
- Eastern services (Montreal-Halifax/Gaspé)
  - are used mainly by the cost-conscious intercity travelers and by tourists.
- Western services (Toronto-Vancouver)
  - caters mainly to the international and Canadian tourist seeking the unique experience of traveling across Canada by train, and particularly in the Canadian Rockies.
- Remote and regional services
  - provide basic transportation including transportation to remote communities with no other means of transport, and also carry some tourists.

3. REVENUE GROWTH

VIA's revenues grew faster than the economy since 1990:

	Increase since 1990
Gross domestic product (nominal)	11.4%
Disposable income (nominal)	11.8%
Domestic travel (trips, one night or more)	0.0%
International travel to Canada (trips from all countries, one night or more)	5.6%
VIA Rail's revenues	23.6%

4. COST CONTROL

- Annual operating costs diminished by $55 million or 10% since 1990. This actually represents a drop of 18% expressed in constant dollars.

5. FINANCIAL PERFORMANCE

- As a result of higher revenues and lower costs, VIA's need for operating subsidies diminished by 28% since 1990. This actually represents a drop of 35% expressed in constant dollars.
- The revenue/cost ratio improved from 29% in 1990 to 40% in 1994.
- This result becomes more meaningful when you realize that VIA is mandated to operate services to remote communities which can only recover about 10% of their costs with little room for improvement.
- Most of this improvement in financial performance occurred in 1994. In fact, in terms of financial performance, 1994 was the best year that VIA ever had.

6. SOME RECENT PRODUCT AND SERVICE IMPROVEMENTS

6.1 On-time performance

- OTP has been excellent, generally at 90% since 1991. This performance is one of the best among North American public transportation companies.

6.2 Trip time and frequency

- Added 41 weekly departures in the Quebec City-Windsor Corridor since 1990.
- Reduced trip time on the Montreal-Toronto express train from 4h30m to 3h59m.

- Improved the Montreal-Quebec City service in late 1992:
  - added a fourth daily departure,
  - reduced trip time from 3h05m to 2h45m,
  - as a result, ridership increased by 18% and revenue by 35%.
- Reduced trip time on the Toronto-Windsor service from 4h05m to 3h41m.

6.3 Industry partnerships

- Expanded the computer reservation system to link up with other systems worldwide. This makes VIA the first railway in the world to be accessible on the reservation systems in the same fashion as the airlines.
  - In March 1994, VIA went online with both the Apollo and Sabre computer reservation systems, giving more than 30,000 travel agencies around the world access to 15 key destinations in the Corridor.
  - In October 1994, VIA joined forces with Worldspan, bringing to over 20,000 the total number of agencies in the U.S. alone, with access to VIA.
- VIA currently operates trains jointly with Amtrak (e.g., Toronto-Sarnia-Chicago and Toronto-Niagara Falls-New York City)
  - shared equipment: e.g., VIA's locomotives and Amtrak's cars,
  - joint crews: VIA's crews in Canada and Amtrak's in the U.S.,
  - shared maintenance expenses.
- Currently have joint ticketing with two bus companies in Atlantic Canada: Acadian and SMT.
- Examining interline agreements with bus companies in the Corridor.
- VIA is participating in air/rail tour packages which offer vacation tours (e.g., Canadian Holidays).

6.4 Intermodal connections

- Increasing the number of intermodal stations which house intercity bus depots for their respective cities, providing intermodal rail-bus travel to a greater choice of destinations:

  Vancouver, B.C. (Greyhound, GCRC, and as of May 95, Amtrak)
  Stratford, Ont. (CHACO bus lines)
  Woodstock, Ont. (Greyhound)
  Quebec City (Orleans)
  Truro, N.S. (SMT)

- VIA jointly uses stations with GO Transit and ONR in Ontario:

GO Transit	ONR
Toronto	Washago
Guildwood	Cochrane
Oshawa	
Oakville	
Aldershot	
Brampton	
Georgetown	
Barrie	

- The Montreal and Toronto stations are connected with the local subway systems as well as commuter rail.

- Dorval station is connected with commuter rail, local bus and the airport using a shuttle bus service.

- Several VIA stations in B.C. are also used by BC Rail.

6.5 Yield management

- Introduced a yield management system in 1993 which optimizes price and capacity on each train.

  - The number of discount seats is increased when and where passenger traffic is weak, while the number of discount seats is reduced where demand is strong.

- Tested limited overbooking in order to offset the costly impact of last-minute cancellations.

6.6 Other marketing initiatives

- Introduced seat assignment in first class.
- Adopted a more direct and innovative approach to advertising.
- VIA is continuously working with tour wholesalers to have passenger rail included as part of tour packages, along with airlines and hotels.
- VIA won the "Global Award" at the World Travel Market in London, England, for the most significant contribution to Canadian tourism in 1992, i.e., the Silver and Blue class sleeping car service on the Canadian between Toronto and Vancouver. The result of introducing this tourist service was that revenue and cost recovery both increased by 44%.
- In January of this year we introduced an all inclusive meal plan for Silver and Blue passengers; we also, improved the level of service for coach passengers.
- Upgraded the Montreal-Halifax/Gaspé sleeping car service and renamed it Easterly Class.

6.7 Investment in equipment

- Completely modernized the Western and Eastern services with 181 refurbished stainless steel cars (vintage 1955) at a cost of $200 million.
- In October 1994, the international railway community presented VIA with a Brunel Award for this project. This is the highest award a company can receive from the international railway industry for design excellence, in recognition of the spectacular results produced by the project team.
- Refurbished 100 LRC car interiors.

- Began the modernization of 33 stainless steel cars for use in southwestern Ontario. The project will cost $58 million, will be completed in 1996, and it will be internally financed through productivity savings.

6.8 Customer satisfaction

- As a result of these product and service improvements, customer satisfaction has been very high. According to on-board surveys, VIA has met or exceeded customer expectations 95% of the time in 1994.

7. SOME RECENT PRODUCTIVITY/EFFICIENCY INITIATIVES

7.1 Eliminated activities which did not add value to the customer

- Reduced overhead expenses through management and administrative restructuring. The 1993 and 1994 reorganizations eliminated 45% of all administrative positions and will save $32 million annually.

- Reduced consulting services, travel expenses and vacation relief staff; eliminated temporary positions, etc.

7.2 Other productivity measures

- Reduced the number of guard and spare locomotives through better equipment reliability and availability.

- Negotiated reductions in the cost of the reservation system.

- Implemented productivity improvements in equipment maintenance. For example:

  - rationalized master maintenance schedules,

  - reduced the number of unscheduled repairs by doing more preventive maintenance and by identifying and correcting the root causes of failures,

  - improved parts workmanship and trouble-shooting.

- Lowered the cost of goods and services purchased by developing long-term partnerships with suppliers.

7.3 VIA is maximizing the benefits from its assets and resources

- By converting old railway stations to intermodal stations, VIA not only attracts more travelers, but attracts more commercial tenants to its stations.
- Third party contracts. For example VIA is:
  - servicing equipment for Ontario Northland Railway at the Toronto Maintenance Center,
  - servicing equipment for Great Canadian Rail Tours Company and for BC Rail at the Vancouver Maintenance Center,
  - bidding to maintain commuter equipment for BC Transit, and for Amtrak's new Seattle-Vancouver service also at the Vancouver Maintenance Center.
- Leasing 35 surplus cars to the Societé de transport de la Communauté urbaine de Montréal (STCUM) and maintaining them.
- Leasing 8 surplus F-40 locomotives to CP Rail.
- Selling surplus equipment and in some cases refurbishing it to the buyer's specifications. For example:
  - VIA sold 8 railiners to the Quebec North Shore and Labrador Railroad Company and refurbished them at the Toronto Maintenance Center.
- Leasing out surplus space in stations and office buildings to retail and commercial tenants.

7.4 Performance Enhancement

- VIA recently introduced a new tool, called Performance Enhancement (performance management) to improve productivity and service delivery. Using PE, managers target results which add value to their unit. They then list specific behaviours that their staff must employ to accomplish the result, and positively reinforce them when they meet or exceed expectations.

- In this way all activities are better focused on service to customers, revenue generation and cost reduction targets.

- Measurement systems identify individual contributions and, through feedback, employees are recognized personally for their efforts. When goals are achieved, the whole work unit celebrates its success.

- This approach has already started to help VIA achieve its main objectives of exceeding customer expectations and turning VIA into a low cost/high quality operator.

8. FUTURE PLANS

8.1 Some examples of product and service improvements which are planned or are being studied

The following initiatives will be implemented only if they improve the bottom line:

- Further reductions in trip time on certain Corridor trains.

- More express trains and more convenient departure times.

- Additional departures.

- "Office on rails". This innovation would add more business related elements in our first class service: e.g., electrical outlets at each seat, enlarged working tables, work stations and a meeting area aboard the train, and fax machines in first class lounges in stations.

- Increasing capacity to accommodate growth in passenger carryings. VIA's traffic is forecast to grow at about 4% per year over the next five years.

8.3 Examples of future productivity/efficiency improvements

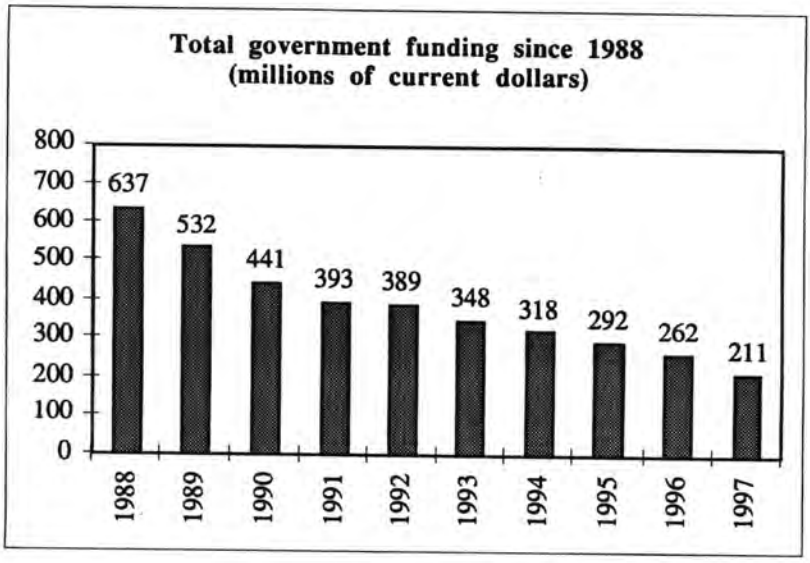
- Achieve lower labour costs through the elimination of unproductive practices including changes in work rules and benefits, and reductions in the size of train crews (e.g., redefine employment security rules; change the method of pay for running trade employees from mileage to hourly basis.)
- Make better use of the fleet.
- Upgrade equipment to further improve reliability and reduce cost.
- Continuously find ways to cut costs in many small ways.

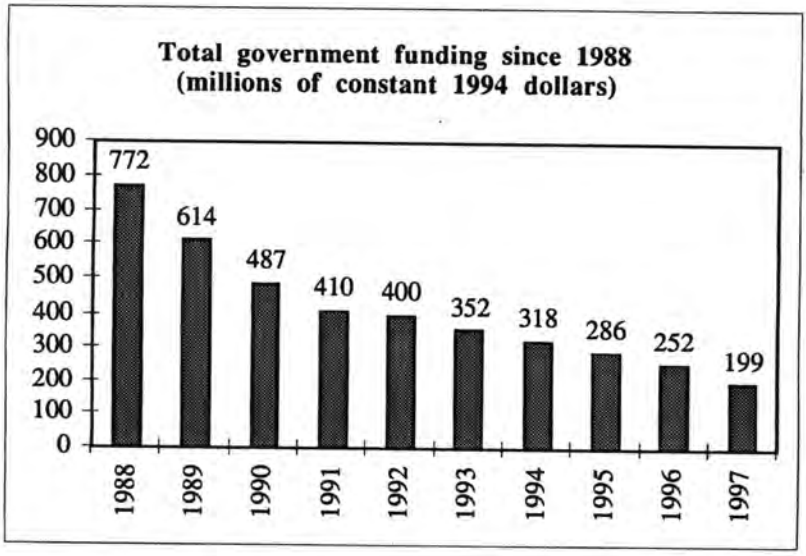
8.4 Projected improvements in financial performance

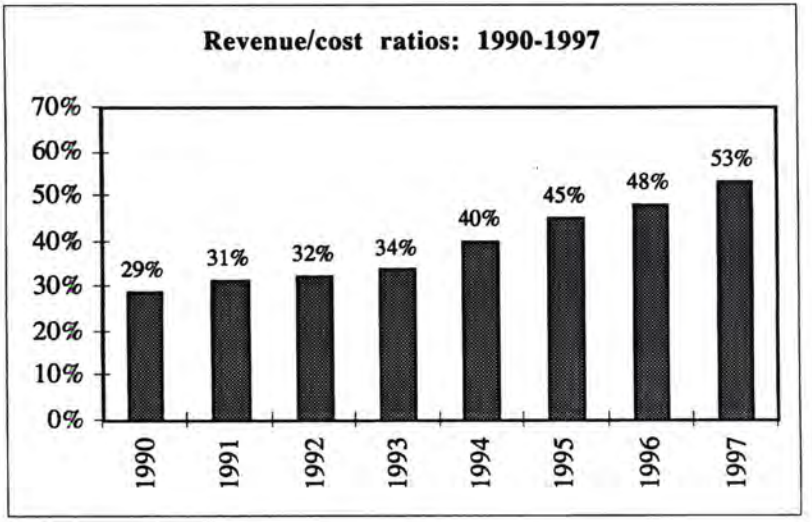
- Increase revenues by at least 22% over the next three years.
- Decrease operating costs by 22% over the next three years.
- These improvements will raise the revenue/cost ratio to 53% by 1997 versus 40% in 1994 and 29% in 1990.
- The operating subsidy will be $199 million by 1997 versus $410 million in 1990, a drop of 57% in real terms.
- All this is being accomplished without any train service reductions.

9. CONCLUSION

VIA is showing how passenger rail can, despite all odds, keep getting better — attracting more riders, offering more trains, providing better service, earning more revenue, with less staff, at less cost to the taxpayer.


Total government funding since 1988
(millions of current dollars)
800
700
600
500
400
300
200
100
0
637
532
441
393
389
348
318
292
262
211
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997


Total government funding since 1988
(millions of constant 1994 dollars)
900
800
700
600
500
400
300
200
100
0
772
614
487
410
400
352
318
286
252
199
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997



Notes to the three charts shown above:
- they exclude restructuring and non-cash expenses e.g., depreciation,
- figures for 1995-97 are projections.

Cooperation in Action: Reinstating Vancouver-Seattle Passenger Rail Service

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Ministry of Employment and Investment, British Columbia

The views presented in this paper are those of the authors and not those of the Ministry of Employment and Investment.

I. Introduction

Is it possible that two provincial Ministries, one regional government, five municipalities, four federal agencies, one state, four U.S. federal agencies, a Congressman, a Premier, a Governor, two railways, VIA Rail Canada and Amtrak can work together to achieve a common goal?

Yes. It can be done! The reinstatement of Amtrak passenger rail service between Vancouver, British Columbia, and Seattle, Washington, is proof positive that cooperative partnerships can produce results. Every partner contributed in a significant way to ensuring the launch of passenger rail service.

This paper describes the process and problems that were encountered during this process. From this experience, we have learned lessons that are applicable to other projects of this size and scope.

The Pacific Rail Corridor stretches from Eugene, Oregon to Vancouver, British Columbia. This region, which parallels I-5 in the U.S., is undergoing rapid growth and urbanization. All of the major centers: Eugene, Portland, Seattle and Vancouver are facing similar challenges and grappling with how to convert these urban growth, trade, economic development, tourism and transport challenges into opportunities.

A consequence of this growth, evident to both residents and visitors, is that the existing transportation facilities and services within the corridor are under pressure. This is evidenced in delays at the border and the urban congestion in the major metropolitan areas. The corridor's population is 7.7 million and is expected to increase 40 percent by 2020. Most of the problems just described are a result of increasing automobile usage. This paper outlines how train travel in the Pacific Rail Corridor is being positioned as a viable alternative to single occupancy vehicle travel.

To attract regular travelers and become a feasible alternative to auto travel, Vancouver-Seattle train service must provide a one-way trip from downtown to downtown in less than four hours.

II. Background

Passenger rail service between Vancouver, British Columbia, and Seattle, Washington, was terminated in 1981 under a series of nation-wide cuts to Amtrak's system in the U.S. Since then, there has been consistent effort on the part of communities and legislators in Washington State to reestablish the service.

Prior to the reinstatement of passenger rail service in May 1995, several studies assessed rail transportation options. The most thorough was the High Speed Ground Transportation Study[1] (HSGT) completed in 1992. For this study, Washington State was the major proponent; in addition, the U.S. Federal Railroad Administration, Burlington Northern Railroad (BN), local, county and state politicians, the State of Oregon and British Columbia participated. The goal of this Study was to identify a feasible, cost effective way of establishing a high-speed ground transportation system in two candidate corridors. The north-south corridor was from Vancouver, British Columbia, to Portland, Oregon.

The Study focused on the economic, environmental, institutional and financial feasibility of implementing HSGT (150 miles per hour or greater top speed). The Study also evaluated five HSGT technologies[2], including magnetic levitation, which all required purpose-built, separated rights-of-way throughout most of the journey length.

While the study concluded that the high-speed rail system would be a "success" in terms of recovering its operating costs and attracting riders, the initial capital costs of approximately $9 to 12 billion dollars were seen as a deterrent to any rapid legislative action. As a result, the Washington State legislature adopted the recommendations of the Study . Initially, the existing rail corridor would be incrementally upgraded as a short-term measure while true HSGT service, 150 miles per hour or greater top speed in an electrified right-of-way, would remain the ultimate goal. Washington State legislature approved a state plan to implement what could be described as a rapid train service on the existing BN north-south right-of-way. The main components of this approach are: infrastructure upgrading; safety improvements; and the application of train technologies which can travel at optimum speeds on the conventional right-of-way. The goal to be reached within the next decade Wil be a right-of-way with extended sections of 125 mile per hour operation.

The U.S. Intermodal Surface Transportation Efficiency Act of 1991 designated five high-speed rail corridors of which Eugene-Portland-Seattle-Vancouver is the only international corridor. This has been helpful in focusing U.S. federal attention on the corridor.

While Washingtonians were being educated as to the advantages of passenger rail for increased mobility, effective growth management and the environment, a key initiative was underway in British Columbia. In 1993, the Georgia Basin Initiative[3] recognized the need for bilateral cooperation to address the problems associated with growth in the Georgia Basin-Puget Sound region. Among the report's far-reaching recommendations was the endorsement of a "proactive strategy for transportation planning and linkage with Washington State" and that a bilateral mechanism be developed to consider regional transportation issues such as ferry linkages and transportation rail links between Seattle and Vancouver.

This desire to constructively deal with these important growth management and mobility issues was reflected in increasing contacts between British Columbia and Washington to find common solutions to shared problems.

On April 5, 1993, British Columbia's Premier Harcourt and Washington State's Governor Lowry established a working group to oversee the restoration of passenger rail service between Vancouver, British Columbia and Seattle, Washington. The Pacific Rail Corridor Working Group is co-chaired by British Columbia's Ministry of Employment and Investment and the Washington State Department of Transportation (WSDOT). The group is responsible for regulatory and operational issues and the many areas where bi-national coordination is required to implement the service.

The lead project proponent is Washington State which has made a major financial commitment to the program by allocating $40.2 million dollars for its 1993/1995 program. Washington has consciously adopted an incremental strategy for providing the infrastructure improvements necessary to increase speeds and reduce travel time to 3 hours 30 minutes, by 1999. To achieve these speed increases, $26 million U.S. in track improvements will be made. Travel time is the most critical factor in determining this project's success. A journey of less than four hours is required to be competitive with auto travel and to make the route economically feasible.

Operating costs for this service are being shared by Washington State and Amtrak. Originally 65/35 percent respectively, funding arrangements are under review as Amtrak moves toward allocating costs to specific trains.

III. Process and Problems

The process required to introduce a new bi-national train service is both lengthy and complicated. The continued cooperation and perseverance of all parties involved in this project was critical to seeing train service reinstated. It is the ability of all project participants to continually tackle challenges that truly illustrates the spirit of cooperation which has underscored the exercise from its inception.

Project Timing

The original start date of October 1, 1994, was moved several times. Delays in obtaining the necessary approvals for construction and scheduling resulted in several new start dates. Service is scheduled to begin on May 26, 1995.

Train Speeds

When Vancouver-Seattle service commences in May 1995, the one-way travel time will be 4 hours and 35 minutes, 40 minutes longer than the goal of 3 hours, 55 minutes for inaugural service that was established by the Working Group. In Canada, any increases in train speeds are subject to approval by Transport Canada. BN has submitted a formal proposal outlining safety measures to be taken along the route. As the owner of the right-of-way, BN is responsible for the costs and construction of these measures if it is to achieve the desired speed increases. The BN right-of-way passes through the urbanized White Rock/Crescent Beach area. Use of the tracks for pedestrian access to beach and recreational areas is common, as there are a number of informal access points to the tracks. Along the White Rock waterfront, the right-of-way is located between the road and the beach. Residents have come to think of the privately owned right-of-way as general use territory.

Safety concerns in this area have served as a lightning rod for media attention. Local councils and the media have expressed their concerns over the proposed speed increases and the perceived negative impacts of one additional train per day on their communities.

Safety concerns about the "new train" derive from several sources.

- First, the project has frequently been referred to as a *high-speed rail* project. However, the Canadian portion of the route restricts trains to extremely slow speeds through urbanized areas. For example, current speed restrictions in White Rock limit trains to 21 miles per hour and the New Westminster Railway Bridge has a speed restriction of 15 miles per hour. However, references to a "high-speed train" evoke images of a 125 mile per hour train traveling though a quiet community accustomed to 21 mile per hour speeds.

- Second, BN, owner of the right-of-way, explicitly aired concerns about public trespassing on a privately owned right-of-way. This conflicted with the established practice of using the railway right-of-way to access the beach. To BN's credit, they are providing specific safety-related improvements and have introduced a successful Operation Lifesaver program to local schools.

- Third, there is a perception that the initial addition of one train per day in each direction will create a safety problem. This highlights the need for education regarding rail safety and the relative safety of rail travel when compared to other modes. When railway accidents do occur, they usually receive disproportionate public attention. One comparison of statistics[4] shows that the risk of death in an auto accident is 18 times that for rail, with 6.67 deaths per 1 billion passenger-kilometers of auto travel and 0.37 deaths for rail travel.

Customs and Immigration Pre-clearance

The train is unique. Passengers will be pre-cleared at downtown Vancouver's Pacific Central Station prior to boarding; the train is effectively 'sealed' until it reaches its first stop on the U.S. side in Bellingham. Within Canada, the only stop is at Pacific Central Station. There are four stops between the U.S. border and Seattle: Bellingham; Mount Vernon/Burlington; Everett and Edmonds.

Pre-clearance of train passengers will position the Mt. Baker International as a modern, efficient way to travel. This is a significant step in moving toward a European standard of operation where train travel between countries is virtually seamless. The special arrangements to allow pre-clearance of trains are covered in the Canada-U.S. Surface Transport Customs Surface Transport Pre-inspection Agreement negotiated between Canada and the United States.

This Agreement allows the U.S. Immigration and Naturalization Service to conduct, in Canada, an inspection of passengers and crew required by U.S. immigration and public health laws and regulations for entry into the U.S. Parties who refuse to submit to inspection will not be permitted to board a pre-inspected or precleared train. Canadian customs officers will provide post journey inspections at the same facility.

In March 1994, the Federal Minister of Revenue announced that customs cost-recovery fees (salary and travel costs for customs officers) will be waived because the Mt. Baker International run is a reinstatement of former service rather than a brand new route.

Pacific Central Station

Pacific Central Station is a heritage train station that has been transformed into a showcase, multi-modal facility in downtown Vancouver. The Station, owned by VIA Rail Canada Inc., has been fully refurbished and, in 1993, Vancouver's inter-city bus terminal was relocated onto the station site. A common station concourse forms an integrated entry for both rail and bus customers. This inter-modal terminal is enhanced by its proximity to BC Transit's Skytrain and bus services. With the launch of the Mt. Baker International, Amtrak, VIA Rail and Great Canadian Railtour passenger services will operate from the same facility.

WSDOT has provided funding of approximately $415,000 for renovations to accommodate the new service and customs/immigration requirements for Canada and the U.S. The layout of the Station is extremely important for managing the demands of the international train and the necessity of segregating customers who have cleared customs. Through the Working Group, negotiations between VIA Rail, Amtrak, Washington State, U.S. Immigration and Naturalization Service, U.S. Department of Agriculture, Revenue Canada (the department responsible for Canadian customs), Citizenship and Immigration Canada, and the British Columbia Attorney-General proceeded on a protracted but ultimately constructive basis. The final result is modifications at the platform entrance to provide a facility that will be shared by Canadian and U.S. customs officers for processing travelers.

Local Government

The rail route from the U.S. border to downtown Vancouver passes through six municipalities; they are all part of the larger entity known as the Greater Vancouver Regional District (GVRD). The GVRD has consistently supported this service. The GVRD Strategic Planning Committee was briefed formally and has specifically endorsed the project. Acceptance of the service has been helped by assuring that local mayors were aware of significant milestones as they were accomplished and by their understanding the role that expanded rail service could have in enhancing mobility and managing urban growth.

IV. Results

Revenue service for the Mt. Baker International commences on Friday, May 26, 1995. A one way trip will initially take 4 hours and 30 minutes. There is one round trip per day which departs Seattle in the morning. The Amtrak trains operate mostly on BN track to Pacific Central Station.

Mt. Baker International Service will initially be provided with a Talgo train. Given Washington's approach to incrementally upgrade the existing right-of-way, the optimum train technology had to account for this approach. Several train technologies were assessed and the ABB Swedish X2000 train set was used for demonstration runs in the corridor.

WSDOT secured a leasing arrangement with Renfe Talgo for a demonstration on Amtrak's Mt. Adam's run between Seattle and Portland during nine months of 1994. The tilt train technology allows trains to maintain higher speeds through curving tracks while maintaining a comfortable ride. The train operated at 76 percent capacity, exceeding Amtrak's projection of 49 percent. The Talgo had a net positive increase on ridership in the Seattle to Portland corridor, as ridership rose more than 20 percent in 1994.

The train has attracted strong interest from the tourism industry throughout the Pacific Northwest. The train is one of the few genuinely new travel products to be introduced this year. The tourism industry is developing strategic partnerships to fill the train during the off-peak winter months; the Mt. Baker International is the final link in a continuous rail tour of North America.

In December 1994, Amtrak targeted national reductions in overall service levels by 21 percent. Because Vancouver- Seattle service is so strongly backed by Washington State, the Mt. Baker International remains intact. However, if this service is to be secure, it will need to meet certain criteria. These include:

- Year-round ridership. Summer riders will be relatively easy to attract. It is expected that major sporting and entertainment events in Vancouver and Seattle will generate a substantial share of riders outside the peak season. Once again, travel time is critical for attracting and retaining the business traveler.

- Fast schedules. The Mt. Baker International is not considered economically viable with a travel time of more than four hours. The interim "higher speed" target of three and a half hours needs to be achieved quickly to assure lower operating costs and to generate the necessary ridership and revenues.

- Regulatory approvals. As BN makes improvements, Transport Canada will be asked to grant speed increases for certain sections of track.

- Support from communities along the route must be built through communication and recognition of the specific economic, travel and tourism benefits generated by this service.

V. Next Steps

In September 1994, Premier Harcourt and Governor Lowry signed a Transportation Cooperation Agreement which established a Transportation Initiative "...to promote and coordinate the provision of transportation services with particular emphasis on establishing modern passenger rail services."

Within British Columbia, it was recognized that there was a need to begin assessing alternate corridors to ensure future reliable, unimpeded, higher speed passenger rail service to downtown Vancouver. From a long-term perspective, the ability to acquire lands for future rail corridors into urban areas is rapidly decreasing, the built-up area between the U.S. border and downtown Vancouver continues to expand and land prices are still on the rise.

A preliminary assessment of alternate alignments is being undertaken in a joint British Columbia/Washington/Oregon study. The reconnaissance-level study will be completed mid-year, the next step is a detailed assessment of the preferred corridor(s). It will be important to recognize the trade-offs that may have to be made to acquire a new rail corridor.

In keeping with the spirit of the Transportation Cooperation Agreement's emphasis on the planning and implementation of passenger rail service, the British Columbia/Washington/Oregon corridor study is a cooperative partnership that provides all three participants with access to multi-disciplinary expertise and a corridor-wide perspective. This study demonstrates British Columbia's continued commitment to a cooperative approach to Pacific Northwest Rail Corridor service that we have with Washington and Oregon.

VI. Conclusion

The Pacific Rail Corridor Working Group functioned as a vehicle for facilitating reinstatement of Vancouver-Seattle service. Although stakeholders from different agencies, different countries and competing firms were assigned to this group, they succeeded in making commitments on behalf of their organizations and; managing, for the most part, critical problems in a forthright manner.

After almost two years of working together, it is apparent that pushing a team such as this toward a common goal requires persistence and determination. It is now apparent that the process would have been somewhat smoother if all requirements and problems were brought to the table early in the process.

In mid-1994, Vancouver-Seattle train service began to attract public attention. It became apparent that there were public concerns about the number of trains, train speeds, and access to the beach across BN's right-of-way. These concerns were highlighted in the media, discussed at community meetings and on the agenda at local council meetings. There was clearly a need for an effective public education program that communicates the economic and tourism benefits of Vancouver-Seattle rail service, the relative safety of rail versus road travel and the potential role of rail as a growth management tool which serves corridor-wide transportation needs.

Another communications issue is that the presentation of any transportation proposal must be specific, rather than general. The continuing references to high-speed rail, rather than higher-speed trains, managed to confuse the public as to exactly what was happening and how it would impact them.

Finally, although there are just two names on this paper, credit for reinstating the service must go to all members of the Working Group as well as a special recognition to the energy and concentrated purpose of WSDOT.

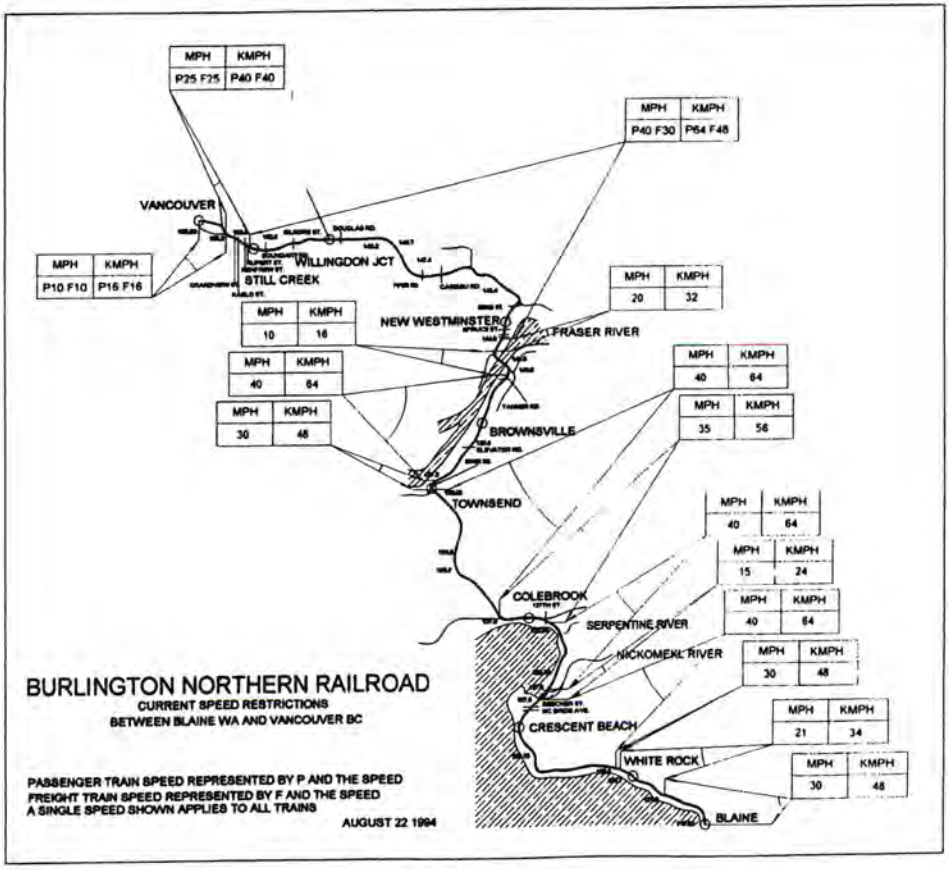
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AUGUST 22 1994

ECONOMIC IMPACT OF A POTENTIAL NIGHT RESTRICTION AT THE WINNIPEG INTERNATIONAL AIRPORT

by

Barry E. Prentice,* Chris Loly** and Robert Morrissey***

1.0 Introduction

The Winnipeg International Airport (YWG) has been an important part of Manitoba's transportation network since 1928. Today, YWG is Canada's eighth largest airport in terms of enplaned and deplaned passengers, and the fifth largest cargo airport.[1] The airport provides Winnipeg's residents with national and international transportation services, access to fast delivery of goods, and significant economic spin-off effects.

Part of the economic benefits that accrue to Winnipeg are a function of its 24 hour operating status. Airlines and air cargo operators have been encouraged to expand their activities at Winnipeg because of the flexibility YWG offers in scheduling their time-sensitive operations. YWG has a 24 hour operating status, and is located in the east/west centre of the country. Three courier operations (Purolator, UPS, FedEx) now use Winnipeg as a hub for their Canadian operations. In 1994, FedEx constructed a 38,000 square foot building at the airport costing more than $2.5 million. YWG is now their main sorting centre for their cargo operations in Manitoba and Saskatchewan (YWG Portfolio, 1995).

As the level of airport operations has increased, the management of aircraft noise has become more critical. Advances in noise management received a set back in 1994 when a large number of older, noisier aircraft began to use the airport. In May 1994, Purolator changed from Air Canada to Kelowna Flight Services to provide its lift. Although less expensive, Kelowna Flight Services

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are using older (Stage I) airplanes that are only half the size of DC-8 freighters used by the Air Canada. As a result, the number of flights has doubled, while the noise of each jet is about three times greater.[2] Naturally, the local residents reacted negatively, and some have suggested that the airport should be closed to night-time activities.

This article reports the results of a study that was commissioned to determine the economic consequences, if a night restriction was imposed on operations at YWG. The first section presents a description of night-time activity at YWG. This includes a trend analysis of movements by month and by night-time hours. The second section presents the results of the economic impact study. The final section outlines the efforts to mitigate the noise problem and to assure compatible land use planning.

2.0 Night Air Traffic at Winnipeg International

The analysis of night-time movements begins with a comparison of total aircraft movements to the movements occurring between the hours 24:00 and 06:00. These data are examined on a monthly basis to illustrate seasonal differences. The night-time flights are further examined on an hourly basis to determine the peak noise periods. The data analysis spans the period 1987 to 1993 to identify any recent time trends.

2.1 Movements by Month

All movements at YWG are classified as either a local or itinerant. A local movement is referred to as an aircraft landing at, or departing YWG, yet remaining within the same airspace. An itinerant movement encompasses all other domestic and foreign aircraft arrivals and departures occurring at YWG. The analysis combines the data for local and itinerant movements between December of 1988 and October of 1993.

Figure 1 provides the total monthly movements for 1992 and 1993. These years are plotted against the previous five year average for 1987-1991. For the years 1992 and 1993, the total number of movements is consistently lower than the previous five year average. This reflects the impact of the economic recession that lowered all air travel in Canada during this period.

There is a strong seasonal pattern in the aviation activity. Aircraft movements during the winter months are considerably lower than the rest of the year, with November and December the least active months. For all years, the most active period commences in May and peaks in mid June. From June onwards, YWG

experiences an overall decline in the total number of local and itinerant movements.

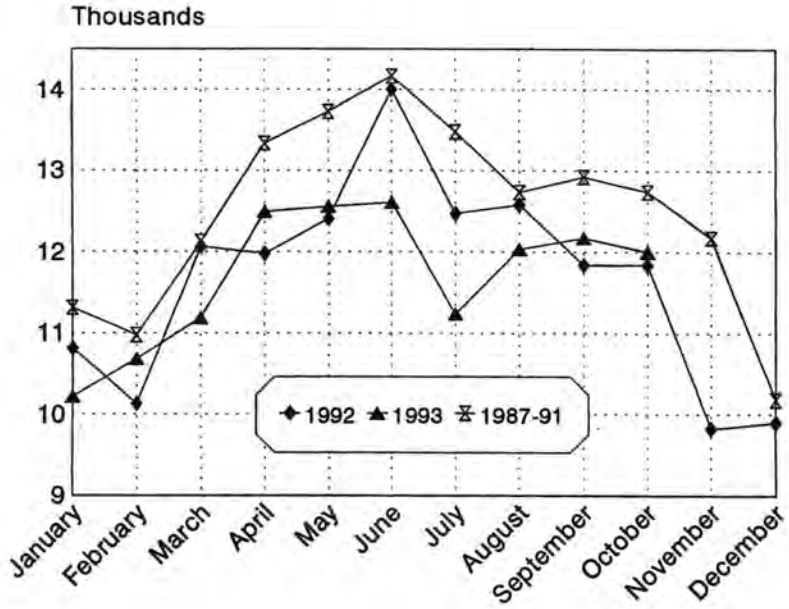


Figure 1 Total Aircraft Movements at YWG by Month, 1987-1993

Figure 2 presents the total number of monthly night movements occurring during the night hours. On average, the airport activity during the night-time represents only 8 to 9 percent of the total air traffic at YWG. The summer months have the highest number of flights occurring at night, with approximately 1030 flights each month. As would be expected, June represents the peak period while the winter months constitute a slower period. In contrast to the total activity that declined during the recession, night-time operations at YWG has increased in the past two years.

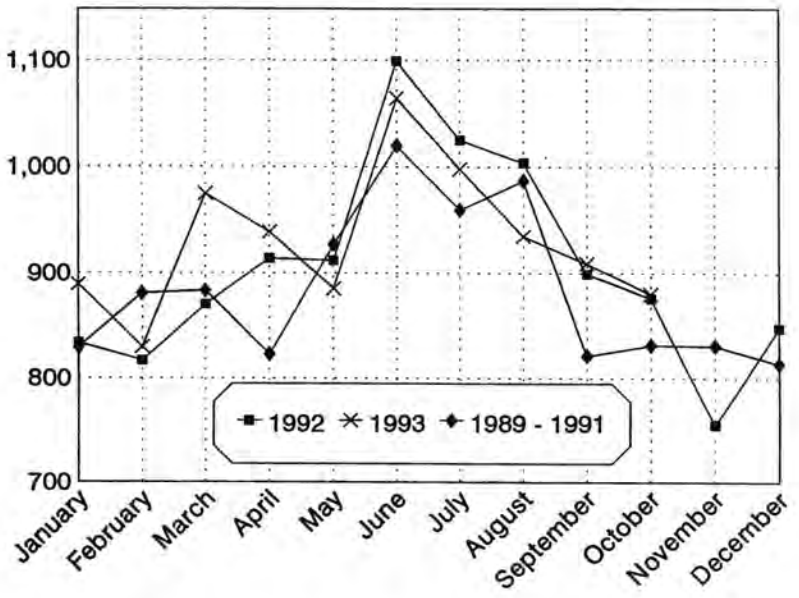


Figure 2: Total Aircraft Movements at YWG by month during the hours 24:00-06:00, 1987-1993

2.2 Night Movements (24:00-06:00)

Figure 3 displays the total night-time activity on an hourly basis at YWG from 1988 to 1993. The data are divided into hourly segments from midnight to 6:00 a.m. Each spike represents a particular year, while the term average is plotted horizontally in a linear format. As would be expected the peak hours of night activity at YWG occurs prior to 02:00, and again at 06:00. Throughout these peak night-time periods, between 1,500 and 2,500 movements occur each year. During the hours of 02:00 and 05:00 the total annual movements have ranged between 700 to 1200.

There is no obvious change in the pattern of night-time movements over the period of study. A movement can be either a landing, or a take-off. The operations of air freight tend to produce more landings during the early morning hours with surge of take-offs just before dawn. Although take-offs are

generally more likely to create noise complaints than landings, the particular runway used is also critical to the noise problem. The airport does have some discretion regarding runway use, but safety factors over-ride noise. Consequently, wind direction often limits runway choice.

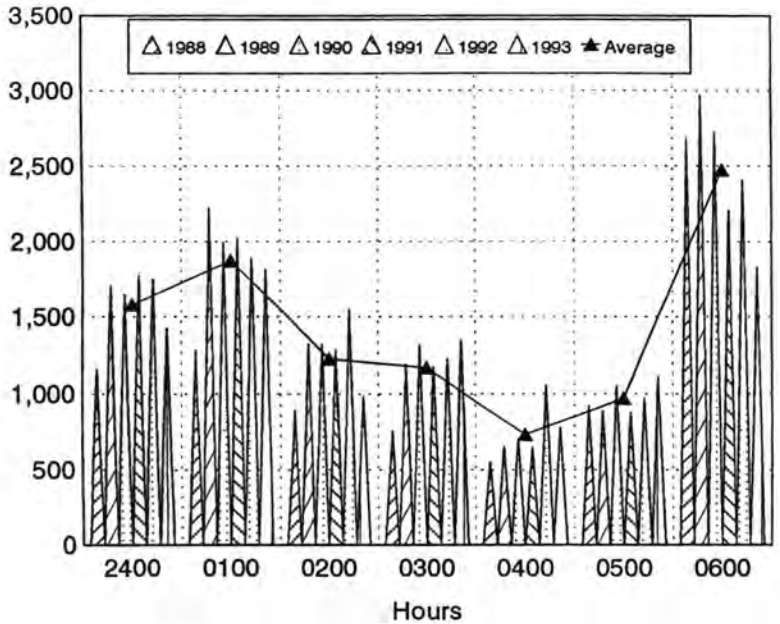


Figure 3: Total Night-time Movements at YWG by Hour of Operation, 1988-1993

2.3 Noise Complaints

The summer peaking of night-time activities tends to accentuate the noise problem at YWG. The severe winter conditions at Winnipeg require well constructed and heavily insulated houses. Triple pane windows and steel insulated doors are common in all recent construction. As a result, noise complaints have been negligible during the fall, winter and early spring months, Only with the approach of summer, when residents living close to the airport

have their windows open at night, do the noise complaints begin to rise. The seasonal peak of night-time flights occurs at the most sensitive time of year.

The introduction of the older Stage I aircraft in the spring of 1994 led to a significant increase in noise complaints. Figure 4 presents noise complaint data for the period 1993 to March 1995. These data report day-time and night-time complaints. Prior to the change in courier aircraft, day-time complaints generally exceed night-time complaints, and very few complaints of either type were registered outside the late spring and summer. Since the change, night-time complaints now exceed day-time complaints, and the level of night-time complaints during the winter months now exceed the previous summer complaint levels.

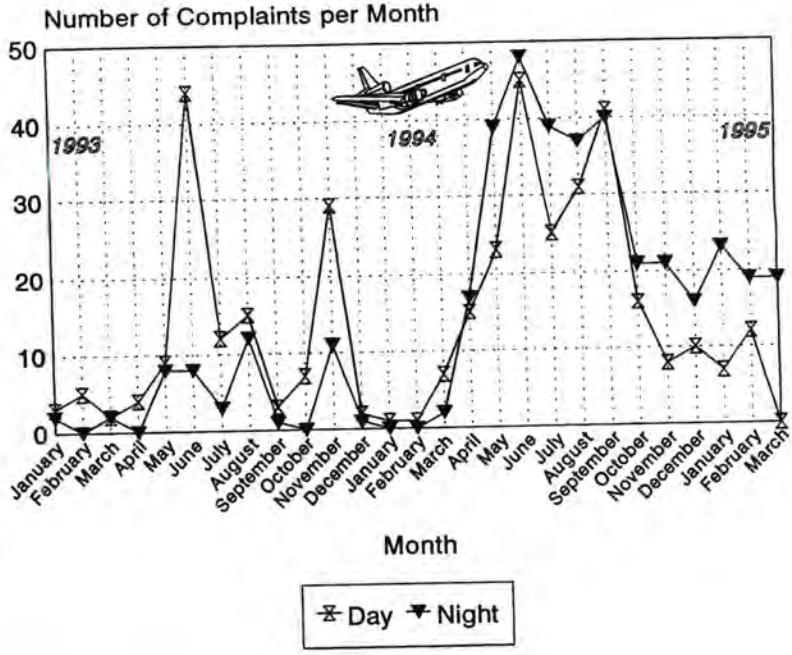


Figure 4 Noise Complaints at YWG, 1993-March 1995

3.0 Economic Impact Study

Aircraft movement data indicate that less than 10 percent of the total air traffic occurs during the sensitive night hours. However, a restriction on night-time activities would cause a significant contraction of the local economy because many of these operations can not be shifted to another time of day. The total economic impact is comprised of direct, indirect and induced effects (Prentice, Futz and Yeow, 1989).

Direct impacts are the losses in revenue and employment that would be experienced by firms that are directly involved in midnight to six a.m. operations at the YWG. Indirect impacts can take the form of input purchases that are no longer made by directly affected firms. Shippers that depend on the outputs of the directly affected firms could also be affected, but this impact is not included in the study.

The induced impacts are "second-round" impacts that accompany a change in economic activity. This is known as the multiplier effect, and it occurs with any change in aggregate expenditure in an economy. If directly affected firms lay off workers, there are less wages to spend in the local economy. Reduced consumption leads to less economic activity, more lay-offs and lower payrolls at other firms.

The direct impacts are calculated through a survey of the firms that operate at YWG during the affected hours. Indirect and induced impacts are estimated by applying an economic impact multiplier to the direct impacts. The economic multiplier utilized in this study was a derivation of an input-output model of the Manitoba economy developed by the Manitoba Bureau of Statistics (1991).

3.1 Direct Economic Impact

The direct economic impact was established through a census of firms that have night operations at YWG, as well as interviews with affected government departments. The direct impacts are based on current operations and do not include the losses associated with future opportunities.

The direct effect of a night-time closure at the YWG is summarized in Table 1. These effects are quantified in terms of employment (person-year equivalents), labour income and gross economic activity (GDP). In 1994, night-time activities at the airport generated $74 million of direct economic activity in the Province of Manitoba and provided 212 full-time equivalent jobs and

earnings of close to $6 million. This is approximately double the level of activity measured by McCoy (1989) six years earlier.[3]

Table 1: Direct Economic Impacts of a Night Restriction at the Winnipeg International Airport

	GDP	Employment	Labour Income
Air Carriers	$25,237,138	59.5	$1,594,700
Couriers	$40,726,190	116.5	$2,921,500
Air Support	$8,094,722	36.0	$1,208,000
Total	$74,058,000	212.0	$5,724,110

The directly affected industries are divided into three categories: Air Carriers, Couriers, and Air Support Services. Air Carriers are firms that own and operate their own aircraft, but are not involved with surface delivery. Couriers are enterprises that are engaged in the pick-up and delivery of small packages. Only inter-city couriers require the use of the airport during the 24:00 to 06:00 period. Although intra-city couriers also use the airport for pick-ups and deliveries, they do not depend on 24:00-06:00 airport operations. The Air Support Services category consists of maintenance facilities, the sellers of fuel and the providers of any other service that cannot be classified in the previous two categories. All Government operations affected by a night-time closure are included in this category.

The courier industry would be directly affected by a night-time closure. Courier firms account for approximately half of the employment, GDP, and payroll generated during 24:00-06:00 period. The 24 hour capabilities of YWG are one of the main reasons that several leading courier companies have decided to locate in Winnipeg. A restriction in the night-time hours would force many courier firms to relocate.

The air carriers and the air support services sector conclude the examination regarding the direct impacts. The air support services sector accounts for 11 percent of the GDP, 18.5 percent of the employment and 21 percent of the payroll, while the air carriers account for 34 percent of the GDP, 31.5 percent of the employment and 28 percent of the payroll generated during the night-time hours.

3.2 Total Economic Impacts

The total economic impact is derived using an economic multiplier, and is the sum of the direct, indirect and induced economic impacts. While it is possible to provide an estimate of the total economic impact, it is quite likely that this estimate will under-represent the total effect of a night closure because several unquantifiable factors have been omitted.

The process of multiplying the direct impact by the economic multiplier takes into account the indirect and induced spending that result from the direct impact. The economic impact multipliers for transportation in the Province of Manitoba are presented in Table 2.

Table 2: Manitoba Economic Impact Multipliers (Transportation Industry 1991)

GDP	Employment	Labour Income
1.5528	1.6739	1.5117

Table 3 summarizes the total economic impact. In short, the total impact of the night operations at YWG is over $114 million in GDP, approximately 355 jobs, and $8.6 million in incomes.

Table 3: Direct and Total Effects of a Night Restriction at the Winnipeg International Airport

	GDP	Employment	Labour Income
Direct	$74,058,000	212.0	$5,724,110
Total	$114,997,262	354.9	$8,653,137

Table 4 relates the changes in GDP, employment and labour income to the average number of landings that occur each year at YWG during the midnight to six a.m. period.

Table 4: Direct and Total Impacts Expressed In Terms of Landings

	GDP	Employment	Labour Income
Direct	$18,062/landing	19.4 landings/job	$1,396/landing
Total	$28,048/landing	11.6 landings/job	$2,111/landing

Each aircraft that lands during this period contributes $18,062 directly to the economy ($28,048 total), and $1,396 in wages ($2,111 total). In terms of jobs, for every 19.4 landings another Winnipegger is employed at the airport, while 11.6 landings create the equivalent of 1 full time job in the Manitoba economy.

4.0 Efforts to Protect YWG's 24 Hour Operating Status

Efforts to protect the operating status of the airport take two forms: noise management by the airport, and zoning by-laws of the municipality. These two efforts are complementary. Noise management attempts to minimize the incidence of noise, and to restrict activities that might result in noise complaints. The zoning by-laws are designed to limit development that is incompatible, thereby minimizing the potential for future complaints.

4.1 Noise Management

YWG has a very sophisticated and proactive noise management policy. Noise reduction is achieved by strict controls on engine run-ups, including day-time use of remote locations on the airfield and prohibitions on night-time activities. In calm wind conditions, runway preference is given such that most night-time aircraft arrivals and departures fly over non-residential areas. On take-off, aircraft are required to use climb profiles that attain higher altitudes more quickly. Finally, runway use is rotated where winds permit to more equitably split traffic over residential areas.

The airport measures and evaluates the effectiveness of its procedures with a radar tracking system. If a resident reports a noise complaint on the 24 hour "hot line" telephone, the airport can trace the flight path of the aircraft. Pilots who have failed to observe the airport's climb/route regulations have received significant fines.

Perhaps the most important aspect of the noise management policy has been the close contact with the local community. The airport has a community noise committee that meets frequently to discuss developments and address issues. When the airport management became aware of the pending increase in night-time noise, a well-publicized public meeting was held to announce the problem and to explain the situation. The sensitivity of the airport managers to the local community has been the key to the continuing night-time operations at YWG.

4.2 Land Use Regulations

The introduction of older Stage I aircraft is a setback to the efforts to protect the operations of the airport. Fortunately, it is a temporary setback in the sense that these aircraft must be phased out by the Year 2002. Nevertheless, it is a reminder that private interests are willing to sacrifice the public benefit to gain a short term profit. The local community has taken steps to guard against other developments that might intensify the threat to airport operations.

In 1990, the City of Winnipeg developed an ad hoc committee to advise on the protection of YWG. The committee recommended that serious consideration be given to strengthening the policies and programs to ensure only compatible land uses within the vicinity of the airport. This recommendation was endorsed by the Province of Manitoba

On March 25, 1992, City Council approved the preparation of a by-law to regulate land use near the airport. The intent of the legislation includes:

> "To ensure the airport continues to function as a 24 hour operation."
> "To protect the airport as an economic asset and catalyst"
> "To ensure development control measures are in place to limit or prohibit noise impacts on new development in the airport's vicinity" (City of Winnipeg, 1993: p.12)

The need for this legislation soon became apparent when a proposal was put forward to build a high rise apartment building (The Pines) on the flight path to the airport. The infamous "Pines" affair generated significant public debate and media coverage regarding the increase of noise complaints and the threat

to the airport operations. This proposal was eventually withdrawn, but not before alerting the community to the current level of economic activity and the potential to make YWG a cargo gateway for North America (NHDA, 1994). Public concern accelerated the development of new zoning requirements.

The protection of the airport is based on four new by-laws that creates a strict zoning environment with boundaries that approximate the 25 Noise Exposure Forecast (NEF) contours. Plan Winnipeg By-Law No. 6339/94 is an amendment that establishes an Airport Vicinity Protection Area. The Airport Vicinity Development Plan (AVDP) is a secondary formal land use plan (By-Law No. 6378/94) that promotes compatible economic development with the AVDP zone through land use management. Zoning By-Law No. 6418/94 formally identifies the type of land use associated with each property in the AVDP. Finally, a building code standard, Acoustic Insulation By-Law No. 6419/94 requires higher standards of construction in higher NEF contours. All by-laws were given third reading and passed by the City of Winnipeg Council on May 25, 1994.

5.0 Conclusions

The economic impact of night-time operations at YWG are significant for the City of Winnipeg and the Province of Manitoba. The airport has been identified as the key to significant economic development based on its potential as a cargo gateway to North America. For this opportunity to become a reality however, the 24 hour operating status of YWG must be maintained.

A study of the current night-time activities indicates a growing economic benefit. The operations of cargo and air couriers create 212 full-time equivalent jobs, $5.7 million in wages, and $74 million in provincial GDP.

When one courier operator changed its air lift supplier in the spring of 1994, all this activity came under threat. The new air lift operator, while living within the limits of the regulations, had chosen to strip the hush kits off its aircraft and impose a substantial increase of noise on Winnipeg residents. The comprehensive program of noise management developed by the management of YWG, and the protective zoning by-laws introduced by the City of Winnipeg, can do little to alleviate this problem. Fortunately, these aircraft must be phased out by the Year 2002. Whether the airport's neighbours will be patient enough to let time solve the noise problem, remains to be seen.

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Endnotes

1. For 1992, SC 51-005, pages 11, 32.

2. This is a temporary problem. Existing legislation requires that these aircraft be retrofitted with 'hush-kits' to bring them up to the standards of new aircraft noise levels by the year 2002. This is a phased process, and part of the current fleet must be upgraded to this standard in the interim.

3. McCoy (1989) estimated night time activity at YWG of $38.5 million and 130 employees in 1988.

AIRCRAFT, AIRPORTS, AND ATMOSPHERIC CHANGE

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Introduction

A forefront area of current environmental research is the investigation of changes to atmospheric chemistry. An important forcing mechanism of atmospheric change is the contribution of gases from human activities, of which the emissions from the combustion of fossil fuels in the transportation sector are a major contributor. Currently, emissions from aircraft account for less than 3% of the annual Canadian total for the production of CO_2, N_2O, NO_x, SO_x, CO, and HC's. While this is not significant in absolute terms, the distribution of aircraft emissions in the environment is, as these emissions are often emitted directly into those atmospheric regions that are particularly sensitive to these specific pollutants.

Emissions from aircraft can be considered in two divisions; first, those emissions that result from operations at airports, and second, in-flight, or mobile, emissions. The greatest of amount of work done to date has been in the quantification of emissions from aircraft at airports (Segal *et al.*, 1985; Wayson and Bowlby, 1988; Bowlby and Wayson, 1990; Woodmansey and Patterson, 1994; Moss and Segal, 1994). The compilation of emission factors for aircraft engines operating in-flight are expected to be released in late 1995 by the International Civil Aviation Organization, but very little has been published to date pertaining to the calculation of aircraft pollutants at altitude (Grieb and Simon, 1990; Patterson and Woodmansey, 1993).

The purpose of this paper is to present the current state of emission inventory methodologies for aircraft at airports, and to look at the general state of environmental impact assessment of changes to airport infrastructure or fleet mix. The focus of this paper is the production of emissions from aircraft at airports, although the general impact of aviation emissions on atmospheric chemistry is also discussed.

Environmental Effects of Emissions from Fossil Fuel Combustion

The principal emissions from fossil fuel combustion are carbon dioxide (CO_2), nitrous oxide (N_2O), carbon monoxide (CO), the oxides of

nitrogen (NO_X), non-combusted hydrocarbons (HC), sulphur oxides (SO_X), and particulate matter. A brief overview is presented here, and for greater detail the reader is referred to reviews in Patterson (1990), Patterson and Woodmansey (1993), and Bunce (1994).

Two radiatively active, or greenhouse, gases, CO_2 and N_2O, are produced through carbon combustion. The concentration of a third greenhouse gas, CH_4, is indirectly affected by the production of CO during combustion. The OH radical is the only known gas phase sink for CO, and it is also an important sink for CH_4 (Bunce, 1994). An increase in the amount of atmospheric CO (as a result of increased carbon combustion) depletes the amount of OH available for reaction with CH_4, thus potentially causing an increase in atmospheric CH_4 (Wofsy, 1976). Global warming as a result of the increased atmospheric concentration of these radiatively active gases has been predicted by many scientists. However, there is considerable debate in the scientific community as to the role of clouds in climate change scenarios, and opinion on future global warming is divided. What is not debated is the fact that atmospheric concentrations of these gases are increasing annually, principally as a result of anthropogenic activities.

Increased acidity of precipitation in industrialized areas and those regions upwind from industrial activities is due to emissions of SO_X and NO_X, which combine with water vapour to form acid. The detrimental effects of acid rain include forest damage and dieback, acidification of lakewaters, and degradation of buildings (Bunce, 1994). Acid aerosols also impact on human health. It has now been demonstrated that acid aerosols on peak pollution days are a significant factor for hospital respiratory admissions (Thurston *et al.*, 1994).

Emissions of CO, NO_X, SO_X, and HC, singly or in combination, have detrimental effects on urban air quality. Carbon monoxide combines irreversibly with hemoglobin, thus making it unavailable for transporting O_2 in the human body (Bunce, 1994). The oxides of nitrogen and HC combine in the presence of sunlight to form photochemical smog, of which ozone and PAN (peroxyacetryl nitrate) are important components (ibid.). PAN is toxic and an eye and respiratory irritant at very low levels. Ozone also causes eye and lung irritation, as well as reduced photosynthetic rates (ibid.). Statistically significant associations are now documented for respiratory admissions to acute care hospitals at the time of elevated ozone and sulphate concentrations (Burnett *et al.*, 1994).

Two impacts on atmospheric chemistry from fossil fuel combustion are unique to aircraft alone. At altitude, aircraft fly either high in the troposphere or in the stratosphere. Ozone formed from deposition of NO_X in the upper troposphere has a potential forcing effect on surface

temperature that is estimated to be approximately 30 times that of NO_X deposited at ground level (Johnson *et al.*, 1992). Jets in the stratosphere directly deposit NO_X, where it catalytically reacts with ozone in much the same way as the chlorine from CFC's (Johnston, 1971). The significance of this reaction to overall ozone chemistry is the target of ongoing investigation (e.g. "Impact of Emissions from aircraft and spacecraft upon the Atmosphere" conference in Cologne, Germany, 1994)

Activities at airports occur beneath the boundary mixing layer, and within a restricted areal dimension, so that the airport may be considered as a point source much as a smelter or fossil-fueled generating station. As airports are usually proximal to large urban centres, the emissions of NO_X, SO_X, CO, and HC's from aircraft are important to the air quality of cities. The deposition of NOx in the upper troposphere and stratosphere is important to atmospheric chemistry. The greenhouse gases CO_2 and N_2O are emitted during all aircraft activities, and mix well in the atmosphere. Other effects which are part of aviation but are not considered here are the impacts of fuel dumping prior to landings, and the runoff into local watersheds of de-icing fluids. Although noise is also considered by some to be a pollutant, it is not considered here.

Emission Inventories

An emission inventory is a catalogue of the quantities of pollutants emitted from a stationary or mobile source. Generally, emission inventories are performed on an annual basis. Emission inventories are important from two aspects: for full evaluation of anthropogenic contributions to global biogeochemical cycles (e.g. the carbon cycle) and for emission studies. For scientists to more completely understand the complexities of global biogeochemical cycles, it is necessary to have an accurate estimation of anthropogenic components in order to analyse the natural reactions between sinks and sources (Grubb, 1994). Secondly, accurate emissions inventories are required for a number of applied programmes and decision making processes. Accurate emissions inventories are required for the development of effective and economically efficient strategies for reduction of urban air pollution (Buhr *et al.*, 1992). Also, once total emissions from a point source are known, they can be applied to long range dispersion models (Lubkert and Zierock, 1989).

Emission inventories from aircraft can be considered in two divisions: emissions from aircraft operations at airports, and emissions from aircraft in flight. To date, two well defined methods, the EDMS (Emissions and Dispersion Modeling System; Segal *et al.*, 1985, and Moss and Segal, 1994) and the Regression Model (Woodmansey and Patterson, 1994) are available for inventorying annual aircraft emissions at airports.

In addition to compiling an emission inventory, the EDMS also permits modelling of the dispersion of pollutants in the vicinity of the airport. The EDMS is widely used in the United States, and it was used in the environmental impact assessment of proposed runway expansion for Vancouver and Toronto international airports. The Regression Model was developed in the course of the environmental assessment of Toronto's international airport, and later used in a study of the small Toronto Island Airport (Patterson, 1994).The inventory of emissions at altitude awaits publication of the ICAO in-flight emission database late in 1995.

The EDMS considers all sources of air pollution at an airport: aircraft, parking lots, on-site roadways, heating plants, training fires, and fuel tanks. Of these, aircraft produce the following proportions of emissions: CO 84.6%, NO_X 94.2%, SO_X 100%, NMHC 94.7%. and CO_2 99.6%. Thus, aircraft are the major producers of pollutants at airports, and therefore are considered solely in the emission inventory methodology, described below.

Emission Inventories at Airports: Methodology

The standard method for measurement of aircraft generated emissions at an airport is to consider only those emissions that occur below the atmospheric mixing height, or boundary layer, which is generally considered to be 3000 feet, or 912 m (EPA, 1985). Subsonic civil aircraft perform in four modes below the boundary layer at an airport: approach/landing, taxi/idle/queue, takeoff, and climbout, collectively known as a landing and takeoff operation (LTO). Ground travel includes taxiing to and from the terminal and waiting in queue for departure or for a gate upon arrival. The total emissions that an individual aircraft produces during an LTO may vary because of changing parameters, including: engine wear and maintenance, aircraft load, thrust management, and meteorological conditions.

Thrust settings on the engines vary in each mode of the LTO, and vary slightly between engines. The time spent in each mode is defined by the standard LTO cycle (EPA, 1992). These are all standard values, except for the taxi/idle/queue time. This can be quite variable depending upon the size of the airfield (length of taxi ways), and the amount of traffic at the airport. It is therefore essential to check the taxi-idle-queue times as part of any airport emission survey (Wayson and Bowlby, 1989).

Calculation of the total annual production of CO, HC, NO_X, SO_X

To obtain the total annual amount of gas (CO, HC, NO_X, SO_X) produced at an airport by aircraft, a series of calculations are done in the standard methodology (EPA, 1985). First, to attain the total amount of

each gas produced by an engine per LTO, the sum of the emissions in each mode is taken:

$$\text{Total emitted} = \sum \left[\text{time in mode (minutes)} \times \frac{\text{emission rate (kg/h) for that mode}}{} \times \frac{1\text{ h}}{60\text{ min}} \right]$$

where the amount of time in each mode is multiplied by the specific emission rate for that mode. For each individual gas, this calculation is done for each mode, and then summed. This yields the total emitted by an engine in one LTO. To attain the amount emitted per model of aircraft per LTO, the LTO emissions per engine are multiplied by the number of engines on the aircraft. Multiplying this value by the total number of annual LTO's performed by that aircraft model, and summing the values for all models of aircraft, yields a total annual emission value for each gas.

Calculation of the total annual production of CO_2 and N_2O

The amount of CO_2 and N_2O produced per LTO is directly related to fuel consumption. Conversion to a multiplier relating fuel weight to amount of CO_2 and N_2O produced was done by Woodmansey and Patterson (1994). These conversion factors are shown in Table 1.

Table 1. Emission coefficients for calculating the amount of CO_2 and N_2O produced by weight of fuel consumed per LTO. From Woodmansey and Patterson (Appendix 1, 1994).

	Emission Coefficients
Aviation turbo fuel	3.14 kg of CO_2/kg of fuel
	0.273×10^{-3} kg of N_2O/kg of fuel
Aviation gasoline	3.32 kg of CO_2/kg of fuel
	0.315×10^{-3} kg of N_2O/kg of fuel

The first step in calculating the CO_2 and N_2O produced is to determine the total fuel usage per aircraft in an LTO, where

$$\text{Fuel used} = \sum \text{(for all modes)} \left[\text{fuel rate} \frac{\text{kilograms}}{\text{hours}} \times \text{time in mode (minutes)} \times \frac{1\text{ h}}{60\text{ min}} \right]$$

The second step is to simply multiply the amount of fuel used per LTO by the fuel conversion factor to obtain the amount of CO_2 and N_2O produced per engine per LTO. Totals per LTO are then determined by multiplying the emissions per engine by the number of engines on the aircraft. Totals for each aircraft for the year in question are then summed.

Calculation of emissions for aircraft with unknown engine emission data

When engine emission indices are not available, the previously used technique involved the substitution of similar engines with known emission indices (Segal *et al.*, 1985; Wayson and Bowlby, 1988). However, emission characteristics can vary dramatically between even similar engines, and this can potentially affect the inventory total. A new methodology was therefore devised to overcome this weakness (Woodmansey and Patterson, 1994).

For aircraft for which engine emission data is available, the amount of fuel consumed is observed to be generally linearly related to the variations in aircraft weight. Similarly, the amount of fuel consumed per LTO is generally linearly related to the amount of emissions produced. Linear regression equations that relate the weight of the aircraft to quantity of emission produced per LTO are developed for the LTO cycle at the airport in question. These equations are in the form

$$y = mx + b$$

where y - gas emitted in kilograms (kg)
m - slope of the line
x - weight of the aircraft in tonnes
b - linear regression coefficient (intercept)

The decision point and t-tail test statistical tests are then run on the results of the regression modelling to test for significance.

For each aircraft, the value of emission per LTO is calculated using these equations for all six gases, and then multiplied by the total number of LTO's that the aircraft made in that year in question.

Total Annual Emission Inventory

The total annual emission inventory for aircraft is attained by the addition of emissions from aircraft with known engine characteristics, to the emissions calculated by the use of the linear regression equations for aircraft with unknown engine emission characteristics.

Comparison of fleet mix

A new area of research in environmental issues is the attempt to cost apportion pollutant and greenhouse gas contributions. At present, aircraft are evaluated solely on total aircraft emissions. Work presently underway by the author involves the comparison of aircraft on the basis of grams of pollutant per passenger per LTO. This will provide an alternative approach to environmental impact assessment that is at present not used. This data base of comparative aircraft emission values can then be used in future environmental impact assessments when airport expansion, or a change in the fleet mix allowed at an airport, is considered.

Passenger traffic at city centre airports is the fastest growing sector of commercial aviation. In Europe, the four city centre airports (London, Belfast, Berlin-Tempelhof, and Stockholm-Bromma) experienced an 80% increase in passenger traffic in 1991-92, and predicted a 50% increase for 1992-93 (Charnock, 1993). Accommodation of the demand can be met by airport expansion or a shift in fleet mix. The aircraft that typically are used at the city centre airports are turbo-props and small to medium -sized commuter jets aircraft.

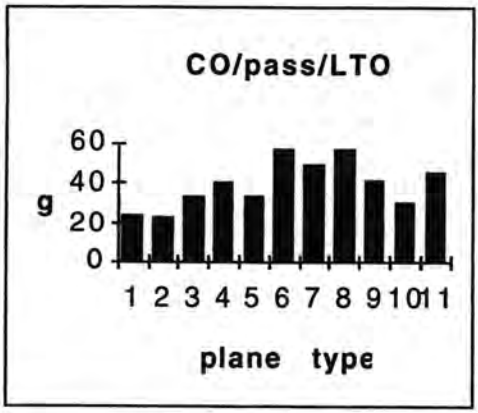
A preliminary comparison of emissions from some common commuter aircraft is presented in Figure 1. The LTO cycle for the jets is 15.35 minutes, involving 8.45 minutes of taxi-idle/queue, and 15.14 minutes for the turboprops, including 7.64 minutes taxi/idle/queue. This cycle is typical for a small city centre airport. The information on make of engine model and number of passengers are taken from Jane's All the World's Aircraft, of various years. Engine emission data is from EPA reports (1985, 1992) and from Pratt and Whitney (p. comm., 1994). The different planes can be configured for a range in the number of passengers, and thus the planes are compared for the ends inthe range of number of passengers.

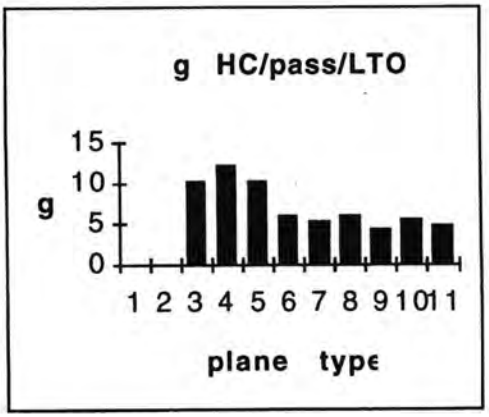
For each aircraft, the emissions for the LTO cycle were calculated, and then divided by the number of passengers, to determine the number of grams of pollutant per passenger per LTO. These are compared for each aircraft for CO_2, N_2O, NO_x, SO_x, CO, and HC's in the following graphs. For each graph, the vertical axis shows the number of grams of pollutant per passenger per LTO (g/pass/LTO), and along the x-axis the plane type, corresponding to the plane number (in the legend) is shown.

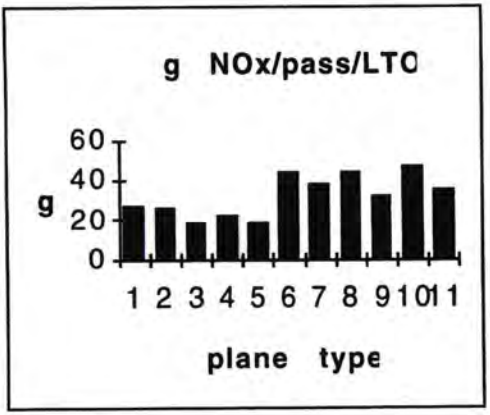
Figure 1. Preliminary Comparisons of Jet versus Turboprop Aircraft

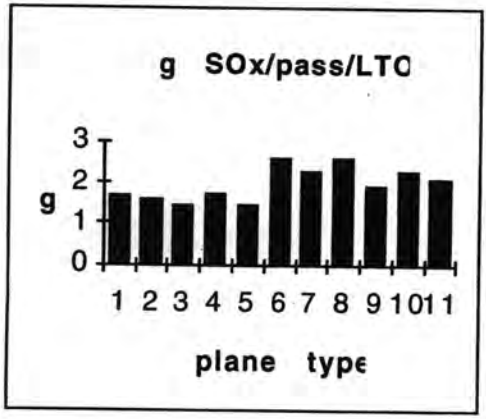
Legend to accompany the graphs

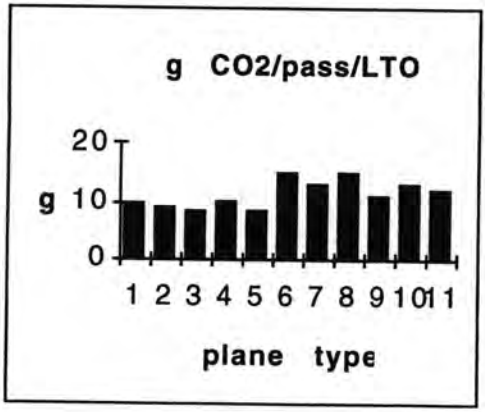
Plane number	Aircraft Model	type of engine	Number of passengers
1	DHC-8 Dash-8 Series 100	turboprop	37
2	DHC-8 Dash-8 Series 100	turboprop	39
3	DHC-7 Dash 7	turboprop	50
4	ATR-42	turboprop	42
5	ATR-42	turboprop	50
6	BAe 146 Series 100	jet	82
7	BAe 146 Series 100	jet	94
8	BAe 146 Series 200	jet	82
9	BAe 146 Series 200	jet	112
10	Fokker 100	jet	107
11	BAe 146 Series 300	jet	103

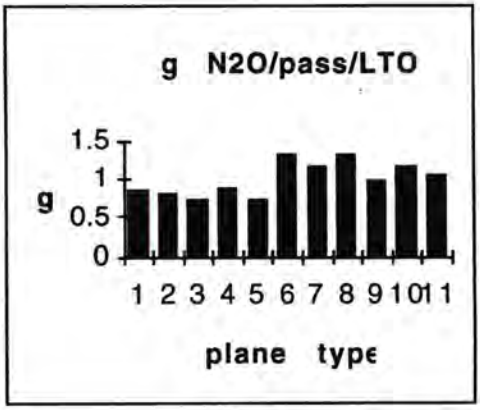



g HC/pass/LTO
15
10
5
0
g
1 2 3 4 5 6 7 8 9 10 11
plane type


g NOx/pass/LTO
60
40
20
0
g
1 2 3 4 5 6 7 8 9 10 11
plane type


g SOx/pass/LTO
3
2
g
1
0
1 2 3 4 5 6 7 8 9 10 11
plane type


g CO2/pass/LTO
20
g 10
0
1 2 3 4 5 6 7 8 9 10 11
plane type



Discussion

A preliminary look at the emissions in terms of gram of pollutant per passenger per LTO from some common commuter aircraft, both turboprop and jet, shows some trends. The amount of CO emitted is variable between the two types of aircraft, and no clear distinctions are visible. With HC, (data not available at this time for the Dash 8-100A engine), the turboprop engines on the other aircraft are clearly more polluting than the jet engines. For all other emissions it appears that the jets emit consistently more than the turboprop, on a gram of pollutant per passenger per LTO basis.

Infrastructure at Airports and Atmospheric Change

As demand for air services has grown in the latter half of the 20th Century, administrations on different continents have chosen various infrastructure changes at airports to accomodate the growth in passenger traffic. In North America, the demand at airports has been met through runway expansion or the construction of new airports. Recently, the preferred option for alleviation of congestion and flight delay at Canada's largest airport (Toronto) was construction of three more runways. While this would reduce the amount of CO and HC produced through shorter queue time (Transport Canada, 1991), there would be an increase in CO_2, N_2O, NO_X, SO_X, as all are directly related to the work done by the engines and fuel consumed, and therefore are not greatly affected by reductions in the taxi/idle/queue portion of the LTO.

In Europe, a different pattern of infrastructure changes at airports has developed. At the international airports in Paris, Lyon, Zurich, and Geneva, it is possible to make intermodal transfers to high-speed rail within the airport terminals. Other airports have direct access to intercity and regional rail. These include Amsterdam, Brussels, Frankfurt, Munich, Rome, Barcelona, Vienna, London-Gatwick, and London-Stanstead. In the United States, only Philadelphia and Chicago have direct rail access.

The ability to easily link long-haul air transport (e.g. trans-Atlantic) to short-haul rail travel has important environmental consequences. For example, in France, high-speed intercity rail is electrified. As the bulk of France's electricity is generated by nuclear energy, there are virtually no emissions of CO_2, N_2O, NO_x, SO_x, CO or HC associated with this intercity travel. The accommodation of short-haul traffic on electrified rail is an option that could be evaluated in future proposed infrastructure changes at North American airports.

Acknowledgments

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DOMESTIC AIR TRAVEL: A GROWTH OR MATURE INDUSTRY?

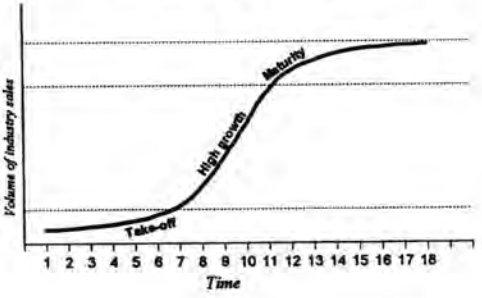
Pierre Zalatan, Senior Economist, Transport Canada*

It has recently been claimed[1] that the U.S. airline industry faces much lower and decreasing growth rates than in the past and possibly even stagnation. In other words, it has reached the maturity stage of its life cycle where growth rates diminish to the point where they become equal to or lower than general economic growth rates. When this happens, the industry ceases to be a leading industry and joins the group of laggard industries. Under what conditions does maturity take place and has the Canadian domestic air travel reached that stage of its life cycle? These are questions this paper attempts to answer.

The Product Life Cycle Concept

According to the "Product Life Cycle" theory and its given two basic conditions, namely homogeneity of the product and perfect competition, the development of that product progresses through three distinct phases. The first is a "take-off" phase (*Figure 1*) where production, fueled by a strong demand, reaches a critical mass that allows the product to enter the second phase of its development. That phase is characterized by mass consumption of the product by users. This is when production increases at very high rates.

Figure 1
The Stages of Growth



* The views expressed are those of the author and do not necessarily reflect those of Transport Canada.

The product then enters maturity - a phase characterized by lower growth rates and market saturation. Growth rates during that phase usually correspond more or less to those of overall economic growth which are, to a large extent, demographically driven. (Maturity may prevail for a while or be followed by declines where growth rates do not just slow down but turn negative. But this should not necessarily be the case. Under specific circumstances, maturity may be followed by a revival of the industry, a renewed "Take-Off" phase[2].)

In this paper, we suggest that the product life cycle concept may also be used to describe the evolution of an industry that produces a service, namely the domestic air transportation industry. However, it is unlikely that the air transportation industry will ever reach the stage where it ceases to grow or starts to decline. Here is why. The demand for domestic air travel is closely linked to total economic activity (itself related to demographic and productivity growth) and travel cost. As long as economic activity shows positive growth, (and travel cost does not reach prohibitive levels), domestic air travel will continue to grow. However the issue here is not growth per se but the *rate* of growth of domestic air travel. Is the recent slowdown in domestic air travel in Canada a sign of maturity or is it merely the result of the slowdown in general business conditions?

This paper examines the *response of domestic air travel demand to changes in its major determinants, namely population, incomes and travel cost* over two time periods: 1961-1979 and 1980-1993. In technical terms, we are interested in knowing if the elasticity of domestic air travel demand with respect to each one of these determinants is smaller over the 1980-93 period than it is over the period 1961-79. If that response in 1980-93 is dimming or if it has become statistically insignificant, means that the domestic air transportation industry is in its maturity phase of development.

But maturity does not happen at random. There are symptoms[3] the presence of which is a sign of a maturing industry. For the Canadian domestic airline industry to be categorized as a mature industry, some of these symptoms, but not necessarily all, must be present. But first, the facts.

Air Transportation Maturity: The Facts from 1961 to 1993

One of the better measures of activity in the domestic air services industry is its Gross Domestic Product (GDP) expressed in real terms. In fact, GDP is a standard evaluative measure of production applicable to any industry, thereby allowing intermodal and inter-industry comparisons. It consists of the industry's

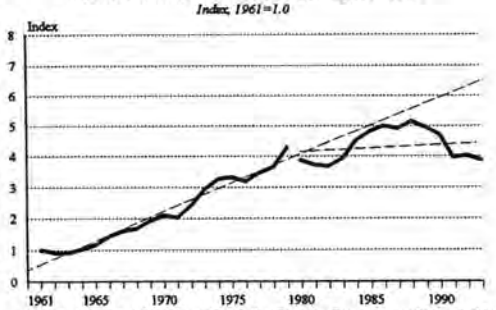
own contribution to total domestic economic activity, its main components being wages, profits and other investment income, rent and capital depreciation of the airline industry.

Figure 2 shows two stages in the evolution of the air transportation industry in terms of its GDP, indexed to 1961 as the base year. The first stage extends over the period 1961-79 while the second stage covers the period 1980-93. As can be seen from *Figure 2*, activity in domestic air transportation over the first period 1961-79 increased more than fourfold. This performance represents an average growth rate of 8.4 per cent a year.

Figure 2

Gross Domestic Product, Air Transportation

Index, 1961=1.0



Source: Transport Canada and Statistics Canada: Gross Domestic Product by Industry, Catalogue # 15-001

Figure 2 also shows that since 1980, air transportation switched to a much lower trend. Over the period 1980-1993 (1979 as base year), air GDP *dropped*, on average, 0.7 per cent per year; in fact, its level in 1993, is equivalent to that of the early eighties.

Since total economic activity has a major influence on air travel, some would argue, for air travel to grow less rapidly during the second period was to be expected, given the recession-induced slack in the economy. In fact, during the period 1980-93, major economic restructuring took place. It was a period of profound structural adjustments[4] (which continue to take place) and in which domestic (and to some extent international) air travel was not spared. However, what appears to be surprising, is the *changing trend* in air GDP.

Growth in air GDP dropped from 8.4 per cent in 1961-79 (*Table 1*) to a *negative* 0.7 per cent over 1980-93 (results in terms of enplaned/deplaned passengers based on a shorter time period show a similar pattern[5]) while economic activity decelerated from 5.2 in 1961-79 to 2.2 per cent in 1980-93. (When an intermediate time period is introduced, namely 1974-80, the deceleration appears to be more gradual.) As a consequence, air transportation in 1993, as a share of total GDP, dropped to its level of the early eighties.

Table 1
Gross Domestic Product
Total Economy and Air Transportation

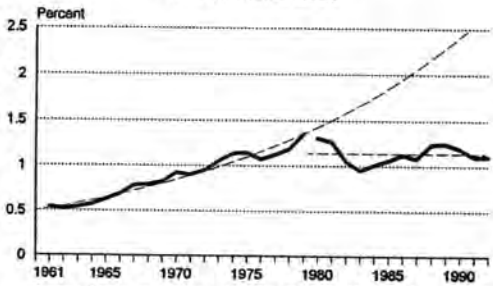
	1961-73	*1974-79*	1961-79	1980-93
	(average annual % change)			
GDP Economy	*5.9*	*3.5*	5.2	2.2
GDP Air Transport	*9.4*	*4.0*	8.4	-0.7

Source: Transport Canada and Statistics Canada: Gross Domestic Product by Industry, Catalogue # 15-001

Others would argue that for air transportation to show such weakness, factors other than low economic growth must have been present. Indeed, personal income, and profits (for some time) remained weak during that period, while fares and taxes were increasing at a rate higher than inflation. Indeed, such factors (some of them cyclical) - both affecting the demand and the supply side - failed to stimulate air transport activity. However, just like total economic activity, the change in those factors is not commensurate with the change (drop) in air GDP. The problem seems to be more fundamental. Domestic air travel has matured. And there are more facts.

Consumer expenditures on air travel as a share of their total expenditures have shrunk. Compared to the period 1961-1979 where the share increased almost continuously to reach 1.4 per cent of total consumer expenditures (*Figure 3*), that share dropped below 1 per cent in 1983 and averaged 1.1 per cent over the period 1980-1993. *Figure 3* also shows the trend for each period. While for 1961-79 the line seems to grow steadily, there is no such trend for the period 1980-93.

Figure 3
Consumer Expenditures on Air Travel as a % of Total Personal Expenditures
Based on constant dollars



Source: Transport Canada; Statistics Canada, National Income and Expenditure Accounts (detailed tables)

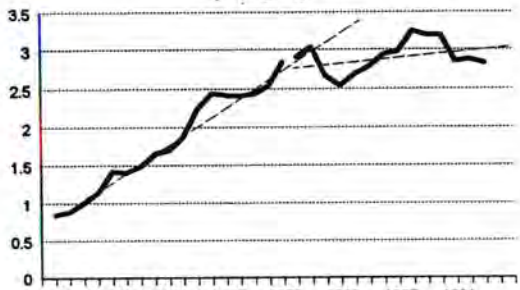
More evidence comes from *Figure 4* which shows the number of enplaned/deplaned passengers per capita (adults aged 20+). From a peak of over 3 in 1981, the average number of enplaned/deplaned passengers in 1993 dropped

to 2.8. Here again, the trend the data describes over the period 1961-79 is quite different from the weak trend charted by the data from 1980-93[6].

Figure 4

Enplaned/Deplaned Passengers per Capita (age 20+)

Top Thirty Airports



Source: Transport Canada publication # TP 9589; Statistics Canada, Intercensal Population Estimates, catalogue # 91-518

Underlying all these events is the maturity that is taking hold in the domestic air market. But maturity does not happen at random. There are symptoms of maturity. For the Canadian domestic air market to be categorized as a mature industry, some of these symptoms (but not all) must be present. In the following section, we examine each of these symptoms in the light of major developments in air travel. We will first discuss the symptoms, then present the statistical evidence.

Air Transportation Maturity: The Symptoms

First symptom:

Slower growing market and entry of too many competitors

Growth in air travel has moderated and the airline industry suffers from overcapacity. That overcapacity has two major origins: a depressed demand for air travel but also an excessive capital stock accumulation resulting mainly from the numerous buyouts (such as Wardair by Canadian). Overcapacity is measured by the *change* in the capital/output ratio. This ratio is defined as the number of units of capital stock required to produce one unit of output (both capital and output are expressed in constant dollars).

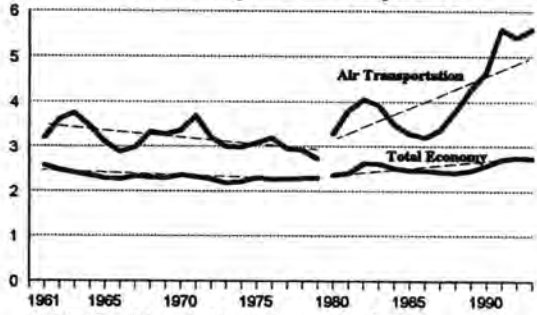
As shown in *Figure 5*, the capital/output ratio for air transportation is higher than in the average Canadian industry. That difference amounts to more than one third during the period 1961-79. This is not too surprising since air transportation is a capital intensive industry. To produce one unit of output

during the period 1961-79, the Canadian economy required, on average, 2.3 units of capital compared to 3.2 for the air transportation industry.

During the second period (1980-93), both the Canadian economy and air transportation required more capital to produce their respective unit of output; however, the acceleration was much higher for air than it was for the economy as a whole. For the air transportation industry the ratio escalated from 3.2 to 4.0 while that for the economy the change was from 2.3 to 2.5. These changes represent increases of 9 per cent for the economy and 26 per cent for air[7]. It is a fact that the capital/output ratio is increasing throughout most industries, including the airline industry; but it is growing faster in the airline industry. We believe that a large part of that rapid increase in the capital/output ratio which created overcapacity (an underutilization of the capital stock) is due to a maturing demand.

Figure 5

Capital Output Ratio*
Total Economy and Air Transportation



* Units of capital required to produce one unit of output
Source: Transport Canada and Informetrica

Second symptom:

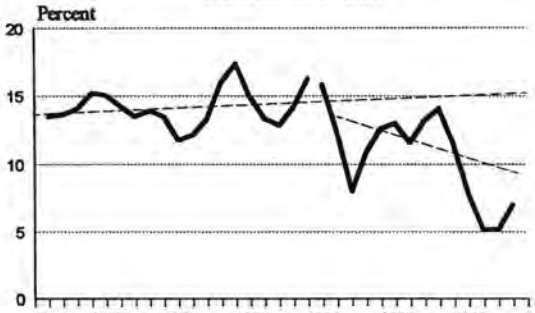
Displacement to a substitute takes place

Telecommunications (TC) is the most important single existing service that can cause displacement away from air travel. Annual surveys conducted by the Canadian Tourism Research Institute (CTRI) indicate that more and more business persons replaced business travel (mostly domestic) by TC. In 1994, some 28 per cent indicated that they took fewer trips because of TC. It was 25 per cent in 1992.

To cause a displacement of air travel, TC must fill the same travelers' needs and in a better way. In the case of business travel, customer need often includes physically meeting people.

This is when a face-to-face relationship (human contact) becomes irreplaceable. In addition, for many business persons, air travel is often considered to be a not so marginal benefit that tends to increase job satisfaction.

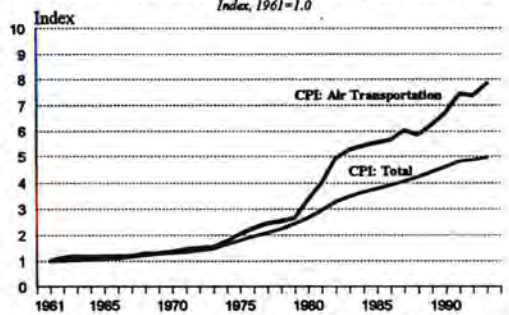
Figure 6
Profits as a Percent of National Income
Based on current dollars



Source: Statistics Canada, Transport Canada and Informetrica Ltd.

There appears to be two major reasons pushing businessmen towards more TC. First, on the demand side. There is the dismal state of corporate profits. Profits are an indicator of business vitality. During 1961-79, corporate profits averaged 14 per cent of National Income (*Figure 6*) and never went lower than 12 per cent (1970). From 1980 to 1993, corporate profits averaged less than 11 per cent and went as low as 5 per cent (1991). This has created a disincentive for business travel. Globalization of markets and the increased competition that is ensuing are the reasons to believe that profits may not get back to their 1961-79 level soon. Second, on the supply side, recent evidence has shown that over the last few years, business travel has become more sensitive to fare increases than it tended to be during the period 1961-79.

Figure 7
Total CPI and Air Transport Component of CPI
Index, 1961=1.0



Source: Transport Canada and Statistics Canada, The Consumer Price Index, Catalogue # 62-001

Therefore, businessmen now travel less when air travel cost increases. Primarily because of higher taxes, air travel cost (approximated by the "air transport" component of the Consumer Price Index - CPI), increased between 1979 and 1993 by an average of 9.6 per cent a year (*Figure 7*) compared to an all-items CPI increase of 5.6 per cent. Moreover, the

cost of the new TC technology relative to the cost of air travel is dropping. Consequently, some businessmen are replacing air transportation by TC.

In this regard, an occasional survey[8] done by the American Express Co. in 1994 indicated that close to two-thirds of responding companies have a "written travel policy" as compared to only 46 per cent in 1987. Moreover, it is suspected that many firms are not yet enforcing such policies but are expected to do so soon.

For non-business travel, displacement to TC is less likely to take place, if ever. In this case, TC is more likely to become a catalyst for air travel than a deterrent. The fact that distant friends or relatives are able to see each other via an advanced TC apparatus may actually stimulate their yearning for a closer encounter and induce more air travel.

Third symptom:

Technical changes enhance cost reduction and retard maturity

During the early years of aviation, significant and important technical advances were relatively numerous and easier to implement because gains in access to new markets made those changes inexpensive to achieve (jet engine in the early sixties, wide-bodied aircraft in the seventies) and their benefits to travelers immense. As the industry matured, the cost of the new technology increased relative to the benefits this new technology was bringing to travelers (such as the Concorde). Moreover, with higher real interest rates, capital intensification becomes more costly. This point is certainly validated by the higher capital/output ratio discussed earlier.

While there may be some evidence of technical maturity in the air travel industry, strategic administrative and operational changes such as the introduction of the hub and spokes concept, for example, tend to reduce the negative effects (increased costs) of that maturing technology.

Fourth symptom:

Customer sophistication is a precursor of market maturity

When air travel was a relatively new service, most travelers were unfamiliar with it and were accepting what the airline industry was offering. As they became more accustomed to and informed of the service, they began demanding quality

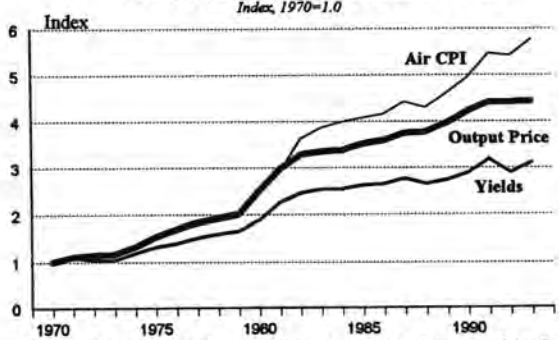
improvements (safer aircraft), more features and choices (at one point more in-flight services, no-frill at another), lower prices (two-thirds of passengers travel on discount fares) and improved service (more frequent and direct flights, fewer delays etc.). These improvements tend to reduce airline profitability and drive out marginal airline companies. In fact, regional non-affiliated airlines such as Eastern Provincial, NordAir, QuébecAir and Pacific Western, are no longer in the picture and the Canadian airline industry is dominated by two large carriers. One sign of a maturing industry is when travelers' requests become numerous and that implementation of these requests reduce airline profitability.

In the air travel industry, customers' requests appear to have been adequately answered, albeit at a certain cost to airlines. In fact, as shown in *Figure 8*, yields (cents/RPK) have been increasing at a rate lower than both air output prices (airlines' operating costs) and air CPI, (air travel cost, what consumers have to pay). Yields, (what carriers receive for transporting passengers) and travel cost, (what travelers pay), are not necessarily equal. Total travel costs are higher than total airline revenues mainly due to taxes and other charges travelers must pay. Among the more important tax increases that raised travel cost, mention should be made of the Air Transportation Tax and the Goods and Services Tax.

Figure 8

Air CPI, Air Output Price and Yields

Index, 1970=1.0



Source: Transport Canada and Statistics Canada, The Consumer Price Index, Catalogue # 62-001

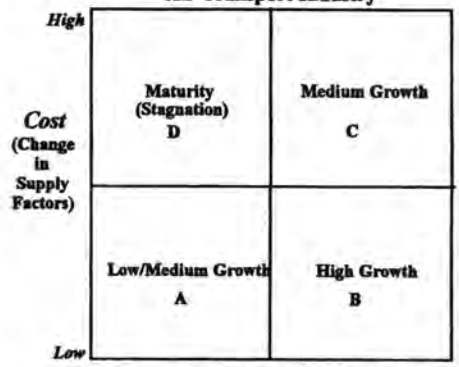
The Schematic Approach to Maturity

To sum it up, all symptoms discussed above may be grouped as affecting either the supply of or demand for air travel. The schematic view shown in *Figure 9* helps determine the potential growth path for the industry. Quadrant A is characterized by low or medium growth rates in air transport activity. This is the result of a low demand for air transport combined to a low cost structure. (This may be called the "Demand/Need Creation" stage of development).

Quadrant B is the high growth state. It combines an *effective* higher growth in the demand for air transport with a low cost structure in the industry. (This may be called the "Demand Satisfaction" stage of development). In Quadrant C, air transport activity grows moderately as a result of higher *potential* growth in the demand for air transport but restrained by a higher cost structure affecting the industry. In quadrant D, small *effective* increases in the demand for air transport are combined with a high cost structure to bring about lower growth in air activity and lead to the maturing of the industry. (This may be called the "Demand Saturation" stage of development). We suspect that this is where the domestic airline industry may now be.

Figure 9

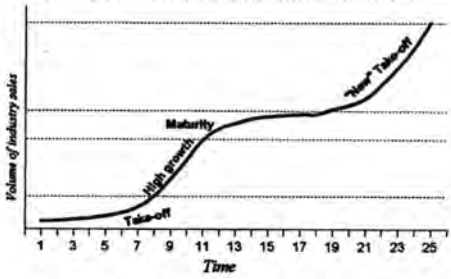
Possible Growth Paths for the Air Transport Industry



The phases described above, follow a counter-clock-wise movement, but, given the right catalysts, nothing precludes a start of another round in the opposite direction. This has happened in other industries. When it does, a "New" Take-Off phase begins (*Figure 10*). It is questionable whether, at this stage, the airline industry is ready and capable to embark on the "New" Take-Off phase. Meanwhile, maturity, a potentially harmful state in the stages of development, is real.

Figure 10

The Stages of Growth with "New" Take-Off



So much for the symptoms, now for the statistical evidence.

Air Transportation Maturity: The Statistical Evidence

Most domestic air passenger demand models[9] relate site-specific travel demand (in some physical form: enplaned/deplaned or origin/destination) to a demographic variable, a purchasing capacity (income or GDP) and fares. More variables may also be part of the relationship but air travel would be mostly dependent on those three variables. This paper applies this same relationship, however, it does it on a macro level and *all* variables are truly domestic and economic. The econometric model thus defined in its multiplicative form is:

$$Y = kD^{\alpha} I^{\beta} \left(\frac{P_A}{P_T}\right)^{\varphi} \qquad (1)$$

and as follows after a logarithmic transformation:

$$\ln Y = \ln k + \alpha \ln D + \beta \ln I + \varphi \ln\left(\frac{P_A}{P_T}\right) \qquad (2)$$

Where Y = air transport Gross Domestic Product (proxy for air travel), expressed in millions of 1986 dollars

k = a constant term

α = elasticity of demand for air travel with respect to total population

D = a demographic variable for total population in thousands

β = elasticity of demand for air travel with respect to personal real disposable income per capita (PRDI/Cap)

I = personal real disposable income per capita (in thousands of 1986 dollars)

φ = elasticity of demand for air travel with respect to relative air transport CPI prices (to all-items CPI), indexed to beginning of period

$\left(\frac{P_A}{P_T}\right)$ = air transport prices (P_A) relative to all-items CPI (P_T); indexed: 1961 = 1.0

Note: All data are annual

Our aim was to test the hypothesis confirming maturity in the domestic air travel during the period 1980-93. Accordingly, we proceeded to estimate the response (elasticity) of domestic air travel demand to changes in (with respect to) its major determinants, namely population, incomes and travel cost, over two time periods: 1961-1979 and 1980-1993 in order to determine if the elasticity of domestic air travel demand with respect to each of these determinants is smaller for the 1980-93 period than it is for the period 1961-79. If the elasticities for the period 1980-93 are dimming or if they have become (statistically) not different from zero, we would have supported the hypothesis that domestic air travel in Canada has reached the maturity phase of its development.

The first step consisted in deriving estimates for the constant term k and coefficients α, β and φ in equation (2) for Canada over the first period 1961-1979. Equation (2) yielded the following results with the t statistics below:

$$\ln Y = -30.6098 + 3.468339 \ln D + 1.065684 \ln I - 1.66456 \ln\left(\frac{P_A}{P_T}\right) \qquad (3)$$

(-4.29) (4.46) (3.88) (-5.65)

Other statistics include:

Period: 1961-79

Number of observations =	20
Adjusted R^2 =	0.99
F statistic =	589

Equation (3) has an excellent fit, all coefficients (elasticities) are significantly different from zero and are of the right sign. Results in this equation are interpreted as follows. Over the period 1961-1979 and all other things remaining equal: for every one percent increase in the Canadian population, air travel would have increased by 3.5 per cent; for every one percent increase in PRDI/Capita (1986 dollars), air travel would have increased by 1.1 per cent and for every one percent increase in the air CPI price index over the all-items CPI, air travel would have *dropped* by 1.7 per cent. The coefficients are large, but air travel was also increasing at close to double digit rates.

We then proceeded to estimate for the second period (1980-1993) the same coefficients and constant term of equation (2). The period covers only 14 observations and with three independent variables, the risk in obtaining unreliable estimates was high. Therefore, we decided to pool provincial data and use it as such. Equation (2) yielded the following results with the t statistics:

$$\ln Y = -4.6562 + 1.018689 \ln D + 0.727155 \ln I - 1.03647 \ln\left(\frac{P_A}{P_T}\right) \qquad (4)$$

(-5.7) (18.4) (2.0) (-1.6)

Other statistics include:

Period: 1980-1993

Number of observations =	130
Adjusted R^2 =	0.81
F statistic =	180

The fit of equation (4) is good, all coefficients (elasticities) are of the right sign, are statistically different from zero (at least 95 % of the time and between 90% and 95% of the time for the coefficient of relative prices) ***and they are all smaller than those obtained in equation (3) for the period 1961-1979.***

Since the elasticities in 1980-93 have all decreased, we therefore conclude that during the period 1980-93, domestic air travel in Canada was in its maturity phase of development, characterized by growth rates more or less equal to those of overall economic growth that are themselves, to a large extent, demographically driven[10].

Conclusion

Over the last three decades, the domestic air travel market has gone from boom to bust. The evidence above suggests that the slump affecting air travel was mostly caused by maturity. However, that maturity has taken place amidst profound structural change in the Canadian economy and this is why the toll on the airline industry appears to be even heavier than expected. Some may still consider the economic slowdown along with deregulation, increased hubbing, globalization and terrorism to be the primary factors affecting air traffic during the period 1980-93. The evidence points to maturity.

Since the above analysis suggests that the air transportation industry is in its maturity phase, what consequences does this have on the future growth of the industry? It simply means the following:

- high growth rates in domestic air travel are a thing of the past;
- air transportation has entered a new era where it may take more effort to increase traffic;
- increasing market shares will become increasingly important;
- international markets, where maturity is still absent, will take on increased importance;
- future profits will come from reducing costs and fine tuning yields;
- airlines will diversify their business and look for new alliances;
- cost recovery accompanying privatization and commercialization of many air transport services will put additional pressure on the cost structure of the airlines.

Some may put hopes on "Open-skies". They are partly right. But "Open-skies" would only give the air travel "product life cycle curve" a one-time boost, raising it to a new height, but then *growth* would soon return to its longer term trend.

The evidence therefore suggests that in the domestic airline industry, it will not be "business as usual" again. Unless things change. What is definitely needed is for the domestic air travel "product life cycle curve" to start a "New Take-Off" phase as was shown in *Figure 10*. How could this happen? A sudden change in consumers' taste for more travel (increased propensity to travel) or a technological change which would bring about such a large price drop that the estimated "maturing" elasticity of air travel with respect to relative travel cost is no more valid. The industry could also form new alliances or diversify its activities into areas unrelated to the travel industry. In fact, the answers are numerous but only a few real solutions may exist. All it takes is speculation.

Endnotes

[1] James, G.W. *U.S. Commercial Aviation: A Growth or Mature Industry?* In the Eighteenth Annual FAA Aviation Forecast Conference Proceedings; pages 182-202; FAA-APO 93-2, February 1993.

[2] This is certainly true in the case of the home electronic entertainment industry as well as the sports shoe industry.

[3] J. N. Nikolchev and al. *Managing the Renewal of Mature Industries: Beyond Smokestacks and Sunsets*; in SRI International, File No. 85-1002, July 1985

[4] Zalatan, Pierre *Economic Cycles, Structural Change and the Transportation Industry*, published in the 1993 Proceedings of the Canadian Transportation Research Forum; ISSN 1183-2770 (runner-up best paper).

[5] Enplaned/Deplaned passengers tends to show higher growth than air GDP because it includes international activity by foreign and Canadian carriers that has witnessed high growth rates and which are not covered under the GDP concept.

[6] See note 5 above.

[7] The capital-output ratio for the air transport industry is most likely underestimated given the fact that some capital used in that industry is leased from another service industry and hence is not shown as part of the air transport industry's capital stock.

[8] Arway, Pamela *Trimming Travel Budgets*, in Canadian Business Review, Autumn 1994

[9] Transport Canada *Transport Canada Aviation Forecasts 1994-2007*, Cat.# TP 7960E; pp. 65-68; Policy and Coordination, Transport Canada.

[10] Although the estimated equation has a good predictive ability, it was not our intention to use it to predict future growth of domestic air travel but only to compare elasticities. However, applying to equation (4) the assumed growth rates described in the document in *endnote 9* (with 1992 as a base year) for population (1.2%), PRDI/Cap (0.6%) and relative fare increases (1%) and accounting for the fact that growth in enplaned/deplaned passengers tends to increase faster than growth in air GDP (*endnote 5)*, we obtain an enplaned/deplaned average annual growth rate of 2.8 per cent per year, a number, that we believe, falls in the range of possible outcomes.

Aviation Punctuality Statistics--Are They Worth the Wait?

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C. John Ross, Chief, Air Statistics, Transport Canada

Introduction

The United States, the United Kingdom and Canada have all tried different approaches at measuring how successful the major scheduled commercial airlines have been at getting their flights to operate at the scheduled time. In the United Kingdom, these are called "Punctuality Statistics". The American angle is possibly more consumer oriented and the data are referred to as "Delay Statistics". The Canadian information was called "On-Time Performance" Statistics. All three terms will be used interchangeably in this paper.

It has been suggested that a carrier's ability to operate flights consistently very close to the times scheduled give it a competitive edge. This article will examine the differences in the methods used to measure punctuality. The problems inherent in the different approaches also will be examined in an attempt at suggesting some possible improvements for future application. This will include a discussion of the utility of the data, reasons for flight delays, how to define "on-time", flight versus passengers affected by delays, the issue of arrival delays as opposed to departure delays and a suggestion as to who, if anyone, should be performing such a statistical analysis.

United States DOT Flight Delays Statistics

The United States Department of Transportation [DOT] has a flight delays statistics series. The coverage is non-stop scheduled flights for domestic flights for the 10 largest air carriers.[1] Although they are required only to report the data for the 29 largest airports, all of the carriers have opted to report for their entire domestic system. The carriers file the data with the DOT.

The concept of being on-time is based on a period of less than 15 minutes from the time shown in the computerized reservation system. This is the time of departure or arrival of the aircraft from/at the gate and not the runway take-off or touchdown time. Cancelled and diverted flights are counted as late. In order to avoid penalizing carriers "for conscientious safety practices, a delay is not reported if it results from a mechanical problem that is required to be reported to the Federal Aviation Administration" [2].

The primary focus is on the timeliness of flight arrivals. Of the eight tables published in the "Air Travel Consumer Report", only two have information on the timeliness of departing flights.

British Civil Aviation Authority Punctuality Statistics

British Civil Aviation Authority [CAA] punctuality statistics cover both scheduled and charter flights for domestic and foreign air carriers at seven airports: Heathrow, Gatwick, Manchester, Glasgow, Birmingham, Luton and Stansted. The data are filed with the CAA by the airports.

The concept of timeliness is presented in six categories with "Early to 15 minutes late" being the category of an on-time flight". The actual times of operation are compared to planned times. Planned times may exclude changes made the week before the flight. Since the planned times are gate times but the actual times are runway times, taxi time adjustments are made.[3] They also publish the number of flights where there was no match between planned and actual activity. This could be due to:

- flights diverted from other airports;
- changes made after the "flights planned" information was provided to the airports;
- errors in the data;
- cancelled flights;

They exclude all-cargo services and air taxi services from their data.

Canadian On-Time Performance Report

In the late 1970's and early 1980's, the Aviation Statistics Centre of Statistics Canada produced an "On-Time Performance Report" which was used as an internal document by the Air Transport Committee, Canadian Transport Commission. On a monthly basis it ranked major scheduled service air carriers (both Canadian and foreign) by the percentage of

passengers on-time for flight arrivals by sector, by city-pair. The comparisons were made between the scheduled time and the actual time as reported by the carriers. A flight was considered on-time if it arrived within 15 minutes of the scheduled time. The data were considered as confidential and used only by the Air Transport Committee, Canadian Transport Commission. There was no public dissemination of the data. The data variable of actual time of arrival/departure is no longer a data element that must be reported to Statistics Canada. The actual time of the runway landing/take-off is available from the Aircraft Movements Statistics Survey. This could be adjusted by average figures for the differences between runway and gate times as a proxy for actual gate times.[4]

Table 1 summarizes the differences between the approaches followed in the three countries.

Table 1: Comparison of British, American and Canadian Punctuality Statistics Reports

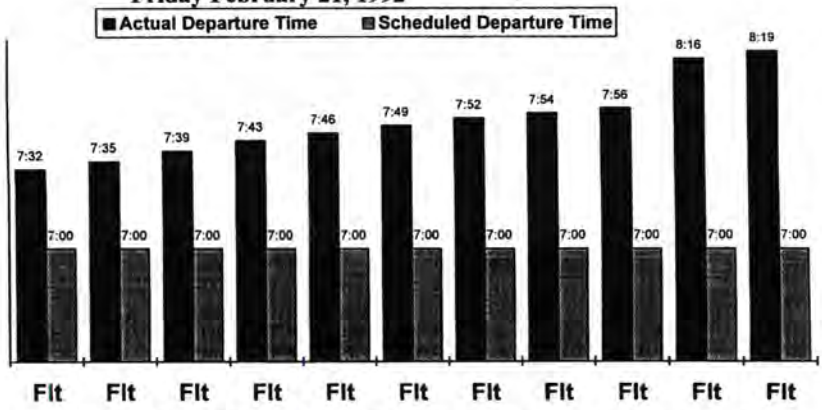
	CAA Punctuality Statistics	DOT Flight Delay Statistics	ASC On-Time Performance Report
Scheduled Flights	✓	✓	✓
Charter Flights	✓		
Domestic Flights	✓	✓	✓
International Flights	✓		✓
Publicly Available	✓	✓	
Arrivals	✓	✓	✓
Departures	✓	✓	
Passengers Affected			✓

Utility of the Data

For consumers, on-time performance can be a factor affecting the choice of air carrier or particular routing. Many "attitude surveys taken among business travellers have placed arrival punctuality as the most highly rated product component"[5]. Delay statistics "are useful to consumers insofar as they encourage carriers to publish realistic schedules..."[6].

Chart 1 shows that there were 11 flights on Friday February 21, 1992, at Toronto's Pearson airport that were all scheduled to depart at 7:00 a.m.. The chart also shows the actual flight departure times.

Chart 1: Scheduled Departures Toronto's Pearson Airport, 07:00, Friday February 21, 1992



Source: Official Airline Guide for scheduled times; Aircraft Movements Statistics Survey for actual times

The above situation may have been similar to those referred to in the U.S. DOT rule-making when they stated: "...many of the delays are predictable or recurrent. Based on historical operations, carriers know or should know that certain times of the day, days of the week, and seasons of the year are more congested than others.".[7]

For air carriers, on-time performance can be used as an advertising tool to attract customers. Making the information available to travel agents and consumers may result in a better construction of a trip routing. A good travel agent may make note of the on-time performance indicator on a Computerized Reservation System and suggest a flight connection other than the one first provided by the automated system. This could have the effect of reducing passenger discontent if passengers are placed onto flights with a better on-time performance.

Both of Canada's major scheduled service carriers consider the issue important enough that they both make reference to on-time performance in their 1993 annual reports. Canadian Airlines International Ltd. noted the importance of on-time performance to frequent flyers and stated that

"Canadian Airlines is the on-time performance leader in Canada"[8]. Air Canada claimed that "Air Canada's on-time arrival rate of 92 per cent led all North American airlines"[9]. In the absence of a common standard for on-time measurement in Canada, both statements may be correct.

On-time performance may also be used as a measure of a carrier's success at planning and operational performance. For example, USAir and Piedmont merged in August 1989 but did not merge their flight schedules until February 1990; for the period September through December 1990 "USAIR had the worst on-time performance of any MAJOR domestic airline".[10]

For government, in a regulatory environment, punctuality data can be a factor in the assessment of a carrier's quality of service. In a deregulated environment, the availability of on-time performance statistics "should help bring marketplace pressures and incentives to bear on the problem by improving the availability and accuracy of consumer regulation."[11]

Reasons for Delays

While it may be relatively easy to reach agreement on the concept of what is a delayed flight, it is much more difficult to reach agreement on why a flight has been delayed. It may be tempting to add the purpose of a delay to any statistical analysis, but this is difficult. Amongst some of the possible causes of delay are:

- unrealistic scheduled times;
- congestion at an airport [this would include both aircraft on the runways and passengers in the terminal];
- weather (lightning, fog, wind shear, snow clearance of runways, de-icing of aircraft);
- air traffic control problems;
- mechanical problems with the aircraft;
- waiting for connecting passengers/baggage.

It is interesting to note that none of the three punctuality statistics systems studied for this paper include cause of delay as an element.

While some of the above elements that cause delay are difficult to forecast or plan for, factors such as congestion and waiting for connecting passengers/baggage should be measurable by past experience. With the purpose of giving more accurate information to consumers, "airline schedules anticipate a certain amount of delay".[12] This can be seen in Chart 2 which shows the flight duration according to the schedule for CAIL for Montreal-Toronto service in the summer 1994. The flights are scheduled to take longer during the more congested morning and evening peaks.

Chart 2:



Source: Canadian Airlines International Ltd., The Guide to Civilized Travel, May 1, 1994

The Appropriateness of the 15 Minute Measure for On-Time

All three countries have reached agreement on the importance of the 15 minute threshold as a measure of being on-time. Is being 20 minutes late on a 55 minute flight from Toronto to Ottawa the same as being 20 minutes late on a 9 1/2 hour flight from Vancouver to Tokyo? Does it make sense to use the same measure or should it be on a percentage or proportional basis? This would be the case in most other disciplines. Would you consider the inaccuracy of a budget estimate being off by $100,000 the same for a $200,000 project and a $10,000,000 project? From this point of view it does not appear to make sense to use the same 15 minute yardstick for all flights but if the ramifications of the inaccuracy are the same then it might make sense. If we assume that a carrier would generally be unprepared to delay a flight for connecting passengers by more than 15 minutes, then the common measure makes sense. Whether I am connecting after a 55 minute commuter flight or a 9 1/2 hour flight, if being 20 minutes late means that I have missed my connecting flight then the outcome is the same.

While the DOT Delay Statistics and the Canadian On-Time Performance Statistics would not differentiate between a flight that is 16 minutes late and a flight that is one hour late, the British CAA Punctuality Statistics do give a range. Their data ranges show the percenatge of flights arriving early to 15 minutes late, 16 to 30 minutes late, 31 to 60 minutes late, 1 hour 1 minute to 3 hours late, 3 hours 1 minute to 6 hours late and more than 6

hours late. In addition, the average delay in muinutes is published for each carrier, city-pair combination.

Air Canada appears to have referred to this "schedule plus 15 minute" definition for on-time to market their service. Their 1993 Annual Report states: that Air Canada has introduced a "demanding Live at Zero standard, which recognizes that the customer considers 'on time' to be what is written in the timetable. Other airlines give themselves a grace period in rating on-time performance. Not Air Canada."[13]

Flight Performance Versus Passengers Affected

Ideally an on-time performance measure would measure separately the number of connecting and non-connecting passengers who arrived on-time or late. This would be the ideal measure but very difficult to collect without tremendous response burden as it would require the information for every flight coupon lifted for a particular flight. This is complicated in that the coupons are lifted at the departure airport but the concept of arriving on-time would be recorded at the arriving airport.

Given the difficulty, it may at least be better to give some indication of the number of passengers on delayed flights.

Does a focus only on the flights mask other important factors? Is it worse to have delays at peak time with a full load than with a low load factor midnight flight? For the individual passenger, there may be no difference or perhaps the situation is worse if the midnight flight passenger misses the last connecting flight out of the airport. For the transportation system, for the air carrier and for the airport, however, a delay of 200 passengers is worse than a delay of 26.

While neither the United States DOT Flight Delay Statistics nor the British CAA Punctuality Statistics have any passenger measures, the On-Time Performance data produced by Statistics Canada did give counts for both the number of deplaned passengers on-time and the percentage of passengers on-time.

Arrival Delays versus Departure Delays

With the three systems studied, all cover arriving flight delays. There is less attention paid to the timeliness of the flight departures. Only the British CAA Punctuality Statistics give equal weight to the flight arrivals and departures [the data are combined so that one cannot compare the performance of arrivals to departures]. For an airport authority the importance of arrivals and departures may be the same. For consumers, however, the time of arrival is key. If my flight departs ten minutes late but the time is made up during the flight so that the landing is on-time, I am less likely to be concerned. A severe departure delay is probably of concern mostly because delays can snowball throughout a system as down line flights are affected. This is because flights may be held to allow connecting passengers on the delayed flight to make their connections. As well a flight that arrives late is more likely to depart late to the next station.

Purpose of Travel

What about the type of flight [scheduled or charter] as a proxy for the purpose of travel? Is on-time performance more important on a scheduled business route where the travellers are being paid, where being late means less time to conduct business at the destination or missed connections, than on a direct charter flight to a leisure destination? The British CAA Punctuality data is the only one of the three studied to show the performance of both scheduled and charter flights. While the charter market is an important one in Canada, the necessary data to produce on-time performance data are not presently being collected by the Aviation Statistics Centre, Statistics Canada. There can be a great variety in on-time performance but the variability may be more severe amongst airports and carriers than between scheduled and charter flights. Table 2 shows the on-time performance for Canada-United Kingdom flights, both charters and scheduled flights, during August 1994. Surprisingly, the charter versus scheduled flights differences appear to be less important than the differences between carriers and city-pairs.

Table 2: On-Time Performance, Charters vs. Scheduled Flights Canada-United Kingdom, August 1994

UK Airport	Canadian Origin/ Destination	Carrier	Scheduled/ Charter	No. of Flights	% Flights On-Time	% Flights Late
Heathrow	Calgary	Air Canada	S	28	46	54
	Halifax	Air Canada	S	56	75	25
	Ottawa	Air Canada	S	81	59	41
	Toronto	Air Canada	S	118	50	50
		Air India	S	26	42	58
		British Airways	S	78	72	28
		CAIL	S	62	94	6
	Victoria	Air Canada	S	1	100	0
	Winnipeg	Air Canada	S	18	72	28
Manchester	Toronto	Air Canada	S	42	81	19
		CAIL	S	26	85	15
		Air Transat	C	44	73	27
		British Airways	C	2	100	0
		Canada 3000	C	16	94	6
	Vancouver	Air Club Int'l	C	8	88	12
		Canada 3000	C	8	88	12
Gatwick	Toronto	Air Transat	C	72	75	25
		Canada 3000	C	18	72	28
		Royal Airlines	C	22	55	45
	Vancouver	CAIL	S	62	81	19
		Air Club Int'l	C	8	25	75
		Caledonian	C	16	19	81
Glasgow	Halifax	Air Canada	S	10	80	20
	Toronto	Air Canada	S	62	87	13
		Air Transat	C	47	77	23
		Canada 3000	C	8	100	0
		Royal Airlines	C	10	50	50
	Vancouver	Air Canada	S	8	88	12
		Air Club Int'l	C	8	100	0
		Canada 3000	C	8	88	12

Source: CAA Punctuality Statistics, Full Analysis, August 1994

City-Pair, Airport or System On-Time Performance?

Should on-time performance indicators be created on a city-pair, airport or system-wide basis? System-wide statistics for a carrier can be misleading due to different conditions in different parts of the country. A carrier with service predominately in congested major cities might have a worse over-all delay rating that a carrier with most of its flights in smaller regional centres. The same may also be true for a carrier operating in an area with poor weather conditions.

To be the most useful, the data should be released on a city-pair basis, by carrier. The second best option would be carrier specific data summarized for individual airports. In Canada, the level of detail required may make the dissemination of data at this level difficult without the permission of the carriers involved.

Who Should Assemble On-Time Performance Data?

The on-time performance systems studied in this paper included two systems run by Federal government agencies and one performed by a government created aviation authority. Is this a role that should be performed by government? There are advantages of a centralized approach. It may be difficult to compare the service level if different carriers at the same airport used different methods to measure punctuality. A common standard of reporting helps to reduce this problem. The aspect of common standards and comparability is the major reason for government presence in this area. It can facilitate "uniform and mandatory disclosure of information by all carriers".[14]
Another reason is the cost effectiveness of government influencing the market in such a manner. Osborne and Gaebler cite the US DOT effort as follows:

> "If consumers are able to choose between competitive providers, government can force fundamental changes simply by publishing information about the quality of each provider. When the federal government began publishing the on-time records of airlines, it had a dramatic impact--far greater than any regulatory command could have achieved."[15]

While the existence of the data was an important move, the information is only of value if available to the public. In their rule-making, the U.S. Department of Transportation stated that "we would hope that carriers do use the information in advertisements".[16] To widen the access to the information they also required carriers to provide monthly on-time performance data, by flight, to the computerized reservation system operators.

Data Frequency

With what frequency should on-time performance data be produced? All three models examined in this paper produced monthly statistics. This would seem advisable given the variability in flight performance. As with all data, the value of the information would be greatly enhanced by the timely release of these data as soon as possible after the reference period. A monthly data series would also seem better to releect seasonality due to weather or varying market conditions.

When the Official Airline Guide scheduled flight information was matched with the Aircraft Movements Statistics Survey data for Air Canada Flight 865 from London, England to Mirabel for four weeks of 1992 [one week from each season], there was great variability. This is shown in Table 3. The Aircraft Movements Statsitics Survey records times of touchdown/take-off from the runways rather than the gate. For this reason, a second column showing adjusted "gate" times is also shown.

Of the 25 flight arrivals over the four weeks, seven arrived at the gate after the scheduled time and three met the definition of late [more than 15 minutes after the scheduled arrival time]. There was a difference of almost two hours between the earliest and the latest arrival of this scheduled 7.5 hour flight. The great variability is another reason that frequent release of the data is advisable.

Table 3: Air Canada Flight 865, London, England to Mirabel, Comparison of Scheduled Time of Arrival to Aircraft Movements Statistics Survey Time of Arrival for Four Sample Weeks, 1992

Week	Time Early/Late in minutes [Based on Difference Between Scheduled Arrival and Runway Arrival Times] +=early, -=late	Time Early/Late in minutes [Based on Difference Between Scheduled Arrival and Gate Arrival Times] +=early, -=late
Feb. 17-23	20	14
	4	-2
	13	7
	31	25
	28	22
	42	36
May 18-24	9	3
	7	1
	3	-3
	-10	-16
	8	2
	17	11
	5	-1
Aug 17-23	6	0
	28	22
	25	19
	-23	-29
	-16	-22
	-3	-9
	9	3
Nov 16-22	20	14
	27	21
	31	25
	52	46
	79	73

Source: Official Airline Guide for scheduled times; Aircraft Movements Statistics Survey for the runway times

Conclusion

On-time performance is an issue that is important to airline passengers, air carriers, airport authorities and the government. To be most useful, the data produced should be monthly, at the city-pair (or possibly the airport) level, carrier specific and produced using a common set of definitions to enable comparison. An indication of the number of passengers affected would be advisable. They should be made available in that form to interested parties as their value is in their use. This is a data gap in Canada which should be examined in any rationalization of the transportation data programme.

Note

The views and opinions expressed in this paper are those of the authors and do not necessarily reflect those of Statistics Canada or Transport Canada.

References and Notes

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4 The amount of time difference between an aircraft touching down and arriving at the gate can be made up of taxiing time, delays incurred at the intersections, runway crossing delays and the distance to the gate. For example, at Toronto's Pearson airport the average time to taxi-in was 9.99 minutes and 9.71 minutes to taxi-out in 1994 according to internal Transport Canada figures.

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The Effects of Airline Codesharing Agreements on International Air Fares

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I. Introduction

The world airline industry is undergoing a major structural transformation in response to the increasing trade liberalization and air transport liberalization and deregulation. During the last few years, major airlines have been busy creating and strengthening their global service networks in order to attract more traffic in the increasingly competitive international markets. Although international air services have been substantially liberalized during the last decade or so, it is impossible for a carrier to set up an efficient traffic collection/distribution system in a foreign territory or continent. Therefore, most major carriers are developing their global service networks primarily via alliances with other airlines whose networks are concentrated in other continents. Wherever allowed,[1] ***codesharing*** arrangements between the two carriers are used to enhance services and to create marketing advantage of on-line connecting services.

Codesharing is a marketing arrangement between two airlines whereby one airline's designator code is shown on flights operated by its partner airline. Two-letter designation codes are provided by the International Civil Aviation Organization (ICAO) to identify the airlines on passenger tickets, computer reservation systems (CRS), airline guides and airport information boards. Under a codesharing agreement the connecting flights being operated by two separate airlines may be listed as being a "single carrier" service, which gives substantial marketing advantages.

At first, codesharing has become an essential tool for linking airline networks between trunk and regional feeder carriers in the same continent.[2] Codesharing has also played an important role in the competitive strategies of international airlines. In 1986, British Island Airways and Air Florida established the first international codesharing arrangement. By late 1989, at least fifty-four international routes were operated on a shared code basis (Hadrovic, 1990). Now it has become an essential tool for linking airline networks inter-

continentally between alliance partners.[3] For example, British Airways-U.S Air, KLM-Northwest and United-Lufthansa have succeeded in linking various European cities with those in the U.S. via code-shared flights being operated through their respective hubs in the two continents.

There are several important economic reasons for a codesharing operation involving international routes. First, the two carriers together can offer a higher frequency service to customers, and thus, are able to expand their combined market share on the international routes. Second, this link-up would allow them to feed traffic between domestic and international routes, and thus, increase market shares in their respective domestic markets. These two effects are magnified by extending the codesharing operations to/from spoke cities at both ends of the two carriers' networks. Most passengers regard a code-shared connecting flight as on-line connection, and thus prefer it to an inter-line connection flight. This is because a passenger originating from (and/or destined to) a spoke city feels that a single carrier will take care of his/her entire journey.[4] Third, code-shared connecting flights get listed ahead of the inter-line connecting flights in CRS and most other flight information sources.

Although codesharing improves quality of service by providing convenient connection and increased frequency on international routes, it may reduce the number of competitors and thus increase market share of the combined carriers. Some people argue that codesharing will increase air fares because it promotes collusive behaviour between the two codesharing partners as well as by increasing the combined market share of the two firms. Others argue that codesharing between two non-leader carriers will increase competition by strengthening the weaker competitors. Another group of people think that codesharing will reduce prices by creating "artificial competition" between the two codesharing partners because codesharing agreements normally require for one airline to sell a block of seats on its partner's flights. Since each firm joining in the codesharing arrangement is now responsible for selling a block of seats in the other's flights, the firm may dump the unsold seats at very low prices in the last few days before the flight departure. Therefore, it appears to be an empirical question whether codesharing increases or reduces air fares.

Many articles concerning the effects of carrier alliances and, to a lesser extent, on codesharing have appeared in popular press (newspapers, airline industry magazines, etc.). However, we know of no studies that have systematically investigated the effects of airline codesharing on firm conduct and air fares. The main purpose of this paper is to fill the void in the literature by investigating the effects of codesharing on firm conduct and air fares in the context of oligopoly. The paper focuses on modelling the oligopolistic interaction between airlines on a route in order to measure the impacts of codesharing agreements between non-

market leaders on the market leader's price and passenger volume. An analytical model of codesharing is developed and then applied to a panel data of fifty-seven transpacific international air routes for the 1982-92 period.

More specifically, we investigate the following three questions. First, is there any "competitive" or "collusive" effect of codesharing between non-market leaders on the market leader's pricing conduct? Second, will the leader gain or lose traffic as a result of codesharing between non-leaders? It may first appear unreasonable for the leader's demand to increase when non-leaders make a codesharing arrangement. However, this is likely to happen because of the following reasons. First, a codesharing between two non-leaders who have route authority to introduce non-stop services of their own means that there may be one less competitor in the market. Secondly, since codesharing normally involves connecting flights to serve on an origin-destination pair, it is less attractive than establishing non-stop services (noting that the leader normally serves the market non-stop). Finally, if codesharing improves the partners' service, this service improvement may increase their prices which in turn would increase demand for the market leader. Because of this secondary relative-price effect, the traffic-enhancing effect of codesharing can be consistent with the hypothesis that codesharing improves service vis-a-vis market leader's service.

If both competition effect and traffic-enhancing effect exist, then clearly the market leader would supply more output. It is less clear, however, whether the leader's price would fall or not. The traffic-enhancing effect would be expected to increase the leader's price, while the competitive effect would reduce its price. This conflict between the two effects gives rise to our third question: will the equilibrium price of the market leader increase or decrease following codesharing between non-leaders? In investigating these three questions, we classify the codesharing cases existing in our data set into two types: codesharing between two major international carriers[5] (hereafter referred to as 'major' codesharing), and codesharing between a major carrier and its feeder carrier, usually the former's subsidiary[6] (hereafter referred to as 'feeder' codesharing). Each codesharing type accounts for roughly one half of the total codeshared routes in our data set.

Our empirical results show that 'major' codesharing makes the market leader behave more competitively while increasing its demand (traffic-enhancing effect). Both the competitive and traffic-enhancing effects are statistically significant and, as expected, the leader's equilibrium output rises as a consequence of the two effects. Furthermore, the combined force of these two conflicting effects result in a reduced equilibrium price for the market leader. On the other hand, 'feeder' codesharing has statistically insignificant effect on the leader's demand while making the leader behave more collusively. As a result, the leader's equilibrium

price rises and output falls when a 'feeder' codesharing occurs on a city-pair route.

In the next section, the theoretical model is developed on the basis of profit maximizing assumption of all firms in a market, and *a priori* expectations are derived using the model. Section 3 describes the data used in this study, performs empirical analysis, and presents the results. Finally, a brief summary and conclusion are provided in section 4.

II. The Model

The Theoretical Structure

Consider a city-pair route. Suppose that there are n airlines on the route which can be regarded as a market. Let firm 1 be the airline which has the largest share of the total passengers travelling on the route. This firm will be referred to as a "market leader", while the rest (n-1) firms will be referred to as "non-leaders". Let N be the set of non-leaders.

Assuming that passenger volume demanded for each airline is a function of its own price, its competitors' prices and other exogenous variables that affect the demand, then the demand function for firm 1 may be written as:

$$Q=Q(P,P^*,\Gamma;\alpha) \tag{1}$$

where Q is passenger volume for the market leader, P is its price, P^* is an (n-1) price vector for the non-leaders, Γ denotes the exogenous variables that affect the market leader's demand, and α is a parameter vector for equation (1). For the non-leaders, their demand functions may be expressed, using vector notations, as follows:

$$Q^*=Q^*(P,P^*,\Gamma^*;\alpha^*) \tag{2}$$

where Q^* is an (n-1) passenger-volume column vector for the non-leaders in the market, Γ^* are all exogenous variables that affect the non-leaders' demands, and α^* denotes parameters for equation (2).

Equations (1) and (2) are n structural demand functions and may be used to solve for the n prices (P and P^*) as functions of outputs (i.e., inverse demand curves). Writing the inverse demand function for firm 1 as $P=P(Q, Q^*, \Gamma; \alpha)$, its profit function can be written as:
where $C(Q,\bullet)$ denotes firm 1's total cost. The first-order condition for maximization of Π with respect to Q conditional on Q^* is:

$$\Pi = Q \cdot P(Q, Q^*, \Gamma; \alpha) - C(Q, \bullet)$$

$$P + Q\left(\frac{\partial P}{\partial Q} + \sum_{i \in N} \frac{\partial P}{\partial Q_i^*} \frac{\partial Q_i^*}{\partial Q}\right) - \frac{\partial C}{\partial Q} = 0 \qquad (3)$$

Similarly, the first-order conditions for the other (n-1) firms may be written, using vector notations, as:

$$P^* + Q^*\left(\left(\frac{\partial P^*}{\partial Q^*}\right)^T + \left(\frac{\partial P^*}{\partial Q}\right)^T \frac{\partial Q}{\partial Q^*}\right) - \frac{\partial C^*}{\partial Q^*} = 0 \qquad (4)$$

where $(\bullet)^T$ denotes a transposed vector.

If output is the choice variable, then at the Nash equilibrium $\partial Q_i^*/\partial Q$ in equation (3) and $\partial Q/\partial Q^*$ in equation (4) all equal to zero and, hence, the bracketted terms in equations (3) and (4) will become $\partial P/\partial Q$ and $(\partial P^*/\partial Q^*)^T$, respectively, both of which are negative because of downward-sloping demand curves. But the choice variable may not be output. If firms in this market choose prices, it is well known that $\partial Q_i^*/\partial Q$ and $\partial Q/\partial Q^*$ are not equal to zero (in fact, negative). Also, if firms manage to collude tacitly and to maximize their joint profits, the resulting "cartel" solutions will imply non-zero $\partial Q_i^*/\partial Q$ and $\partial Q/\partial Q^*$. Another possibility is that firm 1 is a Stackelberg leader firm which chooses output and the remaining firms are Stackelberg followers. Then $\partial Q_i^*/\partial Q = 0$ whereas $\partial Q/\partial Q_i^*$ is the slope of firm i's "reaction function", which is obtained by solving equations (2) and (4) (with $\partial Q_i^*/\partial Q = 0$) for Q_i^* as a function of Q.

Thus, outside the perfectly competitive model, firms do not have supply curves. Instead, quantity- or price-setting conduct or other oligopoly behavioral modes follow more general supply relations:

$$P - t \cdot Q = MC(Q, W; \beta) \qquad (5)$$

$$P^* - t^* \cdot Q^* = MC^*(Q^*, W^*; \beta^*) \qquad (6)$$

Compared with (3) and (4), equations (5) and (6) are more general; the variables t and t^* are simply defined as (P-MC)/Q and (P^*-MC^*)/Q^*, i.e., the ratios of price-cost markup to quantity, respectively. The two equations can be intepreted as the equality between "perceived" marginal revenue and marginal cost for oligopoly models. The extent of the perceived marginal revenue depends on the type of oligopoly models, with t and t^* indexing the degree of competitiveness (or collusiveness) of firm conduct. The lower the level of t, the less the price-cost margin and hence the more competitive (or

less collusive) the firm conduct. Notice that a firm's marginal cost depends on its own output Q (Q^*), input prices W (W^*), and parameters β (β^*).

One way to measure the effects of non-leaders' codesharing arrangement on the market leader's price and passenger volume is to estimate first-order conditions (5)-(6) and structural demand equations (1)-(2) as a system of equations. This procedure would require information about the prices and passenger volumes for the market leader and all of the (n-1) non-leaders. Not all of the non-leaders' data are available for this study.

Because of the data limitation, a more structure must be imposed on our model in order to estimate the model without prices and passenger volumes data of the non-leaders. In particular, we assume that firm 1 is a Stackelberg leader who takes into account the equilibrium responses of the remaining firms when choosing its profit-maximizing output or price. Consequently, the equilibrium price and passenger volume of the market leader are determined as the solution of the first-order condition (5) (i.e., its "supply" relation) and its "residual" demand function. The residual demand the market leader faces is derived by solving equations (2) and (6) for P^* as a function of P, noting that in this system there are 2(n-1) endogenous variables ($P^*$and Q^*) and the same number of equations. P* solved from equations (2) and (6) can be written as:

$$P^*=P^*(P,\Gamma^*,W^*;\alpha^*,\beta^*) \tag{7}$$

Substituting equation (7) into equation (1) yields the following equation:

$$Q=Q(P,P^*(P,\Gamma^*,W^*;\alpha^*,\beta^*),\Gamma;\alpha) \tag{8}$$

which may be rewritten as

$$Q=R(P,\Gamma,\Gamma^*,W^*;\alpha,\alpha^*,\beta^*) \tag{9}$$

Equation (9) is referred to as the market leader's residual demand function. Notice that this demand function is different from the market leader's structural demand function shown as equation (1) because the residual demand function takes the actions of non-leaders into account while the structural demand function does not. Here the price P affects the leader's demand through two effects: the direct own price effect on the structural demand, and the indirect effect of P on the non-leaders' price responses (P^*), given by equation (8), which in turn affect the market leader's (structural) demand. Consequently, the residual demand of equation (9) depends not only on its own variables or parameters (P, Γ, α), but also on the non-leaders' variables or parameters (Γ^*, W^*, α^*, β^*). For simplicity, in this paper the residual demand function is somtimes referred to merely as a "demand function".

As indicated above, the equilibrium price and passenger volume of the market leader are assumed to be determined by its supply equation (5) and its residual demand

equation (9). Notice that these two equations are structural form equations since price (P) and passenger volume demanded (Q) influence each other, and are endogenously determined by exogenous variables such as Γ, Γ^*, W and W*. Thus, one shoud estimate these two questions (5) and (9) as a system of simultaneous equations. Note that the joint estimation of this demand-supply system for the market leader does not require any information about the prices or passenger volumes of non-leaders.

Econometric Operationalization of the Model

(1) Demand Equation

In order to carry out empirical analysis, the models in (5) and (9) must be given specific functional forms. We specify the leader's residual demand function (9) as follows:[7]

$$Q=a_0+a_1P+a_2F+a_3NF+a_4NW+a_5FCS+a_6MCS+\epsilon_d \qquad (10)$$

where NW is an input price index of the non-leaders, MCS is a dummy variable which equals one for 'major' codesharing and zero otherwise, FCS is a dummy variable which equals one for 'feeder' codesharing and zero otherwise, a_i are unknown parameters to be estimated, and ϵ_d is a random error term. F is the number of flights served by the market leader on the route, and NF is the total flight frequency provided by other carriers. F is chosen in that it affects the leader's demand through Γ, whereas NF is chosen in that it affects the leader's demand through Γ^*. The codesharing between non-leaders is assumed to shift the market leader's demand function upward or downward. It is noted that the code-sharing variables could affect the leader's residual demand through either Γ or Γ^* or both.

The price effect of the residual demand is captured by the parameter a_1. As indicated above, a_1 consists of two effects: the direct own price effect on the structural demand, and the indirect price effect on non-leaders' price responses which in turn affect the leader's structural demand. With the direct own price effect being always negative due to downward-sloping demand curve, this parameter is likely to be negative.[8]

(2) Supply Equation

To operationalize the supply equation (5), we need to specify both the conduct term (t) and marginal cost (MC). Consider marginal cost first. The cost per passenger depends on the number of passengers and input price. Given the nature of our pooled cross-section and times series data, it would also depend on the state of technology of the year and the nature of the route such as distance and route group membership (Asia-North America, Asia-Oceania and North America-Oceania). Specifically, the marginal cost is expressed as follows:

$$MC=b_0+b_1Q+b_2W+b_3D+\sum_{i=1}^{10} d_iYR_i+\sum_{i=1}^{2} e_iRG_i+\epsilon_1 \qquad (11)$$

where W is an input cost index of the leader, D is distance between the two cities, YR_i

are year dummy variables, RG_i are route group dummy variables, b_i, d_i and e_i are unknown coefficients, and ϵ_1 is a random error term. Since a profit-maximizing firm produces its output at the upward-sloping marginal cost curve, an increase in the number of travellers (Q) causes increases in the marginal cost, indicating that the sign of b_1 may be positive. However, if the traffic density effect is strong on the route, then the sign of b_1 would be negative. Therefore, the sign of b_1 is, *a priori*, ambiguous. Both the leader's input price index (W) and the distance (D) are expected to have a positive effect on the marginal cost.

Next, we specify the conduct term t. This term may be affected by market structure, such as the extent of competition and of concentration, that varies from route to route. This study considers the number of competing airlines in a market (COM), the leader's market share (MS), and the presence of codesharing (FCS and MCS) as influencing factors on t of a particular route and specifies t as follows:

$$t=c_0+c_1COM+c_2MS+c_3FCS+c_4MCS+\epsilon_2 \qquad (12)$$

where c_i are unknown coefficients and ϵ_2 is a random error. The first two variables intend to capture the extent of competition and of concentration in the market,[9] while the two codesharing variables capture the effect of codesharing on the competitiveness (or collusiveness) of the market.

As the number of firms in the market (COM) increases, the extent of competition would increase. As a result, the magnitude of the markup ratio (t) becomes smaller. Thus, the coefficient c_1 is expected to be negative. The coefficient c_2 is expected to be positive: the markup ratio of the market leader is likely to be positively associated with its market share (MS). The coefficients of two codesharing variables (FCS, MCS), c_3 and c_4, capture the impact of codesharing between non-leaders on the leader's competitive conduct. Their signs, *a priori*, can be either positive (more collusive conduct) or negative (more competitive conduct) and are to be determined empirically.

Finally, substituting the marginal cost expression in (11) and t function in (12) into the leader's supply equation in (5) and rearranging the terms, we obtain the following form of leader's supply equation:

$$P=b_0+(b_1+c_0)Q+b_2W+b_3D+c_1COM\cdot Q+c_2MS\cdot Q+c_3FCS\cdot Q+c_4MCS\cdot Q+\sum_{i=1}^{10} d_iYR_i+\sum_{i=1}^{2} e_iRG_i+\epsilon_s \qquad (13)$$

where ϵ_s $(= \epsilon_1+\epsilon_2\cdot Q)$ represents the random error term in the supply equation. Equation (13) is the market leader's supply relation. Notice that the sign of the coefficient of Q is indeterminate *a priori* because the signs of both b_1 and c_0 are unknown (the coefficient c_0 is the intercept term of the t equation). Dresner and Tretheway (1992) argue that the coefficient of the output variable in a regression on price should be positive since the marginal cost effect and the demand effect are both positive. They also argue that the interpretation of the output variable is important

because previous researchers expected the sign of the coefficient to be negative; that is, increases in output will lead to decreases in price. On the other hand, other previous researchers such as Graham, Kaplan and Sibley (1983) reported negative coefficient for output vvariable.

III. Econometric Analysis

Data

Initially, sixty-four transpacific international air routes were considered for the analysis on which the largest carrier has at least 20% of the market share. But, seven routes were eliminated because of the unreliable flight frequency data reported in *Traffic by Flight Stage published by* the International Civil Aviation Organization (ICAO)[9]. As a result, fifty-seven transpacific routes were included in our data set. Our data consist of 30 North America-East Asia routes, 24 East Asia-Oceania routes, and 3 North America-Oceania routes while involving 7 North American, 7 East Asian, and 4 Oceanian origin and destination cities. The annual data were collected for the 1982-92 period. Since the model was developed under the assumption that two or more competitors exist on a route, the observations (route and year combination) with a single monopoly carrier were further excluded from our data set. As a result, the total number of observations used for econometric implementation is 471 data points, spanning 57 routes for the 1982-92 period. Table 1 shows descriptive statistics for the variables in the data.

Variable	Mean	Standard Deviation	Maximum	Minimum
Price (US$)	1,063	334.3	2,289	527
Passenger volume (annual)	92,017	71,223	412,610	6,386
Route distance (km)	7,776.3	1,451.8	11,106	5,799
Leader's flight frequency (annaul)	356.40	262.16	1,441	31
Nonleaders' total flight frequency (annual)	414.19	457.57	2,500	10
Competition (no.of firms)	3.48	1.89	11	2
Leader's market share	56.4%	16.7%	99%	21.3%

TABLE 1 Descriptive Statistics

The market leader's lowest unrestricted air fares on each route were gathered

from *Official Airline Guide (OAG): Desktop Flight Guide (Worldwide Edition)*. Since this publication reports air fares of some airlines in home currency of their registry, the official exchange rates were used to convert them into the U.S. dollars. The market leader on a route is defined as the airline which has the largest share of the passengers travelling on the non-stop route. The prices chosen are the lowest unrestricted fares available in the month of June.[11]

The passenger volume data were taken from *the ICAO's Traffic by Flight Stage*. This document lists the scheduled passenger volumes and flight frequency by airlines for non-stop international routes. The major omission in this data source is the charter passengers. As for the carrier input prices, the unit cost indices per aggregate output for major international airlines calculated by Oum and Yu (1995) are used for this study. Oum and Yu (1995) calculated the unit cost index for the world's major airlines using a panel data involving 37 airlines for the 1980-92. In order to make the unit cost indices comparable across airlines and over time, these indices are further adjusted by removing statistically the effects of differences in average stage length and composition of outputs (shares of freight and mail service, non-scheduled service and non-airline business called "incidental business").

Airlines that share their flight codes on a particular route are identified by the symbol "★" in the *OAG's Desktop Flight Guide*. In fact, an airline flight code accompanied with the symbol "★" shows that the flights are being operated by another carrier on behalf of the carrier whose code is shown on the flight line. Two different types of codesharing agreements are included in our data set: 'major' codesharing and 'feeder' codesharing. Our data base includes 28 and 26 cases of the first type and the second type of codesharings, respectively. In order to capture any differential effects between the two types of code-sharings, two dummay variables, MCS ('major' codesharing) and FCS ('feeder' codesharing), are used.

The data on the leader's market share, flight frequencies of the leader and non-leader carriers, distance of the route, and the number of competitors on the route are compiled from *the ICAO's Traffic by Flight Stage*.

Model Estimation

The model, consisting of demand equation (10) and supply equation (13), was estimated using Nonlinear Three Stage Least Squares (N3SLS). The model is not a system of linear equations because there are two endogenous variables, P and Q, which influence each other, and equation (13) includes three multiplicative terms involving Q. Substitution of (10) into (13) will then make supply equation (13) nonlinear in parameters. Since the N3SLS method requires reasonable starting values in order to obtain 'global' estimates, we used the one-step Zellner

parameter estimates obtained from the linear versions of equations (10) and (13) as starting values (Judge et al. 1985).

Test for Year and Regional Effects

In order to examine whether there exist differences of our model over time and/or among the three route groups, two linear hypotheses involving parameters associated with year dummy variables and regional route group dummy variables are tested using the Wald asymptotic Chi-square statistic. In general, the Wald χ^2 statistic is equivalent to the F statistic multiplied by the number of hypotheses (q) and is distributed χ^2 with q degrees of freedom.

The computed Wald χ^2 statistic for the null hypothesis that there is no difference in the marginal costs across years (after controlling for the effects of other variables included in the model), i.e., the coefficients of year dummy variables are all zero, is 155.3 with degrees of freedom 10. The same statistic for the null hypothesis that there is no difference in marginal costs across the three different route groups, i.e., the coefficients of route-group dummy variables are all zero, is 59.2 with 2 degrees of freedom. The p-values for both cases are close to zero. However, since we have a nonlinear model and the only probability known with certainty is the upper bound, we cannot rely solely on the asymptotic χ^2 distribution (Dhrymes, 1978). For this reason, we also looked at the upper bounds on p-value by Chevychev inequality. The upper bounds for null hypotheses on year and route group dummy effects are 0.06 and 0.03, respectively, implying that we can reject these null hypotheses at least at 6% and 3% level of significance, respectively.

Thus, it is desirable to include the year and route-group dummy variables when estimating the supply relation (13). The year 1982 and North America-Oceania route group are used as the reference points. As is to be seen below, the significant negative parameter estimates for Asia-North America and Asia-Oceania group dummy variables indicate that leader's marginal cost (and thus prices) for these route groups were lower than similar routes in the North America-Oceania group. It appears that the presence of aggressive low-cost Asian carriers kept the prices down in those two route groups as compared to the prices in the North America-Oceania route group.

Empirical Results

In order to see if there is any difference between 'major' codesharing and 'feeder' codesharing, two different systems of equations were estimated. The first system estimated is the model which does not distinguish between the 'major' codesharing and 'feeder' codesharing, and the second system estimated is the model which distinguishes between 'major' and 'feeder' codesharings. The two models give essentially the same results with regard to all other variables

included in the system. Furthermore, most of the coefficients have correct signs as theoretically expected. We conducted an analysis of covariance test in order to choose between the two models, and found that the model with the two distinct codesharing dummy variables is stastistically better than the model with a common codesharing dummy variable. In what follows, therefore, we discuss the empirical results based on the chosen model: the model with two different codesharing dummy variables. The estimated results of the chosen model is reported in Table 2.

Variable	Coefficient	t-ratio
Price Equation		
Constant	440.41	3.87
Passenger volume	0.00419	4.57
Leader's input price	-24.991	-0.35
Route distance	0.08838	8.18
(Competition)*(Passengers)	-0.00023	-2.61
(Market Share)*(Passengers)	-0.00569	-4.92
('Feeder'CS)*(Passengers)	0.00236	2.98
('Major'CS)*(Passengers)	-0.00085	-2.36
Year 1983	69.606	1.16
Year 1984	33.095	0.55
Year 1985	84.030	1.39
Year 1986	148.900	2.58
Year 1987	125.040	2.21
Year 1988	202.940	3.65
Year 1989	180.840	3.25
Year 1990	235.560	4.15
Year 1991	497.160	8.60
Year 1992	478.030	8.06
Asia-America route	-406.730	-7.57
Asia-Oceanic route	-217.180	-4.22
Demand Equation		
Constant	28095.0	6.55
Price	-25.986	-6.71
Leader's flight frequency	237.70	48.61
Nonleader's flight frequency	16.15	5.60
Nonleader's input price	-1952.5	-0.39
'Feeder' CS	1351.60	0.39
'Major' CS	7489.80	2.19

TABLE 2 Estimates of the Econometric Model

Effects of Variables in the Supply Equation

Most of the variables in Table 2 have correct signs as expected *a priori*. In the leader's price equation (supply relation), the route distance variable has a significant positive coefficient (an incremental price of 8.8 cents per kilometer). The coefficient for the competition multiplied by passenger volume (COM·Q) is negative and significant (-0.00035) as expected.

The yearly dummy variables (YR_i) have significant positive coefficients whose values increase over time for most of the years, indicating that market leaders' marginal costs in transpacific routes have increased for most of the years during the 1982-92 period. Leader's input price variable (W) is statistically significant. It appears that the presence of these yearly dummy variables may have caused statistical insignifance of the leader's input price variable (W) in the same equation. The coefficients of the route group dummy variables (RG_i) are also statistically significant. The coefficients of East Asia-North America routes and East Asia-Oceania routes are -406.73 and -217.18, respectively. This shows that, on average, market leaders' marginal costs on East Asia-North America routes and East Asia-Oceania routes are cheaper than those of North America-Oceania routes by about US$407 and US$217, respectively, after taking into account of the effects of differential route distance and other factors included in the model.

The sign of the coefficient of passenger volume (Q), although *a priori* indeterminate as discussed earlier, is positive (0.00419) and highly significant, suggesting that the market leader's supply curve is positively sloped. The coefficients of 'major' codesharing (in fact, MCS*Q) and 'feeder' codesharing (in fact, FCS*Q) are -0.00085 and 0.00236, with t-ratios of -2.362 and 2.982, respectively. Therefore, a codesharing changes the slope of the leader's supply curve. Specifically, the slope of supply curve is 0.00419 in the absence of a codesharing on the route while it decreases to 0.00334 when a 'major' codesharing occurs, and increases to 0.00655 when a 'feeder' codesharing occurs. In other words, 'major' codesharing rotates the market leader's supply curve toward the clockwise direction, while 'feeder' codesharing rotates the supply curve to the counter clockwise direction (see Figure 1 for a graphical illustration).

This implies that the leader's pricing conduct becomes more competitive with the presence of 'major' codesharing, but more collusive with the presence of 'feeder' codesharing. This may be because a 'major' codesharing in our data appears to have a cost reduction effect for the codesharing partners, thereby creating a more competitive environment. Also, such a codesharing agreement may increase the incentive for the partners to lower price as the increased demand and cost savings from the codesharing are now internalized. In effect, the two major, otherwise independent airlines are normally required to sell a block of seats on the partner's flights. On the other hand, 'feeder' codesharing is typically used by an international carrier in order to replace a single carrier service on a thin route by code-shared connecting flights with its feeder carrier. Such an arrangement appears to decrease competition by reducing the number of effective competitors for the market leader. As a result, leader firms behave more collusively following 'feeder' codesharing agreements.

Effects of Variables in the Residual Demand Equation

The coefficient of price (P), -26, reported in Table 3b, implies that a dollar increase in a market leader's air fare is estimated to reduce its residual demand by about 26 people a year, some of whom may divert to other airlines. The positive and highly significant coefficient of the leader's flight frequency (F) shows that an increase in its frequency would increase demand by reducing its passengers' frequency delay. The coefficient of non-leader's frequency (NF) is positive and statistically significant, whereas the coefficient of non-leader's input prices (NW) is negative and is not statistically significant. The coefficient of MCS is estimated at 7,490 and significant, implying that 'major' codesharing on a route would shift the market leader's residual demand curve upward. As discussed earlier, this traffic-enhancing effect of codesharing can be caused by the possibly less attractive code-shared flights (as compared to the leader's non-stop flights) and/or any price increase by the codeshared partners as they capitalize the improved services as compared to the interline connecting services. In the typical case of 'major' codesharing arrangement in our data, the codeshared connecting service replaces one or two single-carrier service, resulting in a reduction of service quality existed prior to the code-sharing arrangment. For example, Cathay Pacific dropped its service on Vancouver-San Francisco leg of its Hongkong-Vancouver-San Francisco service after launching a codesharing service with American Airlines on HongKong-Los Angeles-San Francisco route.

A 'feeder' codesharing does not have statistically significant effect on the leader's residual demand curve; the coefficient of FCS is estimated at 1,352 but is not statistically significant. This implies that even if an international carrier (Continental, for example) uses codesharing flights with its feeder carrier (Air Micronesia) to extend its route (Brisbane-Guam) to another city (Manila), it may not have significant effect on the residual demand for the leader (Philippine Airlines) who provides direct services on the origin-destination cities (Brisbane-Manila). Therefore, in the rest of the paper we assume that 'feeder' codesharing (FCS) does not shift leader's demand curve.

Effects of Codesharing on Leader's Price and Passenger Volume

The effects of the two types of codesharing arrangements on the market leader's demand and supply curves can be summarized as follows. The two types of codesharing influence the leader's supply curve in an opposite direction (counter clockwise for MCS and clockwise for FCS). On the other hand, the 'major' codesharing (MCS) shifts up the leader's demand curve while the 'feeder' codesharing (FCS) does not have any significant effect on the leader's demand. Since a 'major' codesharing shifts up the leader's demand curve and rotates down the supply curve, it is not clear whether the leader's equilibrium price will increase or decrease although the leader's equilibrium passenger volume is certain to increase. It is clear that the 'feeer' codesharing will increase the market leader's price and reduce its passenger volume by rotating the supply curve upward while keeping the demand unchanged. It is useful, however, to measure the amount of reductions in the leader's price and quantity to be caused by a 'feeder' codesharing. Therefore, for both types of codesharing, a further examination of the estimated model is necessary.

In order to measure the effects on the market leader's price and quantity numerically, we must take into account the simultaneous interaction between its residual demand and supply relations. To accomplish this objective, we derive the reduced form equations for the leader's price and passenger volumn from equations (10) and (13) as follows:

$$P=CQ+B, \qquad Q=(a_1B+A)/(1-a_1C)$$

where $A \equiv a_0+a_2F+a_3NF+a_4NW+a_5FCS+a_6MCS$,
$B \equiv b_0+b_2W+b_3D+\Sigma d_iYR_i+\Sigma e_iRG_i$, and $C \equiv (b_1+c_0)+c_1COM+c_2MS+c_3FCS+c_4MCS$.

We measure the changes in the leader's equilibrium prices and passenger volumes with and without each type of codesharing arrangement. More specifically, after plugging in the estimated coefficients of the model, the leader's equilibrium price and quantity are expressed as functions of the exogenous variables only. Define P(1, Σ) and Q(1, Σ) as the leader's price and passenger volume which prevail under a particular codesharing type, and P(0, Σ) and Q(0, Σ) as those in the absence of codesharing. Σ denotes the set of all other variables except the codesharing variable under consideration. We calculated $\Delta P = P(1, \Sigma) - P(0, \Sigma)$ and $\Delta Q = Q(1, \Sigma) - Q(0, \Sigma)$ for each route and each year.

Table 3 reports the sample mean and standard deviation of ΔP and ΔQ for the two types of codesharing and the t-ratio for testing the hypotheses that there is no change in the leader's price or traffic volume as a result of a codesharing between non-leaders. For the 'major' codesharing, the mean values for ΔP and ΔQ are -$83 and 10,052 passengers and their t-statistics are -31.0 and 143.3, respectively. For the 'feeder' codesharing, the mean values for ΔP and ΔQ are 208 and -5,080 (for the case where the residual demand curve remains the same). In sum, the market leader's equilibrium price decreased by US$83 per passenger due to 'major' codesharing, while it increases by US$205 per passenger due to 'feeder' codesharing.

Statistic	Mean	Standard Dev.	t-value*	Minimum Observation	Maximum Observation
1) 'Major' Codesharing					
ΔP	-$83.28	$58.27	-31.02	$7.06	-$318.69
ΔQ	10052.0	1522.10	143.32	16081.0	7584.5
2) 'Feeder' Codesharing					
<The case where the residual demand curve remains unchanged>					
ΔP	$204.87	$152.56	29.14	$849.70	$9.14
ΔQ	-6350.2	3980.90	-34.62	-1211.4	-22900

*t-ratio is computed as the ratio of the sample mean to the standard error of the sample mean which is equal to the sample standard deviation divided by squareroot of the sample size.

TABLE 3 Test Results for ΔP and ΔQ

Figure 1 gives a graphical summary of the effects of the two codesharing types on the market leader's equilibrium price and passenger volume. Let us assume that point B is the market leader's equilibrium when there is no codesharing between non-leaders. Our simulation results indicate the leader's equilibrium will move from point B to point A_M after a 'major' codesharing while it will move to point A_F, if there is a 'feeder' codesharing. In sum, a 'major' codesharing is expected to decrease the leader's equilibrium price by US$83 per passenger and increase the leader's annual passenger volume by 10,052 persons while a 'feeder' codesharing is expected to increase the market leader's equilibrium price by US$205 per passenger and reduce its annual passenger volume by 6,350 persons.

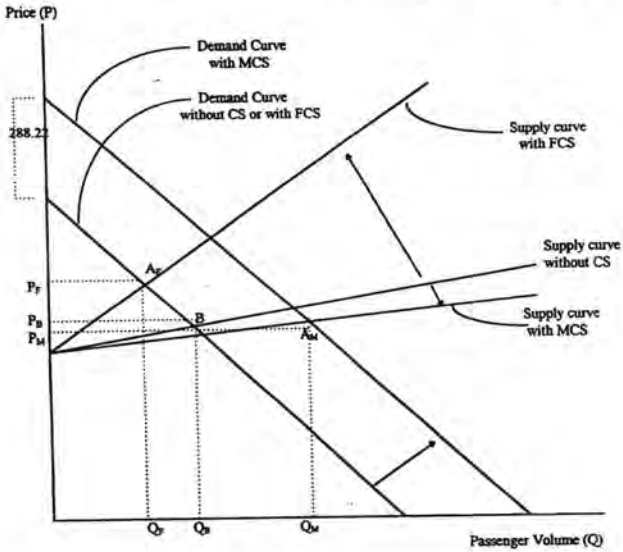


FIGURE 1 The effects of two types of codesharings on leader's P and Q

IV. Conclusion

In this paper, we develop a model based on profit maximization behaviour of n firms in the market, and apply it to a panel data of fifty-seven transpacific air routes for the 1982-92 period in order to determine the effect of codesharing alliance between non-market leaders on the market leader's equilibrium price and passenger volume.

Derivation of the model is based essentially on a leader-follower model in oligopoly where the leader makes its price/output decision taking into account of

the followers' equilibrium supply responses. Specifically, we derive the leader's residual demand function and its supply relation. The model is econometrically specified and estimated as a system of two simultaneous equations via a non-linear three stage least squares method. The estimated model is used to investigate the effects of the two types of airline codesharing agreements between non-leader airlines on the market leader's price and passenger volume as well as to examine the effect of changes in various exogenous variables on the leader's residual demand and supply functions.

To our knowledge this study constitutes the first systematic and econometric investigation into the airline codesharing agreement, which is becoming the major means by which airlines in different continents link their service networks with airlines in other continents. The methodology developed for this study is an improvement over previous studies. Since our model is derived from the profit maximizing behaviour of the leader and followers, it allows us to predict the leader's behaviour in a more realistic oligopoly situtation, and thus, allows us to conjecture *a priori* the signs of coefficients of various variables. The consistency is maintained between the derived model and the econometrically estimated model. In addition, this study treats endogenous variables (price and passenger volume) formally in a simultaneous framework involving non-linear specifications.

We have found that 'major' codesharing rotates the market leader's supply curve clockwise (i.e., it makes the leader behave more competitively), and shifts its residual demand curve upward. As a result, a 'major' codesharing agreement increases the annual equilibirum quantity of the market leader by 10,052 passengers. Furthermore, it reduces the leader's equilibrium price by about $83 per passenger. On the other hand, 'feeder' codesharing rotates the market leader's supply curve counter clockwise (i.e., it makes the leader behave more collusively), and shifts its residual demand curve by an insignificant amount. As a result, a 'feeder' codesharing agreement increases the leader's equilibrium price by $205 per passenger and reduces the leader's annual equilibrium quantity by 6,350 passengers. With respect to other variables of the model, the emprical results conform generally with our *a priori* predictions.

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ENDNOTES

1. In most countries, codesharing is allowed only between the two cities where the foreign carrier l operating authority. However, U.S. Department of Transportation (DOT) has recently allowed Brit rways (BA) and Lufthansa to operate code-shared flights to the U.S. cities where these carriers do ı ve operating authority. In March, 1993, U.S. DOT granted a two-year temporary permit for BA erate code-shared flights with U.S. Air linking between three U.S. Air's gateways (Baltimo iladelphia and Pittsburgh) and 38 interior cities in the U.S. (see DOT Order 94-3-31). Again, nuary, 1994, U.S. DOT issued a one-year permit for Lufthansa to operate code-shared flights w ıited Airlines between Chicago and 29 U.S. cities, between Washington, D.C. and 6 U.S. cities, a tween San Francisco and 6 U.S. cities (see DOT Order 94-1-19). Because of the open skies air tre tween the U.S. and the Netherlands, KLM is allowed to operate code-shared flights with Northw any U.S. cities.

2. See Hadrovic (1990) for an excellent discussion on how Canadian and the U.S. trunk carriers h ed codesharing arrangements in order to create feeder carrier networks in North America.

3. We reviewed 45 cases of simple carrier alliance involving a single international route. 28 out ose 45 cases include flight codesharing agreements. Also, codesharing agreements are included i t of the 13 broad strategic alliances without equity investment involved and 10 out of the 14 strate iances with equity investment involved.

4. Since codesharing arrangements are done in a broader context of carrier alliances, customer servi e normally enhanced by coordinating (arrival and departure) flight schedules, locating departure g connecting flights nearby the arrival gate, coordinating baggage transfer, etc. Therefore, serv ality for code-shared connecting flights could be as high as single carrier (on-line) connecting servi the two codesharing partners collaborate well.

5. An example is the codesharing agreement between Cathay Pacific (CX) and American Airlines (A San Francisco (SFO)-Los Angeles (LAX)-Hong Kong (HKG) route in which AA operates SFO-L. d CX operates flights on LAX-HKG. Another example is the codesharing agreement between Canad rlines International and Qantas involving Vancouver-Honolulu-Sydney route.

5. An example is the codesharing agreement between Continental (CO) and its feeder carrier, icronesia on Brisbane (BNE)-Guam (GUM)-Manila (MNL) route where CO operates BNE-GUM r Micronesia operates flights on GUM-MNL.

The linear functional form is chosen in order to derive computationally feasible reduced form equati r the leader's price and traffic volume which are necessary to determine the equilibrium price iffic volume via a simulation exercise conducted later in the paper.

8. It can be shown the slope of residual demand is given by

$$\frac{\partial R}{\partial P}=\frac{\partial Q}{\partial P}+\sum_{i\in N}\frac{\partial Q}{\partial P_i^*}\frac{\partial P_i^*}{\partial P}$$

otice that the first term of the right-hand side of the equation is negative due to downward slop mand curve. The second term of the right-hand side can either be positive or negative, depending e sign of $\partial P_i^*/\partial P$ which can be positive or negative for alternative oligopoly models. Given t $Q/\partial P_i^*$ is always positive for substitutes, the second term will be negative if $\partial P_i^*/\partial P$ is nonpositive.

9. An alternative predictor of t may be the Herfindahl index. The Hirfindahl index requi formation of market shares for all the individual non-market-leaders which is not available for t udy.

.10. This ICAO publication lists passenger volumes, flight frequency, and other data by carrier route. For the seven routes deleted from our data set, the numbers of flights reported were less t times a year.

.11. We recognize potential problems of using the published prices instead of the actual fares paid ssengers (average yield per passenger). Unfortunately, the route-specific data on average yields t available. In the transpacific markets, however, the unrestricted lowest fares are similar to scount fares widely used in North American markets because Asian carriers have not practiced yi anagement via dyanamic seat inventory allocation methods. During our sample period, m nspacific passengers used the unrestricted lowest fares.

INTEGRATED TRANSPORTATION PLANNING

A Topic Paper
for the
CANADIAN TRANSPORTATION RESEARCH FORUM

By

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1.0: Introduction

Integrated Transportation Planning is a concept which suggests that a detailed package of environmental, social, economic and political tools is necessary to ensure the safe accessibility and mobility of people who wish to travel from one place to another. The notion of integrated transportation planning has steadily progressed over the years. It began with traditional transport planning, oriented toward automobile traffic engineering, then progressed to "multi-modal planning" to include public transit modes. It later broadened to include pedestrians, cycling, small vehicles and variable land use, and now extends furthermore to considerations of full environmental and cost impacts. Integrated transportation planning applies to rapidly urbanizing areas in growing economies and implies also that any environmental impacts should be minimized through comprehensive planning and implementation. Integrated transportation planning includes a number of elements with the principal ones being:

- Enhanced Accessibility and Mobility for all
- Environmental Sustainability
- Participatory Planning
- Transportation Demand Management
- Transportation Systems Management
- Comprehensive Land Use Planning
- Least Cost Optimization

In a climate where traffic congestion, often unbearable air pollution, and ever dwindling energy supplies are becoming a major problem the world over, this paper considers blending specific elements to better achieve environmental and energy sustainability and to better serve the needs of people who wish to travel without impediment.

2.0: Why the Need for Integrated Transport Planning

Exponential population growth and substantial increases in world wide automobile production are leading to acute traffic congestion, air pollution and energy use, particularly in developing nations. The overall vehicle population in the world is approaching 650 million.[1] Moreover, the growth of motor vehicle fleets in Asia, Africa and Latin America has far outpaced the average population growth of these regions. In Asia, automobile fleets are expected to grow by 96 percent between the period from 1988 and 1995. In the former Eastern Block and in Latin America, automobile growth rates for the same period are projected to be 31 percent and 17 percent respectively. This compares with a projected 12 percent growth in Western Europe.[2]

In China, predictions are that five million Chinese families will have annual incomes between 30,000 and 50,000 yuan ($3,500 U.S. and $5,700 U.S.) by the end of the century. If one out of ten such families purchases an automobile, that will mean an addition of 500,000 privately owned cars added to China's streets each year. The Dongfeng Automobile Works, one of China's leading auto makers in central Hubei province, is determined to boost its annual manufactured vehicle output from 200,000 annually in 1994, to 1 - million vehicles by the year 2005.[3]

The adverse affects of such increasing car production are overwhelming. If present trends continue, unacceptable congestion levels will result, along with disproportionately high spending on petroleum products and life-threatening levels of transportation generated air pollutants in local urban areas.

Traffic congestion alone squanders millions of barrels of oil annually. For example, in Bangkok, an estimated US$1.4 million worth of fuel is wasted every day by vehicles idling in traffic. Annually this loss amounts to US$500 million. Moreover, a study by the Engineering Office of the Bangkok Metropolitan Administration suggests that, had person-hours lost from the average 44 working days spent in congested traffic each year been put to productive use, the Gross National Product of Thailand would have grown by an additional ten percent.[4] In many parts of India, transport sectors are still dominated by bicycles, cycle rickshaws, animal carts and pedestrians. In older areas of such cities as New Delhi, Varanasi in the north, Calcutta and Bombay, inner streets are narrow and impenetrable by automobiles, but in newer areas still without area-wide traffic management schemes, increasing mixed traffic and the mounting vehicle population results in wide scale traffic congestion and pollution.[5] Clearly, more efficient and cost effective tools to allow people to travel smoothly from one place to another must be employed. The principles which lie behind the successful implementation of these tools begin with a consideration of enhanced accessibility and mobility.

3.0: Enhancing Accessibility & Mobility

Enhanced Accessibility and Mobility means that the greatest benefit to users must result from any comprehensive transportation planning initiative. That is, transportation development must be user oriented and should ensure that people have free access to the daily needs and wants of urban or rural life.[6] The options for this accessibility and mobility clearly are divergent in different parts of the world. In major parts of the developing world, "Mobility for the Majority" means that most transportation is low cost. That is, the dominant ways of getting from one place to another are through non-motorized transport such as walking, or with the use of bicycles, cycle rickshaws, pedal carts, horse drawn carts or bullock carts. Promotion therefore, of methods to ease access through non motorized transport is fundamental to any integrated transportation planning initiative.[7]

Only in nations where the infrastructures are affordable, can urban transit, commuter rail and ridesharing as well as walking and cycling, be added into the transportation planning equation. If a person needs to travel to work, take the children to school or accomplish daily errands, a menu of options needs to be considered as the best way to provide transportation services. These options undoubtedly will differ depending on geographic and economic priorities. In Tanzania for instance, the notion of using short cuts to get from one place to another is important to the majority of people who often have to walk or cycle to transport water and commodity goods over long distances. A totally different option applies in Curitiba, Brazil, for example, where in some regions around the city, travel need is often eliminated by the creation of compact multi-function zones around a person's home or place of work. Schools and shops are designed to be within easy walking or biking distance. The options, while vastly divergent in Tanzania and Brazil, have one common thread. They are oriented toward transport users.

A key principle to any enhancement of accessibility is that we must begin with the user when defining a modal split or the relative importance of each mode. Estimates from Asian and African countries indicate that "users" bike or walk or employ a cart, in many cases between 60 and 70 percent of the time. For example, in Surabaya, the second largest city in Indonesia, about 20 percent of residents use public transport, about 27 percent use private motorized vehicles and about 55 percent walk or use cycle rickshaws.[8] With this in consideration, being user oriented entails a need to concentrate on each particular aspect of any modal split. The provision of bike paths and bicycle repair shops, for instance, would help to ensure sustainable transportation in an area where there is a high priority on movement for people who use bicycles as the primary mode of transportation. In areas where highly developed transport infrastructures are almost non-existent, a concerted need also exists to concentrate on developing improved transportation mobility for people who can only afford low cost transportation.

The "user" definition, especially in areas where dense populations are involved demands the need for a multifaceted approach to integrated transportation planning. People in built up areas such as Bangkok, Hong Kong, Mexico City, Buenos Aires or New Delhi often employ a variety of means to get from one place to another and in these cases, transport policies must work to ensure all that all people have accessibility -- whether by walking, biking, taking a bus or commuter rail, or driving.

Equitable transportation implies equal access for all. In many developing countries, the majority of people do not own cars and receive no benefit from public subsidies for transportation. Without access to well developed transportation infrastructures, large numbers of people in these countries remain immobilized without being able to fully contribute to the economic and social fabric of their country. Isolation is a characteristic of deep rural poverty. Where poverty is a concern, people become closed off and separated, isolated economically, socially and culturally. This isolation is immediately apparent in Bangladesh, a country where there are few road networks in place to service the indigenous peoples. A recent traffic count taken in Bangladesh for the Asian Development Bank substantiates this observation. Less than one percent of the population is serviced by motorized vehicles. In this case, the needs of rural people are not addressed and the economic base is so low that any progressive transportation development is greatly problematic.[9] Equitable transportation planning would distribute transport funding to services that mobilize an entire population rather than a small, elite portion of it.[10]

Equity also concerns women. Transportation is one of the most crucial problems in the labour-intensive smallholder farming systems of sub-Saharan Africa. Women, as the principal food producers, link their activities to transport within their respective villages, fetching water, gathering firewood and carrying harvested crops. The burden of the transport work performed by women is reflected in the time and labour invested, the mileage covered and the tonnages moved. Problems of womens' access to labour saving technologies and transport aids derive largely from the fact that work performed by women is unpaid and is hence not appreciated by planners, although it is crucial for the very survival of smallholder households. This inequity needs to be addressed.[11]

Equitable access should also aim to promote the maximum use of transport which incorporates available space most prudently for every person who wishes to travel. Not surprisingly, mass transit, especially commuter rail, bicycle traffic and pedestrian walkways vastly outdistance automobiles for the most efficient use of road space. Here the enhancement of the "alternative modes", alternative to the automobile and especially the single occupant vehicle (SOV), is crucial to ensuring sustainable transportation and social mobility.

4.0: Environmental Sustainability

Environmental sustainability suggests three things. First, transportation generated air pollutant levels should be limited in such a way that human health will not be adversely affected. Second, non-renewable energy resources must be harnessed not only to minimize the danger of their extinction but to be financially sustainable so that significantly high expenditures for fuel are not incurred through transportation operation and maintenance. Third, development of land use policies should ensure that congestion does not persist.

In developing countries, high vehicle populations including motorcycles, automobiles and trucks lead to massive congestion and unabated emissions of Suspended Particulate Matter, Nitrous Oxides, Hydrocarbons and Sulphur Dioxide. Traffic congestion in built up areas, results also from the inability of road systems to handle transportation demand. The existing high congestion levels in most heavily populated areas of developing countries stems from an uncontrolled mix of automobiles, buses, jeetneys, bicycles, and hand or animal drawn carts.

Transportation-related air pollutants are the prime reasons for climate change and urban smog formation around the world. Together they amount to millions of kilotonnes of atmospheric waste pumped into the air annually and jointly contribute to environmental denigration of all kinds which knows no borders. Environmental stresses that result from internal combustion fuel burning, characteristic of automobiles and trucks, differ depending on the type of air pollutant emitted. Hydrocarbons, otherwise known as Volatile Organic Compounds (VOCs), are believed to be carcinogens. They come largely from unburnt fuels in engine exhaust and from leakage around engine carburetors or crankcases. Usually on hot sunny days, when VOCs combine with Oxides of Nitrogen (NO_x), ground level ozone appearing as smog is formed, often causing respiratory problems and damaging foliage. Carbon monoxide (CO), even in its low concentrations, causes slow operating reactions, nausea, headaches and dizziness. Particulate matter (PM) is visible in the atmosphere mainly as carbon and dust. This matter can also be inhaled, conveying toxic pollutants to the lungs. CO_2 and Methane are important greenhouse gases contributing to the Global Warming phenomenon.[12] Minimizing these stresses and ensuring environmental sustainability demands the employment of integrated transport planning, a package of options to serve mobility needs.

As noted above, such a package demands:

- Transportation System Management
- Transportation Demand Management
- Controlled Land Use Planning
- Least Cost Implementation

5.0: Transportation System Management

Transportation System Management first implies that improvements to transportation infrastructures such as roads and rail networks, are necessary for the smooth and unincumbered movement of both people and goods. Transportation System Management suggests that improvements to the "supply" side of transportation infrastructures are a fundamental component of any integrated transportation planning exercise. Such improvements include:

- **Implementation of Commuter Rail and Mass Transit Networks.** Commuter Rail takes people off streets and roads. With its ability to carry large numbers of people at one time and through the use of a separate guideway on which to travel, the tendency for congestion on otherwise highly populated thoroughfares, will be vastly reduced.

- **Construction of Ring Roads.** Construction of ring roads on the edges of cities, divert traffic away from city centres. Such bypasses can move vehicles more readily, while alleviating congestion, pollution and safety hazards in downtown areas.

- **Employment of Area-Wide Traffic Signal Systems.** Congestion results in part from antiquated methods of directing traffic. In Bangkok, police manually control traffic lights, limiting the effects of signalization since long cycle times in manual operation mean delays for up to ten minutes. Traffic signalization systems can play a key role in improving traffic flow in areas of dense population. They can be coordinated to minimize the number of stops and maximize average speeds. A traffic signal system in part of Hong Kong reportedly increased peak period traffic speeds by as much as 36%.[13]

- **Introduction of Bus Bays.** The implementation of special bus bays or an area where a bus may pull off to take on or discharge passengers at the side of a road, lessens congestion and improves traffic flow.

- **Grade Separation Construction.** In many countries, considerable congestion exists at level crossings where trains and road traffic intersect. The provision of grade separations would eliminate this. Grade separations are bridges or viaducts built to allow physical separation between a road and a railway where the two meet.

Transportation System Measures cannot be implemented on their own without working in concert with other measures to influence modal shift or lessen travel altogether. Installation of an area-wide traffic signal system would have little long term benefit without the aid for instance, of mass transit or additional traffic restrictions, to lessen density on congested roadways.

6.0: Transportation Demand Management

Transportation Demand Management (TDM) is a relatively new policy tool designed to influence people's travelling behaviours so as to reduce amounts of vehicle traffic and congestion. TDM is usually accomplished in three basic ways.

- **By shifting the mode of transportation.** Some TDM measures attempt to influence people to switch from single-occupant automobiles to public transit, car pools, van pools, bicycles and walking.

- **By eliminating trips**. Some TDM measures attempt to reduce the total number of person trips made. For instance, through telecommuting, employees working at home are connected to the office by phone, fax or modem.

- **By lowering peak demand**. Some measures attempt to stimulate travel during off-peak hours to reduce congestion during peak demand periods.

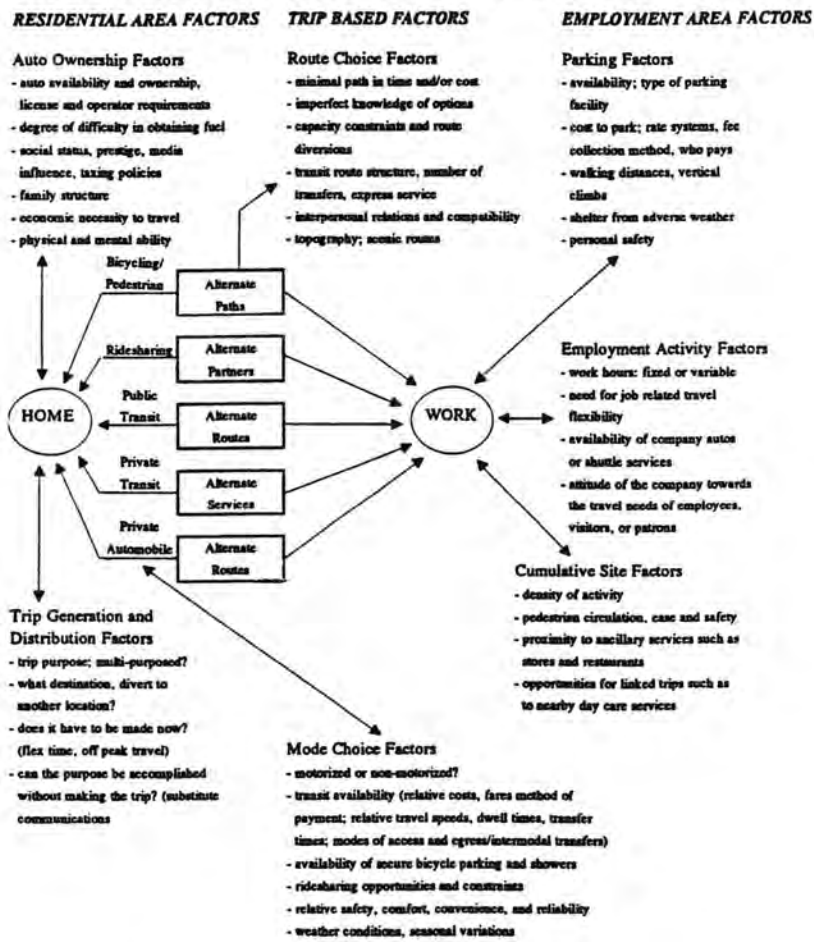
Exhibit 1.1 (overleaf) provides a context for thinking about TDM measures by showing the wide range of factors which influence travel behaviour. The exhibit shows factors affecting a trip from home to work. TDM measures can be used to change travel behaviour by modifying many of the factors at the origins and destinations of trips as well as modifying the relative characteristics of alternative modes such as walking, bicycling, using public transit, ridesharing or driving. TDM measures cannot, however, significantly influence population and employment levels, distribution and densities, which are the major determinants of trip demand patterns.

TDM measures come in "carrot" and "stick" varieties. "Carrot" measures are relatively easy to implement, are voluntary and emphasize incentives to encourage people to change their travel behaviour. "Stick" measures, in the form of regulations or by-laws, are mandatory and rely on time and cost penalties to actively discourage automobile use, especially during peak periods.

"Carrot" measures include preferential treatment for high occupancy vehicles (HOVs), such as buses and taxis, voluntary employer-based trip reduction programs, ridesharing programs, giving public transit operating priority, bicycle-to-transit intermodal transfer measures and public education and communications.

EXHIBIT 1.1

TRAVEL BEHAVIOUR FACTORS RELATING TO A TRIP FROM HOME TO WORK



Source: GVRD Air Quality Management Plan - Stage 2: Appendix D, March, 1992.

Preferential treatments for High Occupancy Vehicles give travellers an incentive or reward for travelling in transit vehicles. Incentives for HOV use can take several different forms:

- **Economic:** Some measures reduce out-of-pocket costs for the HOV user. Example: Reduced parking fees for high occupancy vehicles.

- **Convenience:** Some measures make a particular trip more convenient for the HOV user. Example: Park & Ride Spaces for HOV users.

- **Space:** Some measures reserve transport facilities for HOV use only, requiring other vehicles to take another route. Example: Transit malls and auto restricted zones.

- **Time:** Some measures decrease the travel time for HOV users. Example: HOV reserved lanes and transit vehicle traffic signal preemption.

Employer-based trip reduction programs, another "carrot" measure, prepare and implement strategies to reduce automobile use. These strategies include encouraging employees to use public transit, rideshare, telecommute, adopt alternative work schedules, or simply bicycle or walk to work. Some of the incentives employers can give their employees include:

- Early leave privileges to allow car pool users to meet their rides and transit users to make transit connections on time, or for pedestrians and cyclists in winter months.

- A guaranteed ride home policy whereby the employer arranges after-hour car pools or pays the transit fares of individuals who do not bring an auto to work and have to work late or leave the work site for an emergency.

- A shuttle service to public transit stops and stations located more than a short walk from the work place.

- Providing company vehicles for work-related trips.

- Providing a transportation subsidy to all employees and charging for employee parking instead of subsidized parking, which only benefits car users.

- Providing showers and lockers for employees who jog or bicycle to work.

Ridesharing, often used for work trips, can take the form of car pooling, van pooling or even bus pooling. Mass transit is, of course, the ultimate "car pool".

Park and Ride lots are parking facilities adjacent to rapid transit or commuter rail stations, bus route terminuses or HOV lane facilities where people can park bicycles or automobiles and transfer to transit for the rest of their journey. Reserved parking spaces for HOVs and bicycle storage racks or lockers may be incorporated into the park and ride lot design.

Four specific strategies can be used to increase transit operating speeds and transit travel time reliability. These strategies include transit vehicle signal priority, transit vehicle queue jumpers, proof-of-payment on transit vehicles and legislation requiring motorists to yield to buses pulling from bus stops.

- **Transit Vehicle Signal Priority:** At signalized intersections, the green light can be extended by approaching transit vehicles using onboard transmitters or detectors in the roadbed or at roadside. Other forms for transit signal priority include exclusive advanced green phases for transit vehicles at signalized intersections, and transit-vehicle-activated signals where transit vehicles must enter a main road from a side street.

- **Transit Vehicle Queue Jumpers:** Special lanes on roadways and at vehicle staging areas, such as at ferry terminals, can be reserved for the use of transit vehicles so they can by-pass long automobile line-ups. These lanes are usually used on congested approaches to bridges, tunnels, ferry docks, toll collection booths and other traffic bottlenecks.

- **Proof of Payment on Transit Vehicles:** A fare collection system can be introduced where transit riders purchase or validate their tickets, usually by machine, before boarding transit vehicles. This system allows transit vehicles to be loaded faster through all doors as the driver is relieved from checking fares or transfers. Fare payment is enforced using roving inspectors in the transit system and the method is often called an "honour fare" system.

- **Legislation:** Changes to legislation can be made making it mandatory for motorists to give way when a bus pulls out of a stop or signals to change lanes.

Greater use of bicycles, especially as part of longer work trips, can be encouraged through policies or facility provisions which make it more convenient for cyclists to transfer to and from transit vehicles. Two such measures include providing bicycle storage racks at rapid transit stations and allowing bicycles to be transported on specially designated transit vehicles equipped with on-board bicycle storage racks.

Public education campaigns can be effective in changing peoples' attitudes about the environmental effects and relative attractiveness of various travel modes and ultimately, in changing travel behaviour.

Telecommuting, a relatively new concept, implies no need to travel at all. In telecommuting, individuals are connected electronically to an office using communications links such as telephones, fax lines, computer modems and video hook-ups at home or at a nearby satellite office. Telecommuting eliminates trips altogether in the case of working at home, and shortens commuting distance in the case of telework satellite centres. Telecommuting is most suitable for employees working at information-based industries such as consulting, accounting or journalism - any type of work where being face-to-face with coworkers and customers is not always required. It has relatively little potential in industries such as manufacturing, wholesaling, or direct retailing. Telecommuting is most suitable for employees who are self-motivated, productive, conscientious and who work on relatively independent tasks.

Variable work hour schemes spread work trips over the day, thereby reducing peak period demand. Employing flexible hours, or "flex-time", employees choose their own start and finish times with guidelines set by the employer. Staggered hours suggest different start and work times for different branches of an organization. Compressed work weeks imply that an employee might complete required work in a fewer number of days than a standard work week.

The "carrot" measures as described above, share the key feature that they are all based on one incentive or another. "Stick" measures on the other hand, are also very effective. They suggest some sanction particularly for automobile use. These measures involve area licensing and road pricing schemes, vehicle quota schemes, parking supply controls and pricing, and increased fuel taxes.

Area licensing involves using admission charges, supplementary licences or electronic road pricing for vehicles to gain entry either into, through, or out of a restricted zone where traffic congestion usually presents a problem as is often the case in central business districts. Admission charges are usually inefficient as collection toll plazas force starting and stopping for vehicles which is costly in terms of energy usage and emission generation.

Supplementary licences involve the purchase and display of additional licences to gain entry into designated areas, however, this method is gradually being supplanted by electronic road pricing which employs transponders mounted on a licence plate or windshield. A computerized roadside reader bounces low frequency radio signals off the transponder and thus records vehicle use in a designated area. At the end of each month, the vehicle user is billed for the time spent driving through the electronic road pricing territory. Area licensing has been adopted by Singapore for reducing peak period congestion in the city centre and is part of a package of measures symbolic of integrated transport planning. During morning peak hours, motorists nearing a designated restricted zone in the city centre have to meet one of three conditions:

1. There must be four occupants in the automobile.
2. A supplemental charge is payed if there are less than four occupants, or
3. Automobiles are parked at a fringe car-park outside the zone boundary with public transit employed to enter the central area.[14]

Vehicle quota schemes have also been introduced in Singapore as a restrictive method to regulate vehicle use. Under the system, potential buyers have to bid for a certificate of entitlement (COE) on a monthly basis. The Singapore Government then announces the number of new vehicles that will be allowed on the road for that month. Should a potential owner be successful, only the lowest successful bid price - called the quota premium, needs to be paid. This bidding system along with the high purchase price of new vehicles in Singapore, has been viewed as a singly very effective method for controlling congestion on area roadways.[15]

In addition, a variety of parking disincentives such as higher pricing or no parking at peak periods is also viewed as an effective disincentive to automobile use.

Increased fuel taxes, while considerable revenue generators, are not generally a disincentive to driving because of their relative inelasticity. That is, there is not a strong correlation between the amount one pays for fuel and the amount that a given vehicle is actually used. Both energy and environmental savings are maximized when the need to travel can be eliminated entirely and comprehensive land use planning makes this possible.

7.0: Comprehensive Land Use Planning

In 1985, eight out of 12 urban areas with 10 million or more inhabitants, existed in developing countries. By the year 2000, 23 urban areas will have populations over the 10 million mark and 17 out of these will be in developing nations.[16] These population concentrations suggest that to minimize any adverse environmental impacts of transportation use, people should situate themselves so that they may live close to where they work or work close to where they live.

Transportation and land use are inextricably linked. Neither one can develop without the other. Holistic development hinges on the efficient exchange of goods and services, and the accessibility for people to their necessities. This is increasingly being done in "Village Centres" where all facets of life including work, recreation and family functions closely revolving around a village core. The end result of the concept of "Villagization" is that the need to travel is considerably reduced and so are the negative effects of it.

Many large cities are finding that the most transport-efficient land use pattern combines a dense, well-mixed downtown with several outlying, compact centres of activity -- all linked by an extensive public transport system. This way, people can walk, cycle, and take short public transport trips within a given area, and can reach other areas via express bus or rapid light rail.[17]

8.0: Participatory Planning

When people perceive that they have a part to play in the planning process, very often an orientation toward any desired social change follows. All countries need to establish responsibility at the local level for a process that will guide future transportation development, balancing different modes, minimizing travel demand, and reducing the costs of land development. Only then can financially and environmentally sustainable principles be effective and workable. Integrated transportation planning means involving those who will be affected by any significant transportation initiative.

9.0: Least Cost Implementation

Integrated transport planning, to be socially and environmentally sustainable, needs a consideration of all measures which could be implemented at the least cost. One novel example of cost effectiveness has been introduced in Lusaka, Zambia, where an entire commuter rail transit system has been built by mounting the bodies from scrap buses onto the underframes of unserviceable wagons.

The Njanji Commuter Service ("Njanji" being the local word for rail) now runs through downtown Lusaka, with 25 of these rebuilt coaches. Each coach has a capacity of 65 seated and 35 standing, although loadings of up to 120 are quite common. This is a model of innovation and exists as the first purpose-built commuter railway in sub-Saharan Africa. Its advantages are immediately apparent. The commuter service remains the cheapest mode of modern transport in Lusaka and is thus very popular. Because of inexpensive fares, the service faces significant overcrowding. The demand is not surprising.

The service moves over 16,500 passengers per day and the entire 16km rail line was built for about US$1.5 million, a remarkable feat. Rail travel to include commuter and inter-city service, has been pinpointed by the Washington based WorldWatch Institute and the International Institute for Energy Conservation, to be the most economically and environmentally sustainable transportation infrastructure for moving large numbers of people from one place to another, notwithstanding other low cost transportation such as walking and cycling. For every passenger carried one kilometre, an intercity train uses one-third the energy of a commercial aircraft and one-sixth the energy of an automobile with a sole occupant. In developing countries where economic resources to develop are often scarce, the potential of the Lusaka example cannot be underestimated.

10.0: Conclusion

There are many challenges to a holistic integrated transport planning approach. Much time, energy and consultation is needed for its concerted application. Already, however, its benefits are clearly apparent. Improved accessibility, decreased travel times, better safety, energy conservation and pollution reduction are all signs of its effectiveness. However, in order for future transportation systems to be economically viable and environmentally sustainable, integrated transportation planning will need to fulfil a number of common goals. A rationalization and reduction of the use of automobiles is the first goal. A second, is to make public transport the most attractive means for medium and long distance journeys. A third, is to promote increased use of non-motorized means of travel and finally and most importantly, the conditions should be enhanced for increasing the proportion of journeys on foot. Only with these goals in mind will we have a reasonable hope of sustaining both our resources and our environment in the decades ahead.

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COMPLEMENTING TRANSIT IN OTTAWA-CARLETON
- Intermodal Partnerships for Bus Rapid Transit in the Nation's Capital

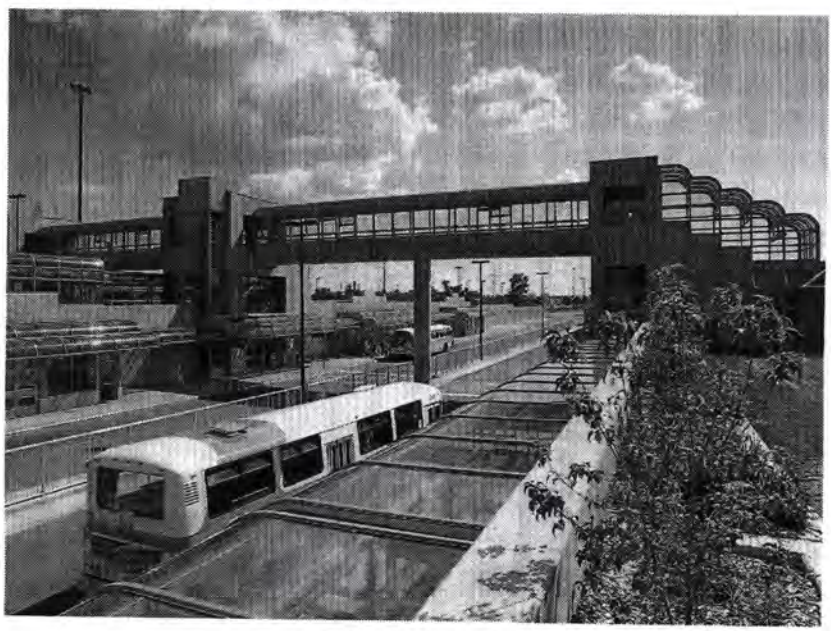
Dr. Helen E. Gault, P.Eng.
Ottawa-Carleton Regional Transit Commission

INTRODUCTION

OC Transpo Operations

The Ottawa-Carleton Regional Transit Commission, or OC Transpo for short, is a regional body which provides public transit for the 625,000 people who live in the urban area of the Regional Municipality of Ottawa-Carleton.

Regular transit services are operated with a fleet of 825 buses, which carried 73.5 million passengers in 1994. While most of the service is provided with 40-foot 'standard' buses, the fleet includes 164 60-foot articulated buses and 4 low-floor 25-foot Communibuses.



Blair Transitway Station

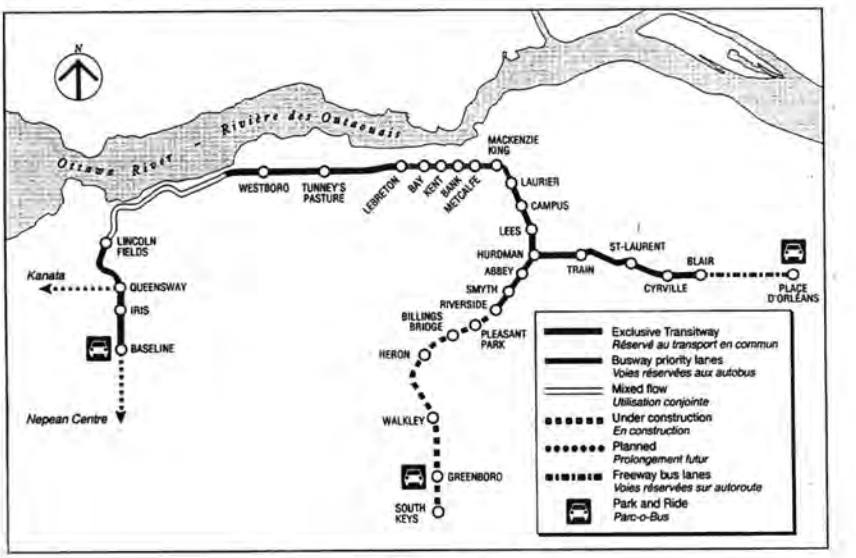
OC Transpo's regular transit services have an annual operating budget of approximately $160 million, a little over half of which is collected through fares, 28% is covered through local taxes and 19% is funded by the Province of Ontario.

As well as the provision of regular transit service, OC Transpo also provides specialized transit for people with disabilities, known as Para Transpo.

Para Transpo carries 700,000 trips per year through a contract with a private operator. OC Transpo staff are responsible for the registration of passengers, service reservations, passenger trip assignments and overall service quality and control.

The Transitway System

Ottawa-Carleton's rapid transit system takes the form of a busway system, known as 'The Transitway'. This exclusive bus roadway is currently 25 kms in length and has 18 stations. Approximately 200,000 passengers per day travel for some part of their trip on the Transitway. Passenger, peak hour volumes in the peak direction exceed 10,000 passengers per hour in the approaches to downtown Ottawa.



Ottawa's Transitway d'Ottawa

The Transitway provides a flexible rapid transit network, which is capable of being staged in such a way as to make early use of investments. Although the Transitway in the downtown area has not yet been built, and the east and west Transitways are connected by bus lanes on surface streets, it is estimated that without the Transitway, 145 more buses would be required to carry the same number of passengers.

Transitway operations permit the number of transfers passengers must make to be minimized through the extensive use of suburban express services in peak periods. This is a very important element in attracting and retaining 'choice' transit riders, ie. those who could use other means of travel, for whom making transfers is a deterrent.

Transitway stations are designed to provide a comfortable, sheltered and secure environment for waiting passengers. Public information is available at the stations, through printed schedules and maps, automated television screens and through direct-dial access to OC Transpo's public information office. There are pass and ticket sales offices at three Transitway stations: Lincoln Fields; St. Laurent; and Place D'Orleans. Park and Ride and Bike and Ride facilities are provided at same Transitway stations and kiss and ride facilities are widely available.

Other Transportation Service Providers

Ottawa-Carleton is situated close to the boarder between Ontario and Quebec. Transit service on the north side of the Ottawa River is provided mainly by the Société de Transport de L'Outaouais (STO). OC Transpo services penetrate Quebec to a limited extent, running into downtown Hull, while a large proportion of STO services run into downtown Ottawa.

There are also taxi services throughout the region, some of which service outlying Transitway stations through direct taxi telephone lines.

The major intercity and international public transportation providers in Ottawa-Carleton are: VIA rail train services which run to and from the VIA Rail Station east of downtown Ottawa; Voyageur Colonial intercity bus services which run from a bus station just south of the central core; and the airlines which operate from Ottawa MacDonald-Cartier International Airport in Gloucester, about 15 km south of downtown Ottawa.

As well as these motorized service providers, Ottawa-Carleton is also an area where cycling and walking are popular. Access to transit for pedestrians and cyclists is an important consideration in facility and service design.

Enhancing Opportunities for Multi-modal Travel

This paper illustrates ways in which OC Transpo is cooperating with other agencies to improve overall mobility in the National Capital Region. In particular three recent initiatives are used to illustrate opportunities for intermodal cooperation:

- providing rapid transit services to the Ottawa MacDonald-Cartier International Airport in partnership with Transport Canada and the National Capital Commission;
- working with Voyageur Colonial to provide better connections for passengers between intercity bus services and OC Transpo; and
- a multi-disciplinary study to determine ways to encourage use of transit centres and Transitway stations.

RAPID TRANSIT SERVICES TO THE AIRPORT

In the summer of 1995, the Southeast Transitway from Billings Bridge Station to South Keys Station at Hunt Club Road will open, which will mean that the southern terminal of the Transitway will be within a few minutes' of the Ottawa-MacDonald Cartier International Airport terminal building. This puts Ottawa-Carleton in a unique position to provide excellent public transit connections to downtown businesses and hotels. When the Southeast Transitway is in place it will be possible to travel by rapid transit from the airport to the central core of the National Capital Region in less than 25 minutes. It will also provide many Ottawa-Carleton residents with a fast connection to and from the Airport with their local bus route. Unlike other modes, this travel time will be unaffected by traffic congestion on the roads, and it can be provided at a competitive price.

It is forecast that this service could carry 10-15% of air passengers given good on-site facilities at the airport and a strong promotional campaign. The greatest market potential is for residents of Ottawa-Carleton who are making short trips for business or other reasons and people from outside the Region who are visiting downtown businesses or staying in hotels near the Transitway and who are not burdened with heavy luggage. In addition the service will make transit travel more attractive for airport employees.

In order to capitalize on this opportunity, OC Transpo staff have been working with Transport Canada and National Capital Commission staff to provide appropriate on-site facilities and public information. In addition, opportunities for a partnership in promoting this ride-and-fly service are being

explored with the airport authorities. Access to the airport via the Airport Parkway, which would provide the most direct route from the South Keys Station to the airport terminal, is being negotiated with the National Capital Commission.

This service was proposed in the fall of 1994, through OC Transpo's annual service planning public consultation process, and was enthusiastically received by members of the public

VOYAGEUR OPERATIONS ON THE TRANSITWAY

Since mid-November, under a one-year trial agreement, Voyageur's Montreal, Mirabel, Cornwall, Hawkesbury, Smith Falls, Kingston and Belleville intercity routes have been making stops at certain Transitway Stations to pick up or drop off passengers. For example, people travelling to Kingston can board Voyageur buses directly at Lincoln Fields Station while people travelling to Montreal have direct access to Voyageur's service at St. Laurent Station.



OC Transpo can purchase their Voyageur tickets at OC Transpo's public offices or on the Voyageur bus. Voyageur is also selling OC Transpo bus passes and tickets at their Catherine Street terminal. Prominently displayed posters at the Voyageur terminal and in Transitway stations advertise this cooperative venture.

Another element of the Voyageur experiment which enhances intermodal accessibility is the agreement that people wishing to connect with other Voyageur services may board inbound Voyageur trips at the Transitway stations served by Voyageur and travel directly to the Catherine Street terminal. The $5 fare paid for this local trip is set against the fare for the main Voyageur trip.

Overall, the experiment is proving successful. The increased cooperation between the two bus companies is beneficial for both, and more importantly, for passengers.

MOBILITY CENTRE STUDY

A third example of OC Transpo's commitment to enhancing mobility through the use of complementing modes is a study which is currently underway of mobility centres, or transit centres. The study, being carried out with the Regional Municipality of Ottawa-Carleton's Transportation Department, has the following objectives:

- to identify and recommend transportation services and facilities to incorporate into mobility centres in the RMOC;
- to recommend policies at all levels of government that will facilitate mobility centre development in RMOC;
- to develop a plan that identifies short and long term priorities for implementation of recommended facilities at identified mobility centres; and
- to develop guidelines for future mobility centres that will provide multi-modal transportation services.

The way in which this work has proceeded was first to categorize 'types' of mobility centre. In all six types of centre were defined. An example is 'an activity centre with a linehaul Transitway station'. Stations such as Tunney's Pasture, Campus and Lees are included in this category.

This categorization was then used to guide focus group discussions of the facilities that should be provided at stations of each type. For example, park and ride, kiss and ride, bike and ride, and taxi services were included in the focus group discussions, as well as internal facilities such as public information, heating and seating. The study also considered the possibility of opening Transitway stations to businesses. Amenities such as newspaper and magazine kiosks, convenience stores and vending machines were discussed.



Bike and Ride at Baseline Station

The focus group discussions were held with a cross-section of the region's residents.

The results of this study will be available in the late Spring, and it is expected that they will provide guidance about how to improve overall mobility in the region through the integration of transportation modes.

OTHER EXAMPLES OF INTERMODAL COOPERATION

Two other areas where efforts are being made to make transfers between modes easier are: integration with STO services; and rapid transit to the VIA rail station.

More than 1 million passenger transfers per year are made between OC Transpo and STO services. The two bus company's planning staff work closely together to avoid duplication and to ensure cost-effective interprovincial services. An important factor in simplifying interprovincial travel is an

integrated fare system. This has been achieved in the National Capital Region where OC Transpo's passes and transfers are accepted on STO buses and STO's on OC Transpo buses.

In addition OC Transpo and STO are currently participating in a project with the objective of developing ways to improve customers' information about interprovincial services. An example of this work is the joint development of a leaflet describing all interprovincial bus services.



'Train' Transitway Station

Transit service to the VIA rail station is of very high quality. 'Train' Transitway station is integrated with the VIA rail station and rail passengers can take a 7 minute bus trip to downtown Ottawa every 5 minutes during the day. OC Transpo staff have recently improved the public information available at VIA station by upgrading directional signage and improving display cases.

OC Transpo's system map has, over the years, shown an increasing amount of information about other modes. The map now shows a full range of information for modes from Park and Ride through airline service.

CONCLUSIONS

This is a broad topic to cover in a short paper. However, these examples show how positive steps are being taken by OC Transpo to ensure that transit services in the National Capital Region complement and are complemented by other modes of transportation as far as possible.

Overall, it is clear that it is in everyone's interests for public transport providers to work together to find ways of enhancing mobility. In this way the use of the private automobile can be minimized, with the attendant environmental benefits.

BUS-BASED PARK AND RIDE: A TOOL TO HELP THE URBAN CORE ECONOMY?

David M. Cape, Ryerson Polytechnic University
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I INTRODUCTION

Central Business Districts in many cities in North America are in trouble. Traffic congestion coupled with exurban relocation is all too familiar, there being usually some arteriosclerotic causality. One net impact is a declining property/business tax revenue base and an ensuing impact on the ability of cities to finance services. One way of stanching the flow of businesses away from the CBD is to maintain accessibility. Bus-based Park+Ride is one approach to traffic containment in Britain which has in the last decade in Oxford attracted up to 17% of commuters out of the automobile. North American urban cores could also benefit significantly from bus-based Park+Ride services, if a few fairly clear pre-conditions are met involving the physical components, the funding, and appropriate operational practices.

As in North America, in most British cities the demand for and supply of personal automobile services are moving at variance with one another. In England Park+Ride has emerged as one method of diverting excess demand. In some towns, proposed developments of new roads and parking lots have been forestalled as a result of the presence of a large number of "listed" buildings, all of which are to be preserved in situ for posterity (whenever that may come). In other towns, councils are unwilling to bulldoze even squalid housing to clear the way for more autos. These proclivities, coupled with the ever increasing demand for personal mobility, tend to ossify existing traffic arteries which, by the year, are attempting to carry ever more traffic. This, in turn, generates increasing pollution and slower traffic. Bus-based Park+Ride offers an alternative by reducing the amount of road traffic necessary to sustain economic activities in Central Business Districts.

II BUS-BASED PARK AND RIDE (P+R): The State of the Art

a. FUNCTIONS OF PARK+RIDE

As part of The Bolton Bus Study commissioned by the Greater Manchester Passenger Transport Executive [1994], Colquhoun Transportation Planning, drawing upon in particular work done for the English Historic Towns

Forum of June 1993 which this paper examines in further detail later, states that P+R performs several useful functions and, depending on the combination of attributes, has varying likelihoods of success. Colquhoun, however, laments that "...the determinants of P+R demand are poorly researched and understood at this time" [1,53].

The Colquhoun study is a useful, although incomplete and partially deceptive survey of P+R as will be explained later. A prime function identified by Colquhoun is **"to reduce the need for permanent (central area) parking, which releases central area land (for a higher economic use), reduces the capital cost component of (central area) car parking, and reduces central area traffic movements."** Colquhoun might have added "and roadways" for completeness.

A second function is that of **"permitting temporary use of redundant land."** The concept of redundant land is, however, unknown to economists, for whom all resources are valued in their next best alternative use. Presumably, Colquhoun refers here to currently low value land, but if so, his use of "temporary" has ominous connotations for any permanent P+R operations which might be set up on such land.

Yet a third function is **"...to provide a cheap method of access to central areas to meet expected growth."** In the eyes of the sustainability faction, excessive growth should be neither encouraged nor expected. Rather, serious efforts should be made to halt growth where diseconomies of scale might prevail, or even downsize using more appropriate technology as well as less intrusive manufacturing and distribution systems. Perhaps serious consideration of that viewpoint at both the central government level and that of local councils, might lead to a reduction in the urban growth forecasts. This approach has major adverse implications for freedom of selection of places to live and work, a communistic point that is well beyond the scope of this paper. Colquhoun ignores P+R's potential to slow expected decay.

The remaining objectives include the **provision of greater access for the "mobility-challenged"**, and **reduced traffic levels** which, according to the author, would reduce travel times for the remaining car travellers, as well as reduce accidents (questionable), and reduce environmental impacts (also questionable). The traffic accident issue is questionable in that at heavy congestion with very low speeds accidents are both more easily avoided and tend to be less serious than at faster speeds. Faster traffic, and less of it, could in fact generate more, and more serious accidents.

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1 Colquhoun Transportation Planning, (1994) The Bolton Bus Study, commissioned by Greater Manchester Passenger Transport Executive.

As far as the environmental impacts are concerned, recent findings suggest that the burning of diesel fuel is carcinogenic as is the burning of some gasoline [2,122]. Cleary [3,157] cites Marriott and Dickenson 1990 in stating that unleaded fuel using benzene to replace lead is also carcinogenic. Lead or benzene - what's YOUR poison? Colquhoun's functions are therefore somewhat deceptive, though probably well-meant.

b. COMPONENTS

Operationally P+R has three financial components:

1) the sources of funding,
2) the collection of funding, and
3) the recipients of the funding;

And four physical components of parking and transportation:

1) a suburban collection/ distribution point,
2) either a CBD collection/distribution point or central area delivery/pick up service,
3) a link connecting (1) and (2), and
4) a system to collect riders from suburban residences and transport them to the suburban collection/distribution point.

Turning first to the financial components, most P+R operations have a user pay component, but also most Park+Ride operations are subsidized by city councils in one way or another - tax relief, cash contributions, and capital subsidy being the more common. An indirect subsidy can be considered where express rights of way are provided, thus cutting operators' costs.

Collection may be on a per carload or per rider basis. Each has, of course, differing implications. Carload pricing would control use of the parking lot, and is discussed later under operational concerns, but most installations provide free car parking and charge only for the line-haul travel cost, sometimes at a substantially discounted rate. In Southport, for example for the princely sum of 20p (CAD $0.45) including parking fee! the Park+Rider gets frequent, non-stop service into town, generally with a choice of seats.. A resident from local streets midway between the P+R site and downtown pays three times that amount for indifferent, less frequent, stopping services. Clearly, this is an equity issue which sees travellers from more remote points being given priority in terms of either speed or fare or both over commuters who

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2 Whitelegg, J. (1993) Transport for a sustainable future: the case for Europe, London, Belhaven 0-47022-018-X p.122

3 Cleary, Johanna (1992) "Benign modes: the ignored solution" in Whitelegg, J. Traffic Congestion op.cit. p.157

travel shorter distances. Such a policy designed to appeal to longer distance commuters, discriminates against, and even alienates, the local rider.

Another, relatively small, funding source is advertisers. In Oxford, one double deck vehicle is sponsored by the Fox-FM radio station which plays its relaxing product for the riders en route, many appear to enjoy the entertainment [4], satisfying the frequent claim that many people who travel by auto do so to listen to music - a supposed modal choice factor. There seems to be more potential for directed advertising by CBD businesses.

Recipients of the funding, on the face of it are the carriers, but indirect benefits obviously accrue to the riders and to the CBD.

Consider, now, the options available for each of the four component physical parts.

1. For the *suburban collection/distribution point* some cities (or operators) simply find some low-value land and either pave it or lay grass-penetrating concrete blocks. Other places, such as Tampa Florida, have simply struck deals with available facilities such as local churches to allow transit riders to park at the church on weekdays when church demand is slight.[5] Some towns in Germany have purpose-built multi-level parking structures complete with internal vehicle loading platforms, security for both passengers and parked vehicles, convenience stores and snack bars. In Seattle some suburban collection/ distribution points serve dual duty by allowing car drivers to change either on to the transit service or on to their own bicycles. In Copenhagen, the suburban collection/distribution serves yet another function, that of being a remote parking lot for bikes, the riders of which subsequently hop on transit. Seattle has some provision for carrying riders' bikes on the outside of buses.

2. For *the central area delivery/pick up service* in some towns, services have only one drop-off point, for example the railway station; others, such as Oxford, provide bus services with several pick-up/drop-off points throughout the CBD and along the way. There, bus services run through town from one P+R site to another, so while the bus is dropping off riders from one lot it is available for boarding riders outbound to another. The quality of the waiting space is also important. In Oxford there are some bus shelters for waiting passengers in case of inclement weather, although these tend to be insufficient

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4 Personal experience, August 1994

5 Sharon Dent, Executive Director, Hillsborough Area Regional Transit, Personal conversation with the author, August 10, 1993

and of woefully inadequate size to handle rush hour traffic. Little effort seems to have been done to estimate the importance of such "comforts".

3. For the *link between the CBD and the suburban collection/ distribution point*, some locations use rail-based services (railheading), as is common in Canada, but most others are bus based. Some provide dedicated buses on exclusive rights of way, while others use service buses on city streets with no bus priority; Seattle even encourages commuters to use their own bicycles on specially created bike paths.

4. The fourth component, the *link between the residence and the suburban collection distribution point*, may be more problematical, raising an economic danger to existing local area feeder services. As the intended purpose of P+R is to foreshorten car ridership into town to alleviate congestion in town, what may instead or also happen is that bus passengers may be diverted from the local feeder bus into their own cars.[6] This has implications for the continued financial viability (if any) of the suburban feeder services. Few feeder services are however money-spinners, and where services must be cut-back or even withdrawn as a result of declining patronage, there are socio-economic implications for the non-car travelling populace including children, the aged, the infirm and the financially challenged.

c. SUCCESSFUL VENTURES.

Perhaps the most successful Park+Ride services in Britain are those in the English Historic Towns - Oxford, Chester, York, and now Cambridge. In each of these cities economic growth has been constrained by the proliferation of "listed buildings" which must be preserved as-is for the future, preventing their removal or demolition to build more roads or parking lots. These towns are, however, under attack from ever-increasing numbers of tourists and business persons who wish to access the town and consequently park in the central areas; and also from the effects of air pollution, not a small amount of which has been generated by the internal combustion engine. To help overcome this squeeze, P+R has been recognised as one way to reduce central area traffic, usually as part of a broader transportation policy bundle.

d. GOOD PRACTICES.

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6 Parkhurst, Graham "Park and Ride: Could it lead to an increase in car traffic" Presented to the 22nd PTRC September 1994; and Whitelegg, J. (July 1994) in discussion with the author.

In June 1993, the English Historic Towns Forum, currently a collection of some 49 towns, published Bus-based park and ride: a good practice guide [7] . This is at present considered to be "the" seminal work in Park and Ride. It covers the period since 1980 where 15 operations commenced, since when all systems but Oxford's closed for a re-think but, by 1993 at least 20 systems had re-developed to the point where they are now considered successful. This guide provides chapters on: Justification of the need for P+R, Choice of site and site design, The service provided, Tips on selling and financing the system, and a dozen case studies including three locations where problems were encountered. As the organization's primary objective is "to promote and reconcile prosperity and conservation in historic towns" [8,64], one can deduce a congruency with the theme of this paper which is to assess the impact of park and ride on the economy of the central business district.

The EHTF rightly sees park and ride as part of an overall strategy involving the pricing of long-stay parking, and a relatively fast travel speed of the P+R vehicle as compared with the private car. In addition, the concept has to be convenient and well marketed. A firm commitment is necessary on the part of all engaged in the provision of public sector Park & Ride [9,39] In general, sites in excess of 500 spaces allow for "the most cost-effective and efficient bus operation," [10,16] Although the EHTF suggests a minimum capacity of 500 cars, many successful lots are smaller. (e.g. Preston - 280).

A seven to ten minute frequency is seen as necessary, with more frequent well-maintained and relatively full minibuses preferred to shabby, less-frequent and sparsely laden 80-seat double-deckers in order to convey the image of popularity with the public. [11,28] Most services run ex-Sundays 07:30 - 18:30, although one Oxford service (to Redbridge) runs until 21:30 (1994). Clearly, the issue of keeping commuters in town for evening activities is not yet generally considered lucrative -even in Oxford for university theatrics.

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7 English Historic Towns Forum, Bus-based Park and Ride: A Good Practice Guide, Bath, EHTF, 1993 0-86063-611-9

8 op. cit.

9 Op. cit. p.39

10 Op. cit. p.16

11 Op. cit. p.28

The EHTF recognizes that the charging system selected has to cover use of the remote parking space as well as the return journey to the centre. Some systems charge for parking with a free ride, others do the converse. The former favours the full automobile (which should be preferable), whereas the latter favours the single rider. In both cases there is a potential for abuse as stated above. In the first case by non-parkers, unless a parking ticket has to be shown which means multiple riders must converge and travel together. In the second case, by parkers who are not destined for the town centre. Multi-ride tickets are also available in certain circumstances.

Operator competition is also addressed. In Oxford, services provided by the Oxford Bus Company compete with "Park and Glide" services run by Thames Transit Ltd. Together these two companies collectively intercept 17% of all city-bound car traffic -the largest in England. Thames Transit Ltd. uses its own service mini-buses rather than the dedicated P+R service buses used by the former. Consequently, the Park and Glide service is slightly slower by having intermediate stops. By not leaving prospective customers waiting at intermediate stops, this defuses intra-route patron hostility to P+R. De-regulation and the single or multiple franchising of services suggest that the operational specification of the service be closely monitored by the local authority. [12,33]

In terms of selling the system, the EHTF recognises the value of a strong (favourable) image. Also one must consider selling the P+R service - to whom? Parkhurst and Stokes (1994) in preliminary findings [13,1] note that more women than men and more people in the younger decades use P+R. With a future aging population, this author would expect P+R to be designed in the future to appeal also to the more elderly, but still mobile segments of society. Indeed, those authors compute that P+R generates 10% of trips, i.e. without P+R the trips would not be made. "Hence," they comment "park and ride sites have economic benefits to the city."[14] That benefit, when estimated and included in the sums, will help turn P+R into an economically sound venture. Knowing the wider benefits should make councils more willing to subsidize in order to create a commercial basis for the operators.

The EHTF recognizes that a commercial remit is desirable, and believes that

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12 Op.cit. p.33

13 Parkhurst, Graham and Stokes, Gordon, "Park and Ride in Oxford and York: Report of Surveys (1994)" TSU Ref: 797 p.1

14 Ibid.

> if the local authority retains control of the Park & Ride operation by collecting a single charge at the car park and uses a tendered bus service there is no reason why a successful scheme should not eventually operate without the need for a subsidy. [15,39]

As any good economist will suggest, the EHTF recommends capture of at least some of the consumer surplus acquired by NON-users as a result of the P+R operation to help defray some costs.[16] The document then provides a step-by-step suggestion as to how to get a new P+R proposal rolling.

e. LESS SATISFACTORY APPLICATIONS.

Problematically, the EHTF looks particularly at Cambridge, Nottingham and Cirencester. Cirencester is only slightly more than a village and so not really comparable. In the case of Cambridge, initial problems came from not only user resistance, but from conflicting attitudes of involved authorities and a perception that the lots were encroaching on the Green Belt. The lesson learned in Cambridge was the necessity for a full and complete discussion among the involved parties prior to launch. The problems in Cambridge have now been overcome.

In the case of Nottingham, a "collar control" was initiated to deflect inbound and through-bound automobiles on to a ring road. Although the system was well-designed it received bad media coverage both nationally and internationally which discouraged local users. Additionally, many vehicles slipped through the collar to use the many free parking places in the city which were outside council control. As recently as 1990 Nottingham is taking steps to re-introduce Park and Ride. In January 1991, Preston and Wardman wrote a paper for Nottinghamshire County Council on "Forecasting Motorists Long Term Behaviour in the Greater Nottingham Area"[17]. In the report the authors claim that Park and Ride could cater for up to 7% of travel into Nottingham if, as they stress, it is part of an overall traffic management package. This compares to the 17% already captured by P+R in Oxford.

The Forum concludes that P+R is generally viable as an integrated component of transportation planning, but as a stand-alone policy has a much less certain fate.

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15 Op. cit. p.39

16 ibid.

17 Dr. J. Preston and Dr. J. Wardman, "Forecasting Motorists Long Term Behaviour in the Greater Nottingham Area", Working Paper 322, Institute for Transport Studies, Leeds.

Because documentation of British P+R activities has been perhaps done more thoroughly and made more widely available than elsewhere, this section will provide a brief overview of operational concerns of essentially British Park and Ride (P+R) operations.

f. OPERATIONAL CONCERNS.

There are six main operational concerns

i. Dedicated vs. shared service

The carrier may provide either a dedicated service or a service shared with non-P+R users. Shared services often lose the "limited stop" speed advantage, but the trade off is less frustration for intermediate point riders.

ii. Frequency and service speed.

As far as frequency is concerned, the EHTF suggested that service should be every 7-8 minutes (peak) and at least every 10 minutes off peak (many operators do not meet this headway), and the service should not only travel at full traffic speed to the centre, but ideally travel in a bus priority lane faster than car traffic speed.

iii. Multiple destinations and vehicle size.

P+R service should serve several in-town locations on a regular basis. Smaller vehicles are both easier to divert through traffic calmed areas and, with a given ridership because they have a low capacity, the load factor is and LOOKS greater giving an impression of busy-ness, ergo success.

iv. Commercial vs. contracted out.

Whether service is commercial or contracted out is, in Colquhoun's eyes, important. That issue is, however, a complete red herring, as any characteristic that is desired by council can be made to be a pre-requisite of a franchised service, with subsidy provided as and when necessary.

v. Parking lot location and security.

The location and set-up of the parking lot or suburban collection/distribution point is critical to its success. It needs to have plenty signs to attract potential users from two or three adjacent radials, and should be located on the in-bound side of the radial route and be equipped with easy entry. Speed of access to the CBD is deduced to be of greater importance than egress at the end of the business day. Security for both vehicles and occupants should be provided, perhaps by closed-circuit television (CCTV), by security staff, and by "bus always on site" or by ensuring adequate ancillary use outside its peak hours, for example by provision of a recycling centre.

vi. Pricing policy for CBD parking facilities.

Critical to the success of P+R is a restrictive (relatively expensively priced) central area long-stay parking policy. P+R has multiple target markets - journey-to-work, shopping, recreation, and social. Depending on which is the prime focus group so both long-stay and short-stay pricing policies for parking will be important, as will the charging policy for use of the service. Charging by carload (parking lot user fee) has differing implications than applying a per-capita fee (bus ticket). The parking lot fee encourages car-pooling but adds difficulties in controlling bus use. A bus rider fee by itself does not control use of the parking lot by non-riders such as those wishing to conduct local business.

Tickets may be issued on a single use basis, or a multi-use basis but very few operators in Britain, if any, offer a family pass such as is in use in Toronto on weekends and holidays, where multiple riders may use a combined ticket while travelling together.

g. Financial prospects.

Let us return now to financial estimates of P+R operations. At the PTRC Conference on Park and Ride 31 March 1992, Ian Mitchell of Colin Buchanan and Partners provided some estimates of bus service costs in 1992 figures. Mitchell calculated to break even with a 15 km/h journey speed over a four mile run on a 10 minute headway using a high-specification bus (kneeling, wheelchair accessible, etc.) that between 400-800,000 passengers per year would be necessary. Using a 300 day year translates these figures into 1,300 - 2,600 passengers/day (Oxford is typically 3,800 but up to 12,000 at Christmas). However a 25 km/h service using a small-new or large-old bus would, according to Mitchell, only need one quarter of that ridership - 350 - 700 per day.

An economic analysis of an hypothetical P+R scheme presented at that same conference by Kingsley Lewis, also of Colin Buchanan and Partners based on a 1000 space facility taking present value effects up to the year 2010 comes up with a *negative* net present value of about 13% of the cash subsidy required, the other 87% being benefits to travellers. So, even including the benefits to non-users, P+R under those assumptions is a net COST to society. This analysis, however, does not APPEAR to reflect the benefits accruing to the local economy. This is an issue which this author feels crucial to the economic success of P+R, and which may, if correctly assessed, put P+R in a more favourable light. It is the intent to rectify this short-coming in a future paper.

h. SYSTEM CRITICISM

At the one-day conference at Aston University (April 20, 1994) with the theme: Park and Ride: Increasing the chances of success Barry Simpson opened the proceedings with a synopsis of the successful strategies in Britain to date. These were basically those explained above. He claimed, however, that P+R is a profligate use of resources, both by using suburban land and by leaving cars unproductive and at the mercy of vandals. Carried to its extreme, this myopic perspective suggests a car owner is illogical in stopping the vehicle from creating passenger-kilometres or freight tonne-kilometres instead keeping the car in continuous operation. To be fair, though, there are estimates that a car is in productive use only 2.8% of the available time - but if owners did not value the use and *potential* use of the car, they would not buy. Regarding the land, it may only have a marginally low value in its next best alternative use. Hardly profligacy, only the *difference* should be calculated. Rather than look at only land, such logic should consider the total resources saved by P+R. The author does, however, go on to suggest incorporation of road pricing schemes in the total transportation strategy package. This latter is Simpson's contribution.

In another document Simpson, after being very cynical of the political approval process, goes on to observe the very poor customer service provided to many P+R users with the expectation that the users are "too old, too young, too ill-informed or too lethargic to create the political rumpus needed to get better services."[18] P+R certainly has its share of determined critics as well as devotees.

i. SYNTHESIS

A fairly cogent case has been made for integrating P+R into urban transportation policy as part of a bigger package. Several analysts have used this framework to assess the likely success of new P+R exercises. Among them, Colin Buchanan and Partners; the School of Planning, Oxford Polytechnic (now Oxford Brookes University); and the University of Westminster provided access to a selection of their cases for inspection, all of which recommend a similar strategy. Even the European Federation for Transport and Environment in its January 1994 document Green Urban Transport: A Survey [19] recognizes some potential for Park+Ride, but only as part of a bigger strategy, and at that only reported in less than three lines on page 32 of the 45 page document. Clearly, in the eyes of the EFT&E, P+R is not likely to be the saviour of mankind. This is probably a correct assessment, particularly in areas of overlapping conurbations.

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18 Simpson, Barry J. (Date?) Urban Public Transport Today, Andover, Spon,0-419-18780-4 Promotional Document

19 EFT&E (1994) Green Urban Transport: a survey, Brussels No ISBN.

Cape

III PARK AND RIDE - NORTH AMERICAN PROSPECTS

Regarding the U.S., Fielding says:

> After two decades of expansion, the American transit industry has begun to consolidate its rejuvenation and emphasize more efficient production of service. Transit has not been able to restructure cities as it did in the first decades of this century. Nor has transit been especially effective in conserving energy or reducing air pollution. However transit does play an important role in reducing peak-hour congestion in the central city and along arterial corridors between the CBD and the suburbs. Peak-hour commuter travel is a market that transit has retained and is now expanding to accommodate travel to and from the regional megacenters emerging in the outer suburbs. [20,245]

And Jones recognizes, as in the case of Leeds, that:

> Transit policy is a social contract in which many parties have a stake and an interest: the transit rider, the transit worker, the taxpayer, the downtown employer, the motorist, just to name a few [21, vii]

Strangely, Jones noticeably omits the transit operator. Included in the "few" are merchants, and downtown business associations, such as the Board of Trade of Metropolitan Toronto. The latter is actively involved in traffic efficiency in Toronto. [22] All these stakeholders have an interest in the appropriate use of Park and Ride systems but even in March 1995, little effort has been made in North America to analyze extant P+R operations, operators simply do not collect and file the appropriate data...yet [23].

While the star Park+Ride cities in England are Oxford, Chester and York have geographical constraints much different from North American cities, the public is increasingly being lured out of the automobile by both incentives and penalties. A convenient and frequent Park+Ride scheme using special accelerated and unimpeded bus routings coupled with disincentives such as severe non-bus traffic congestion forced along circuitous routes, high long term parking rates, and outright automobile bans in parts of the core appears to tip the scales against the motorist. Oxford is even experimenting with battery-powered buses to help curb CBD atmospheric pollution.

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20 Fielding, Gordon J. "Transit in American Cities" in Hanson, Susan (ed.) op. cit.

21 Jones, David W. Jr. Urban transit policy: An economic and political history, Englewood Cliffs: Prentice-Hall Inc.

22 The author is the chair of that sub-committee.

23 Personal discussion with the Librarian, American Passenger Transit Association, Washington D.C. September 7, 1994.

Driving to a transit station is not uncommon in Canada's major cities, but usually the public transport mode is rail - light rail, heavy rail, or subway. All three of these tend to be rather capital intensive, expensive to install and operate, and very expensive to modify significantly in either route or capacity. Bus based Park+Ride does not suffer from these shortcomings and has been increasing in importance in England and in Europe in the last decade. Vancouver actually has gone "one step beyond" Park+Ride for twenty years. Its "hub-and-spoke" bus services use isolated hubbing points at which feeder and main line buses are timed to converge regularly. This system does not pose the threat to local distributor services discussed earlier as suburban parking lots are either absent or not served well. Unfortunately , this hub-and-spoke concept is the exception rather than the rule.

Already several concepts are in place in parts of Canada that would mesh well with Park+Ride. Among these are:

i. Express Bus Routes - Toronto, Vancouver
ii. Limited Stop Services - Toronto, Vancouver
iii. Contraflow lanes - Montréal (Pie IX)
iv. Diamond Lanes - Montreal, Toronto, Mississauga
v. Suitable suburban parking lot sites

a. PRECONDITIONS FOR SUCCESSFUL BUS-BASED PARK+RIDES.

i. Ability to preclude cheap long-term CBD parking
ii. A general concern that all is not well in the CBD.
iii. A willingness to endorse the Park+Ride concept.
iv. A willingness to entertain car-reduced CBD precincts.

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RÉSEAU DE CAMIONNAGE

Pierre Mercier, Ministère des transports du Québec

RÉSUMÉ

Le ministère des Transports a commencé un projet visant à mettre en place un réseau routier de camionnage sur les chemins publics qui sont entretenus par le Ministère. Ce projet s'inscrit dans les choix stratégiques du Ministère dont, entre autres, la conservation du patrimoine routier. Il dote le Ministère d'une vision globale facilitant la gestion de la circulation des véhicules lourds sur le réseau routier québécois.

En collaboration avec Revenu Canada Accise, Douanes et Impôt, des mesures seront prises de manière à favoriser une meilleure circulation des véhicules lourds aux frontières. Ainsi, les camions long courrier seront dirigés vers des postes de douanes offrant des services améliorés. Les partenaires du Ministère dont les municipalités, les camionneurs et la Société de l'assurance automobile du Québec sont associés au projet.

Les objectifs poursuivis par ce projet sont de :

- diriger les véhicules lourds sur un réseau routier plus approprié pour minimiser la détérioration des infrastructures et réduire les inconvénients que présente la circulation des camions en dehors des grandes artères;
- faciliter le contrôle routier et ainsi atteindre plus facilement les objectifs de protection du réseau, de sécurité routière et d'équité entre les transporteurs;
- permettre aux municipalités de planifier plus facilement la circulation des véhicules lourds (plaintes reliées au bruit, à la pollution, à la vitesse, aux dommages causés au réseau, etc.);
- permettre au ministère des Transports et aux municipalités de cibler les interventions visant à améliorer le niveau de service des routes les plus utilisées (meilleur service à la clientèle-camionneurs).

1. INTRODUCTION

En décembre 1991, le ministère des Transports du Québec (MTQ) publiait la Politique de circulation des véhicules lourds et des matières dangereuses au Québec. Cette politique s'appliquait sur tout le réseau routier québécois, c'est-à-dire tant celui à l'entretien du Ministère que celui à l'entretien des municipalités. Elle établissait les critères permettant aux directions régionales du Ministère et aux municipalités d'interdire la circulation des véhicules lourds sur les chemins publics. Même si cette politique répondait au besoin de pallier à la gestion du cas par cas, elle ne permettait tout de même pas au Ministère de gérer le réseau routier québécois en vertu d'une vision globale.

En effectuant son exercice de planification stratégique, le Ministère a défini sa mission, qui est d'assurer, sur l'ensemble du territoire québécois, la circulation des personnes et des marchandises par le développement, l'aménagement et l'exploitation d'infrastructure et de système de transport.

Depuis, le gouvernement du Québec a transféré aux municipalités la responsabilité en matière de voirie locale. Cette dévolution de plus de 33 000 kilomètres de routes a entraîné une augmentation du nombre de demandes, de la part des citoyens, pour fermer des chemins publics à la circulation des véhicules lourds; il est important de développer des outils adéquats pour gérer ces demandes.

De plus, le ministère des Transports a entrepris une réorganisation administrative dont un des objectifs vise à rapprocher les centres de décision des clientèles. Enfin, il a décidé, par le biais du projet de réseau de camionnage, de se doter d'une vision globale facilitant la gestion du réseau routier québécois.

2. RÉSEAU DE CAMIONNAGE

En octobre 1992, la Direction du transport routier des marchandises a procédé à une étude de faisabilité pour établir un réseau de camionnage qui aurait entre autres pour effet de réduire le nombre de postes de douane autorisés au camionnage en transit.

En novembre 1992, le Comité de direction, après l'analyse des résultats de l'étude de faisabilité, donnait son accord à la production d'une carte routière, faite à partir des plans régionaux. Il s'agissait d'identifier un réseau privilégié de camionnage sur les chemins publics demeurant à l'entretien du MTQ.

2.1 Problématique

Des camions en provenance ou à destination des États-Unis traversent la frontière à différents endroits et se retrouvent ainsi sur les routes secondaires ou locales plutôt que sur les grands axes routiers. De plus, il est bien connu que certains camionneurs contournent les postes et aires de contrôle pour éviter les vérifications. Les élus des localités touchées se plaignent des dommages que causent ces véhicules lourds au réseau routier construit pour des charges limitées. Ils déplorent les inconvénients associés à la circulation de tels véhicules que doit subir la population (achalandage sur le réseau, bruit et pollution).

Depuis la déréglementation économique du camionnage au Canada en 1988, l'industrie demande un resserrement des contrôles des camionneurs en provenance de l'étranger. En fait, les camionneurs canadiens se plaignent de la concurrence déloyale que leur font certains camionneurs étrangers qui circulent sans permis ou sans payer la taxe sur le carburant. Pour solutionner ce problème, il est proposé de mettre en place un réseau de camionnage. Le MTQ a déjà entrepris des actions dans ce dossier avec Revenu Canada Accise, Douanes et Impôt pour identifier des postes de douane dédiés au camionnage en transit et avec la Société de l'assurance automobile du Québec (SAAQ) qui est responsable des contrôleurs routiers.

De manière à bien informer ces partenaires (camionneurs, industries, municipalités, etc.), le MTQ a débuté la confection d'une carte routière de camionnage, carte qui les informe des restrictions (limitations des charges pour les ponts, hauteur libre des structures, circulation interdite, etc.). Cette carte identifie également les services disponibles aux camionneurs (haltes routières, postes de douane, etc.). Elle servira à diriger les camionneurs sur un réseau où les restrictions seraient très limitées. De plus, elle leur indiquera le réseau routier sur lequel plusieurs restrictions pourraient les empêcher de circuler. Enfin, elle permettra au MTQ de mieux cibler les interventions permettant d'améliorer le niveau de service et la sécurité sur les routes de camionnage de manière à attirer davantage les poids lourds sur un réseau plus approprié. Ce réseau de camionnage permettra également aux municipalités et aux MRC non seulement de cibler les interventions sur leur réseau routier mais également de planifier plus facilement l'aménagement de leur territoire (exemple : parc industriel).

2.2 Objectifs du réseau de camionnage

Les objectifs du réseau de camionnage sont de :

- diriger les véhicules lourds sur un réseau plus approprié pour minimiser la détérioration des infrastructures et réduire les inconvénients que présente la circulation des camions en dehors des grandes artères;

- faciliter le contrôle routier et ainsi atteindre plus facilement les objectifs de protection du réseau, de sécurité routière et d'équité entre les transporteurs;

- permettre aux municipalités de planifier plus facilement la circulation des véhicules lourds en milieu urbain (les plaintes reliées au bruit, à la pollution, à la vitesse, aux dommages causés au réseau, etc.);

- permettre au MTQ et aux municipalités de cibler les interventions permettant d'améliorer le niveau de service des routes les plus utilisées (un meilleur service à la clientèle-camionneur).

2.3 Option retenue

Trois options ont été développées et présentées au Comité de direction du MTQ. Ces options présentaient tous des avantages et des inconvénients.

Option A) **VERT : Autorisé à tous camions**
ROUGE : Interdit à tous camions (sauf local)

AVANTAGES

- Standard nord-américain;
- facile à contrôler;
- panneaux sur le terrain ont force de loi.

INCONVÉNIENTS

- Camionneurs «long courrier» mal orientés sur le réseau régional;
- beaucoup de panneaux d'interdiction inutiles;
- permet difficilement au MTQ et aux municipalités de cibler des interventions pour améliorer les routes de camionnage.

Option B) **VERT :** Autorisé à tous camions
JAUNE : Interdit à tous camions (sauf local et régional)
ROUGE : Interdit à tous camions (sauf local)

AVANTAGES

- Représente la réalité, 3 types de camionnage - 3 types de routes;
- oriente bien le camionneur «long courrier»;
- permet de cibler les interventions pour améliorer les routes de camionnage.

INCONVÉNIENTS

- Nouvelle notion de camionnage régional / notion origine-destination régional / laisse place à l'interprétation;
- oblige une carte réglementaire puisqu'il n'y aurait pas de panneau d'interdiction sur le réseau régional;
- pas un standard nord-américain;
- difficile à contrôler;
- on revient à réglementer le camionnage général par région (ex. : camionnage en vrac, camionnage général avant la déréglementation).

Option C) **VERT :** Autorisé à tous camions
JAUNE : Indicatif pour le camionnage régional et local seulement
ROUGE : Interdit à tous camions (sauf local)

AVANTAGES

- Standard nord-américain;
- oriente bien le camionneur «long courrier»;
- permet de cibler les interventions pour améliorer les routes de camionnage;
- simple à contrôler;
- le réseau régional (jaune) fait le tampon entre le réseau de camionnage (vert) et le réseau interdit (rouge);
- avec l'expérience, on pourra dans le futur restreindre ou assouplir la circulation des camions en se servant du réseau régional comme soupape;
- applicable à court terme.

INCONVÉNIENTS

- Pourrait ne pas régler certains problèmes régionaux.

Le 7 juin 1993, le Comité de direction donnait son accord à la production d'une carte préliminaire de réseau de camionnage et acceptait le principe de classement des routes selon l'option C, soit les trois niveaux de route identifiés par les couleurs vert, jaune et rouge. Voici une définition de ces niveaux :

2.3 Classification du réseau de camionnage

ROUTES DE TRANSIT (VERT)

Routes dont l'accès est autorisé à tout véhicule lourd. Ces routes comportent un minimum de restrictions à la circulation des véhicules lourds.

Note : Le niveau de restriction minimale pour le camionneur sur ce réseau fait en sorte que ce dernier devrait être incité à l'emprunter le plus souvent possible.

Les routes de camionnage constituent donc les principales routes pour le camionnage en transit. Ce sont surtout les autoroutes et les routes nationales.

ROUTES RESTREINTES (JAUNE)

Routes dont l'accès est autorisé à tout véhicule lourd. Ces routes comportent certaines restrictions à la circulation des véhicules lourds.

Note : Le camionneur devrait emprunter ce réseau sur la plus courte distance possible pour atteindre le réseau routier de transit.

Ce sont surtout les routes régionales et les collectrices et elles seront principalement utilisées pour le camionnage local ou interrégional.

ROUTES INTERDITES (ROUGE)

Routes dont l'accès est interdit aux véhicules lourds. Des exceptions sont prévues essentiellement pour des fins de transport local. Ces routes comportent de nombreuses restrictions à la circulation des véhicules lourds.

Note : Ces routes sont identifiées par les panneaux de signalisation appropriés «Accès interdit aux véhicules lourds» auquel est joint un panonceau «Excepté livraison locale».

Le panonceau **"Excepté livraison locale"** permet aux véhicules suivants de circuler :

- un véhicule routier dont la masse nette est inférieure ou égale à 3 000 kg.
- un véhicule effectuant une cueillette ou une livraison sur le chemin fermé aux véhicules lourds;
- un véhicule en provenance ou à destination de son port d'attache situé sur le chemin fermé aux véhicules lourds;
- un véhicule servant à faire l'entretien, la réparation ou le remorquage d'un autre véhicule situé sur le chemin fermé aux véhicules lourds;
- un véhicule effectuant un travail ou donnant un service sur le chemin fermé aux véhicules lourds (exemple : service d'utilité publique, chasse-neige);
- un véhicule hors normes circulant sur le chemin fermé aux véhicules lourds en vertu d'un permis spécial de circulation de classe 6 ou 7 prévu au Règlement sur le permis spécial de circulation. Il est à noter que le permis spécial de circulation doit autoriser expressément le véhicule hors normes à circuler sur le chemin fermé aux véhicules lourds;
- un autobus, un minibus et un véhicule récréatif;
- un véhicule d'urgence (exemple : un véhicule pour combattre les incendies, une auto-patrouille, une ambulance;
- un véhicule circulant sur le chemin fermé aux véhicules lourds pour rejoindre un point situé sur un chemin enclavé par cette interdiction.
- À la machinerie agricole, aux tracteurs de ferme, aux remorques de ferme et aux véhicules de ferme, tels que définis dans le règlement sur l'immatriculation des véhicules routiers (décret 1420-91 du 16 octobre 1991).

Il y a lieu de considérer comme une seule et même prohibition toutes les prohibitions sur des chemins contigus et ce, indépendamment si l'entretien est à la charge d'une municipalité, de plusieurs municipalités ou du ministère des Transports.
Une quatrième couleur est également identifiée sur les cartes de réseau de camionnage afin de faciliter la compréhension du réseau par les camionneurs.

ROUTES MUNICIPALES (GRIS)

Routes dont l'entretien est sous la responsabilité d'un municipalité et dont l'accès **peut être** interdit à la circulation des véhicules lourds.

Note : Les restrictions à la circulation des véhicules lourds n'apparaissent pas sur la carte.

2.4 Motifs justifiant les choix de couleur

L'exercice du choix des couleurs a été fait régionalement, afin de garder une certaine cohérence au niveau provincial, une liste des motifs pouvant justifier le choix des couleurs a été prévues pour les routes du réseau de camionnage. Ces motifs ont été inventoriés dans un système informatisé du MTQ et pourront être disponibles au besoin pour référence.

CODE	JUSTIFICATION
1 *	Réseau privilégié
2 *	Réseau interprovincial et international
3 *	Transit via le réseau municipal
4 *	Lien économique
5 *	Intérêt régional
6 *	Accès aux ressources
7 *	Route sans issue
8 *	Compatibilité avec le réseau municipal
9 *	Ponts à tonnage réduit
10 *	Limitation de hauteur
11 *	Contournement poste et aire de contrôle
12 *	Contournement d'une municipalité
13 *	Pont fermé au camionnage
14 *	Géométrie de la route

15 * Route impraticable
16 * Sécurité routière
17 * Infrastructure de la chaussée
18 * Route parallèle à un réseau privilégié
19 * Poste de douane fermé
20 * Route panoramique
21 * Site touristique
22 * Circulation en milieu urbain
23 * Concordance interrégionale
24 * Interconnexion avec un réseau privilégié
25 * Obligation d'utiliser un réseau privilégié
26 * Route fermée au transport des matières dangereuses
27 * Route non reliée au réseau
28 * Accès au traversier
29 * Lien avec un aéroport international
30 * Section de route conjointe

2.5 Carte préliminaire

La publication de la carte préliminaire en mai 1994 a permis de débuter le processus de consultations auprès de nos partenaires usuels :

- municipalités et MRC;
- SQ, SAAQ et corps policiers municipaux;
- transporteurs;
- expéditeurs;
- courtiers;
- organismes gouvernementaux;
- douaniers;
- états et provinces limitrophes.

3. POLITIQUE DE CIRCULATION DES VÉHICULES LOURDS SUR LE RÉSEAU ROUTIER MUNICIPAL

Le Code de la sécurité routière permet à une municipalité d'interdire, par règlement, la circulation des véhicules lourds sur les chemins publics dont elle est responsable de l'entretien. Pour assurer la fluidité de la circulation

des véhicules lourds sur le plan provincial, le code prévoit qu'un tel règlement ou ordonnance doit recevoir l'approbation du ministre des Transports ou de son délégué pour entrer en vigueur.

Les critères en vertu desquels le Ministre approuve un règlement municipal ont été établis pour la première fois en 1991 dans la "Politique sur la circulation des véhicules lourds et des matières dangereuses au Québec". Cette politique s'appliquait sur tout le réseau routier québécois, c'est-à-dire autant celui à l'entretien du Ministère que celui à l'entretien des municipalités.

Désormais, le réseau de camionnage permettra la gestion du réseau qui est à l'entretien du Ministère. Et, la nouvelle politique, adoptée par le Comité de direction du ministère des Transports du Québec le 7 mars 1994, s'applique au réseau routier municipal.

3.1 Objectifs de la politique

La Politique de circulation des véhicules lourds sur un réseau routier municipal vise à atteindre les objectifs suivants :

- préserver la sécurité et la fonctionnalité du réseau routier québécois;

- assurer l'accès à un réseau routier permettant le développement des activités économiques québécoises, tout en tenant compte de la sécurité du public et de la tranquillité des citoyens;

- assurer une application uniforme de la réglementation dans le domaine du camionnage, notamment en ce qui concerne:
  - les normes de charges et de dimensions;
  - les règles relatives au transport hors normes (charges indivisibles);
  - les règles relatives au transport des matières dangereuses;
  - les normes de signalisation routière.

- faire connaître aux municipalités les critères en vertu desquels le Ministre les autorise à restreindre ou à prohiber l'accès à des véhicules lourds ou à la circulation de matières dangereuses sur des chemins publics municipaux.

Dorénavant, le MTQ exigera que les interdictions soumises par les municipalités soient compatibles avec le réseau de camionnage. De plus, les règlements d'interdictions municipaux devront être approuvés par chacune des directions territoriales, rapprochant ainsi les décisions le plus près possible de la clientèle.

3.2 Critères pour limiter la circulation sur un chemin public municipal

Une municipalité qui désire restreindre ou interdire la circulation des véhicules lourds sur un chemin qu'elle entretient doit respecter les critères suivants pour que ce règlement reçoive l'approbation du MTQ :

1° La municipalité doit laisser à l'usage des véhicules lourds des rues qui leur permettent de traverser son territoire.

2° L'interdiction municipale de circuler doit être compatible avec celles prévues au réseau de camionnage.

3° La municipalité qui veut adopter un règlement qui risque d'avoir des incidences à l'extérieur de son territoire doit, au préalable, obtenir une résolution d'appui du conseil municipal des municipalités limitrophes qui sont concernées par les implications du règlement projeté.

4° Le règlement municipal doit indiquer le ou les chemins interdits. La municipalité doit joindre un plan ou une carte illustrant ces interdictions.

5° Prévoir que les interdictions s'appliquent aux véhicules routiers dont la masse nette excède 3 000 kg, mais qu'elles ne s'appliquent pas à :

- un véhicule effectuant une cueillette ou une livraison;
- un véhicule en provenance ou à destination de son port d'attache;
- un véhicule servant à faire l'entretien, la réparation ou le remorquage d'un autre véhicule;
- un véhicule effectuant un travail ou donnant un service;
- un véhicule hors normes;
- un autobus, un minibus et un véhicule récréatif;
- un véhicule d'urgence;
- un véhicule agricole.

4. PANNEAUX DE SIGNALISATION NORMALISÉS

Pour des raisons d'uniformisation, le Règlement sur la signalisation routière, adopté en vertu du Code de la sécurité routière, s'applique sur tous les chemins publics incluant ceux entretenus par les municipalités. Ce règlement prévoit le type de panneaux de signalisation qu'une municipalité ou le ministère des Transports doit utiliser pour interdire la circulation des véhicules lourds.

Voici les panneaux les plus couramment utilisés :



Le panneau «**Accès interdit aux véhicules lourds**» signifie que ces véhicules ne peuvent emprunter le chemin où ce panneau est installé.



Le panneau «**Trajet obligatoire pour véhicules lourds**» signifie une obligation d'emprunter le trajet où ce panneau est installé.

Afin de prévoir les exceptions aux véhicules de livraison ou de circulation locale, un nouveau panonceau a été normalisé et complétera le panneau précédent d'accès interdit.



Le panonceau «**Excepté livraison locale**» devra être placé en dessous du panneau «accès interdit» pour permettre le transport local.



5. LES DOUANES

Les premiers documents présentés sur le projet de réseau de camionnage parlaient de fermeture de postes de douane. Or, le Québec n'a pas les pouvoirs constitutionnels lui permettant d'intervenir dans ce domaine, il s'agit d'un domaine de juridiction fédérale. Aussi, est-il important de préciser que le projet de réseau de camionnage n'a pas pour objectif de fermer des postes frontaliers; il s'agit plutôt d'un effet entraîné par la mise

en place du réseau de camionnage. L'objectif du Ministère est de faciliter le transport des marchandises en transit, conformément aux ententes commerciales de libre-échange. Le ministère a formé un groupe de travail avec Revenu Canada Accise, Douanes et Impôt pour, entre autres, identifier des ports d'entrée pour le camionnage en transit. Le groupe de travail cherche à harmoniser le statut des postes de douane avec les routes privilégiées aux véhicules lourds, tel que prévu par le réseau de camionnage.

Les Douanes ne peuvent procéder à la fermeture d'un poste frontalier; elles peuvent cependant offrir des niveaux de services qui varient d'un poste à un autre. Ainsi, lorsque le niveau de services est bas, le camionneur peut être amené à débourser des sommes importantes pour obtenir des services de dédouanement. Souvent, dans de tels cas, le camionneur préférera se rendre à un poste de douane offrant un meilleur service de dédouanement des marchandises. À moins d'une modification de la loi fédérale, cette situation demeurera inchangée après l'implantation du réseau de camionnage.

Les douaniers ne sont intéressés que par les marchandises. Pour eux, un camion vide est considéré comme un véhicule de promenade, lequel est libéré sans formalité lorsqu'il n'y a pas d'achat de biens personnels.

Certaines marchandises sont dédouanées à l'intérieur des terres plutôt qu'à un poste de douane. Le dédouanement se fait alors dans un bureau désigné commercial (il y en aurait environ 800 au Canada, dont une cinquantaine au Québec). Ces marchandises peuvent entrer sur le territoire québécois par n'importe quel poste de douane.

Revenu Canada Accise, Douanes et Impôt a mis sur pied un Système d'examen avant l'arrivée (SEA) d'un véhicule. Le camionneur envoie aux douaniers les informations concernant les marchandises qu'il transporte. Les douaniers analysent la documentation reçue et indiquent immédiatement un code à l'ordinateur. Lorsque le camionneur arrive au poste de douane, il présente son code à barres et, lorsque les marchandises n'ont pas besoin d'être vérifiée, le camionneur peut entrer sur le territoire québécois sans autre formalité. Bien sûr, ce service n'est offert qu'aux postes de douane principaux (il y en a cinq actuellement) ainsi que dans quelques entrepôts; ces postes de douane débouchent sur une route de camionnage en transit.

Il y a aussi le Système de mainlevée pour importateur fréquent (SMIF). Ce système a été mis sur pied pour les envois similaires, répétififs et non risqués. Les véhicules transportant ces marchandises peuvent circuler par le poste de douane de leur choix.

On peut constater qu'il n'est pas possible de demander aux douaniers d'empêcher la circulation de camions aux endroits où le ministère veut interdire la circulation des véhicules lourds. Revenu Canada Accise, Douanes et Impôt est toutefois prête à collaborer avec le MTQ.

L'implantation du réseau de camionnage est intimement liée aux travaux qui sont prévus au poste de Lacolle sur l'autoroute 15; soit une voie de contournement pour les camions, qui pourront alors être dédouanés sans attente (ce qui devrait favoriser l'utilisation du SEA), et un stationnement pour les véhicules lourds.

Notons que les procédures de dédouanement des marchandises prennent environ 45 minutes.

Le groupe de travail étudie actuellement la possibilité d'émettre des permis pour le transport local, dans les cas où il ne sera pas possible de résoudre le problème de livraison.

6. PROCHAINES ÉTAPES

Les camionneurs, les municipalités et les principaux intervenants ont eu l'occasion de nous faire connaître leur point de vue sur le projet de réseau. Une version révisée de carte routière sera diffusée au printemps 1995 et l'implantation du réseau est prévu pour l'été 1995.

Cette carte devra être mise à jour annuellement pour s'assurer d'une bonne compréhension des camionneurs. Au cours des mois qui vont suivre, le projet continuera avec la production de cartes régionales sous forme d'atlas incluant le réseau d'interdiction municipale.

Finalement, on peut prévoir informatiser toutes ces cartes dans un avenir très rapproché ce qui permettra pour beaucoup de compagnies de transport de tracer des circuits de livraisons très précis.

IMPACT DU PROGRAMME DE SUBVENTIONS AU TRANSPORT DES MARCHANDISES DANS LA RÉGION DE L'ATLANTIQUE SUR LES TAUX DE TRANSPORT ROUTIER

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1.0 Introduction

Le Programme de subventions au transport des marchandises dans la région de l'Atlantique est régi par deux lois: la Loi sur les taux de transport des marchandises dans les provinces Maritimes (LTTMPM) et la Loi sur les subventions de transport des marchandises dans la région de l'Atlantique (LSTMRA). La première loi, promulguée en 1927, avait pour but de réduire les taux de transport des marchandises transportées par voie ferrée. La deuxième loi, promulguée en 1969, accordait des avantages comparable aux autres modes, essentiellement le transport routier.

Le but de notre analyse est de vérifier si le Programme de subventions a un impact sur les taux de transports des marchandises subventionnées. Plus précisément, si les transporteurs de l'industrie du camionnage font profiter les expéditeurs du montant intégral des subventions perçues.

La première partie de cette étude donne un bref aperçu du Programme de subventions lorsque la présente étude a débuté. La deuxième partie traite de la fiabilité de la base de données utilisée. La troisième partie explique les variables qui influencent les tarifs dans l'industrie du camionnage. La quatrième partie décrit la méthodologie utilisée dans cette étude. Enfin, la dernière partie présente les résultats obtenus.

2.0 Le profil du Programme de subventions

La région visée par le Programme de subventions est appelée "territoire choisi". Cette région comprend les provinces du Nouveau-Brunswick, de la Nouvelle-Écosse, de l'Île-du-Prince-Édouard, de l'île de Terre-Neuve, et la partie du Québec située au sud du Saint-Laurent et à l'est de Lévis.

Le Programme comprend trois volets: le Programme de subventions au transport intra-régional, le Programme de subventions de base aux mouvements de sortie, et le Programme d'aide sélective au transport de sortie. Le Programme de subventions au transport intra-régional s'applique uniquement aux marchandises admissibles, et est destiné au trafic dont l'origine et la destination sont situées à l'intérieur du territoire choisi. Il s'applique également au trafic d'exportation passant par des ports situés dans ce territoire. Les marchandises admissibles représentent environ 80% des revenus de transport de ce marché et, en 1992, le taux de subvention était de 10%. Le Programme de subventions de base aux mouvements de sortie vise le trafic dont l'origine se trouve dans le territoire choisi et la destination est un autre point au Canada mais hors de ce territoire. En 1992, toutes les marchandises étaient admissibles et le taux de subvention représentait 30% des coûts moyens du transport effectué à l'intérieur du territoire choisi. Le Programme d'aide sélective au transport de sortie est de même nature que le Programme de subventions de base aux mouvements de sortie, à l'exception du fait qu'il s'adresse seulement à des marchandises qui ont été cultivées, récoltées, ou qui ont été transformées dans le territoire choisi. Ces subventions s'ajoutent aux subventions de base et, en 1992, les marchandises admissibles représentaient environ 40% des revenus du transport de ce marché. Le taux de subvention était de 20% des coûts moyens du transport effectué à l'intérieur du territoire choisi.

En principe, les subventions sont directement versées aux transporteurs qui acceptent de réduire les frais de transport d'un montant équivalent.

En 1992, les subventions versées ont totalisé 109,9 millions de dollars, dont 9,6 millions en vertu de la LTTMPM, et 100,3 millions de dollars en vertu de la LSTMRA. La ventilation par mode de transport est présentée au tableau 1.

Tableau 1
Total des subventions payées en 1992
Programme de subventions au transport des marchandises dans la région de l'Atlantique
(millions de dollars)

Programme	Chemin de fer	Maritime	Camion	Total
LTTMPM	9,6	-	-	9,6
LSTMRA				
- Mouvements de sortie (base)	-	-	28,8	28,8
- Mouvements de sortie (sélective)	3,7	-	10,1	13,8
- Intra-régional	9,6	0,7	47,5	57,8
Total	22,9	0,7	86,3	109,9

Source: Office national des transports

Comme le démontre le tableau 1, en 1992 plus de 78 % de toutes les subventions ont été versées à l'industrie du camionnage. Pour cette raison, la présente étude porte sur l'industrie du camionnage.

3.0 La fiabilité et la validation de la base de données

Notre analyse utilise la base de données établie à partir de l'Enquête sur le transport routier de marchandises pour compte d'autrui - origine et destination (EOD) de 1990[1] de Statistique Canada. Pour cette enquête, on sélectionne un échantillon de bordereaux tirés des dossiers des transporteurs; la base de données de 1990 renferme plus de 500 000 bordereaux. Les subventions versées aux transporteurs ne sont pas incluses dans les frais de transport présentés sur les bordereaux, sauf dans de très rares cas. Pour cette raison, nous avons ajouté les subventions au taux de transport des marchandises pour chaque dossier échantillonné, de façon à calculer le coût de transport total.

Quoique la base de données sur l'EOD sous-estime les subventions versées, notamment pour le transport intra-régional des marchandises, nous avons constaté que la base de données peut être utilisée en toute sécurité pour les fins de cette étude puisqu'elle contient suffisamment de bordereaux[2].

Nous avons constaté cependant qu'il existe d'importants écarts entre la base de données sur l'EOD et celle de l'Office national des transports (ONT)[3], qui repose sur les paiements de subventions, lorsque l'importance relative de chaque marchandise est étudiée. Si les résultats des modèles obtenus pour chaque groupe de marchandise à partir de la base de données de l'EOD demeurent valides, on ne peut en dire autant des moyennes pondérées pour l'ensemble de l'industrie. Pour corriger ce problème, nous avons, pour chaque groupe de marchandise étudié, pondéré les résultats de nos modèles à partir des revenus de transport estimés dans la base de données de l'ONT.

4.0 La tarification dans l'industrie du camionnage

On peut expliquer la variation des prix dans l'industrie du camionnage à partir de variables comme le type de marchandise transportée, la concurrence sur le marché,

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[1] *L'année 1990 a été retenue simplement parce qu'à l'époque, c'était la base de données la plus récente.*

[2] *Pour plus d'information sur la validation de la base de données, veuillez consulter l'appendice 2A du rapport intitulé "Programme de subventions au transport des marchandises dans la région de l'Atlantique: cahier d'information", Politiques et coordination, Transports Canada, juillet 1994 (TP 12105-F).*

[3] *Cette base de données a été créée par Transports Canada. Pour plus d'information veuillez consulter le rapport "Projet de création d'une base de données de 1992 - subventions au transport des marchandises dans la région de l'Atlantique", Statistiques et prévisions (ACAC), Analyse économique, novembre 1993 (TP 12153-F).*

les disponibilités de chargements pour le voyage de retour, les coûts des transporteurs, le poids des chargements, la distance, la marge de profit et finalement, les distorsions du marché entraînées, par exemple, par les programmes de subventions. La présente section renferme une brève analyse de ces variables:

a) parce que la densité, la valeur, la fragilité et les exigences de manutention des marchandises - qui ont une influence sur les coûts et par conséquent sur les recettes - peuvent différer, il est important de comparer les recettes afférentes à des marchandises homogènes. Pour cette raison, nous avons regroupé les marchandises au niveau des codes à deux chiffres de la classification industrielle standard.

b) la concurrence entre les transporteurs dans chaque région peut avoir des répercussions sur les taux de fret. Les niveaux de concentration dans l'industrie constituent un indicateur de cette concurrence. Comme le montre le tableau 2, la concentration dans l'industrie du camionnage est similaire dans le territoire choisi à celle observée dans le reste du Canada; nos modèles supposent donc que les pressions découlant de la concurrence ne jouent aucun rôle dans les écarts au niveau des recettes de transport des marchandises;

Tableau 2
Concentration dans l'industrie du camionnage par province
(Pourcentage des revenus des plus grandes entreprises par rapport aux revenus totaux)

	Territoire choisi	Québec	Ontario	Manitoba Sask.	Alberta	Colombie Britan.
Revenus (5 principaux)	33	20	15	26	21	24
Revenus (15 principaux)	53	38	32	57	42	46
Revenus (30 principaux)	69	52	48	78	61	63

Source: Enquête sur le transport routier de marchandises pour compte d'autrui, origine et destination

c) la disponibilité de chargements pour le voyage de retour peut aussi avoir une influence sur les taux de transport des marchandises. Lorsque les recettes découlant des voyages de retour augmentent, les taux de transport pour le voyage initial devraient diminuer. Dans la présente étude, les possibilités de ramener des marchandises sont plus pertinentes pour les mouvements de sortie, qui se font sur de plus longues distances. Pour ces derniers mouvements, les données indiquent que ces possibilités sont au moins aussi élevées - sinon plus élevées - dans le territoire choisi que dans le reste du Canada. Par conséquent, la disponibilité de chargements pour le voyage de retour ne peut, en aucune façon, expliquer des tarifs plus élevés pour les marchandises en provenance du territoire choisi, pour cette raison, on peut en faire fi lorsqu'on établit nos modèles;

d) les écarts au niveau des coûts constituent un facteur crucial des écarts au niveau des taux de transport des marchandises. Aux fins de la présente étude, nous supposons que les écarts au niveau des coûts entre les provinces ou les régions sont les mêmes pour les marchandises admissibles que pour les marchandises non-admissibles;

e) le poids a des répercussions sur les coûts unitaires d'un chargement. Les petits chargements exigent plus d'opérations de regroupement et de manutention, donc leurs coûts de transport sont plus élevés. Les taux unitaires devraient donc diminuer à mesure que le poids augmente;

f) la distance influence de la même façon les taux unitaires. Les chargements transportés sur de courtes distances occasionnent les mêmes coûts de chargement et de déchargement que les chargements transportés sur de plus longues distances. Les taux unitaires moyens devraient donc diminuer à mesure que la distance augmente;

g) selon nos données, les profits dans l'industrie du camionnage sont généralement semblables d'une région à une autre au Canada. Par conséquent, cette variable n'est pas retenue dans nos modèles;

h) les distorsions de prix créées par le programme de subventions constituent le point central de la présente analyse. Nous expliquons dans la section suivante comment ces distorsions ont été captées.

5.0 La méthodologie

Dans le reste de la présente étude, le terme «taux de transport des marchandises» renvoie aux taux payés par les expéditeurs pour le transport de leurs produits. Ces taux sont donc nets de toute subvention. Par ailleurs, le terme «recettes de transport des marchandises» renvoie aux recettes réalisées par les transporteurs pour des opérations de transport; elles sont égales à la somme des taux de transport des marchandises et des subventions versées aux termes de la LSTMRA. Afin d'étudier l'impact des subventions, nous faisons reposer nos comparaisons entre le territoire choisi et le reste du pays sur les recettes de transport des marchandises. Pour standardiser les recettes de transport des marchandises, nous avons utilisé les recettes par tonne-kilomètre[4] qui constituent la variable dépendante dans tous nos modèles

[4] *Utilisation des recettes par tonne-kilomètre est largement répendue par comparer les tarifs dans l'industrie du camionnage, les premières études remontent au début des années 1970 avec Sloss, J. , "Regulation of Motor Freight Transportation: A Quantititive Evaluation of Policy", The Bell Journal of Economics, Vol. 1, Automne, 1970, pp. 327-366. et McLachlan, D.L., "Canadian Trucking Regulations", The Logistics and Transportation Review, Vol. 8, janvier 1972, pp. 58-81.*

économétriques. Nous comparons les recettes de transport des marchandises dans le territoire choisi aux recettes générées dans les autres provinces ou régions du Canada à l'aide de modèles économétriques. Dans ces derniers nous expliquons les recettes de transport des marchandises à partir de la distance, du poids des expéditions et de variables dichotomiques représentant chacune des régions. Nous avons établi un modèle pour chaque groupe de marchandises.

La formulation des modèles repose sur des transformations Box-Cox des variables dépendantes et indépendantes. L'avantage de cette méthode est que les données dictent davantage le profil de la forme fonctionnelle de la relation. La forme fonctionnelle de toutes les équations est :

$$\frac{R^{\lambda_0}-1}{\lambda_0} = \alpha_0 + \beta_1\left[\frac{D^{\lambda_1}-1}{\lambda_1}\right] + \beta_2\left[\frac{P^{\lambda_2}-1}{\lambda_2}\right] + \beta_3 d\,1$$

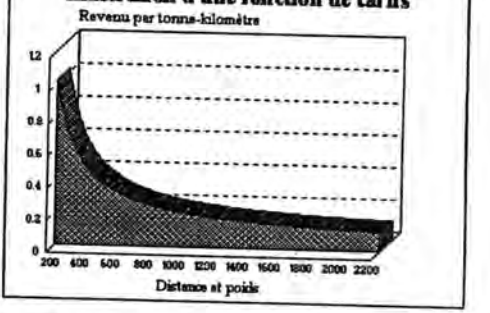
où

R = les recettes par tonne-kilomètre;
D = la distance;
P = le poids;
d = les variables dichotomiques pour chaque région.

et λ_0, λ_1, λ_2, λ_3, α_0, β_1, β_2 et β_3 sont les coefficients à estimer. Pour le trafic intra-régional, les coefficients λ ont été préalablement fixés à 0, ce qui suppose que l'équation a une forme logarithmique.

La figure 1 illustre la relation entre des variables combinées pour des distances et des poids bien précis. Cette figure est une représentation en deux dimensions d'un graphique en trois dimensions; pour ce faire, les distances et les poids sont égaux sur l'abscisse.

Figure 1
Illustration d'une fonction de tarifs



Comme l'illustre la figure 1, lorsque la distance et le poids augmentent, les recettes par tonne-kilomètre diminuent de façon non-linéaire, du fait d'économies d'échelle progressives.

6.0 Les résultats

Nous avons effectué des analyses sur deux types de marché: les mouvements intra-réginaux et les mouvements de sortie. Les résultats de ces analyses sont présentés dans cette partie[5].

6.1 Les subventions intra-régionales

Pour mesurer les répercussions du Programme de subventions au transport intra-régional sur les recettes des transporteurs, nous avons effectué deux types d'analyse. Premièrement, nous avons comparé les recettes de transport des marchandises admissibles et non-admissibles dans le territoire choisi aux recettes de transport des marchandises admissibles et non-admissibles dans les autres provinces ou régions. Ici, il est important de se rappeler que pour chaque groupe de produit, une étude spécifique a été réalisée; par conséquent si les marchandises transportées diffèrent d'une région à une autre, cela n'a pas d'impact sur les résultats de l'étude. Il faut également insister sur le fait que nous comparons les recettes de transport des marchandises admissibles et non-admissibles; ce qui implique, par exemple, que si le climat d'une région a des effets sur les coûts de transport et par conséquent sur les recettes, puisque ce climat est la même pour les marchandises admissibles et non-admissibles, cela n'a pas impact sur les résultats.

L'hypothèse de départ est la suivante: si le programme de subventions dans la région de l'Atlantique n'a pas de répercussions sur les recettes (c'est-à-dire que si le montant entier des subventions sert à réduire les taux payés par les expéditeurs), les écarts au niveau des recettes de transport des marchandises entre le territoire choisi et les autres provinces ou régions devraient alors être les mêmes pour les marchandises admissibles que pour les marchandises non-admissibles.

Nous avons dans une deuxième étape comparé les écarts au niveau des recettes de transport des marchandises entre le territoire choisi et les autres provinces ou régions aux écarts au niveau de coût entre ces mêmes régions. Nous avons supposé que si le programme de subventions n'a pas de répercussions sur les recettes de transport des marchandises les écarts au niveau des recettes entre le territoire choisi et les autres provinces ou régions devraient alors refléter les écarts au niveau des coûts entre ces mêmes régions.

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[5] *Les résultats des analyses économétriques sont présentées à l'appendice 2B du rapport "Programme de subventions au transport des marchandises dans la région de l'Atlantique: cahier d'information", Politiques et coordination, Transports Canada, juillet 1994 (TP 12105-F).*

6.1.1 Le trafic intra-régional - les marchandises admissibles et non-admissibles

Nous avons évalué 39 équations de recettes, dont 30 s'appliquent aux marchandises admissibles et neuf aux marchandises non-admissibles. Ces 39 équations englobent plus de 80 % des recettes de camionnage réalisées à partir des mouvements intra-provinciaux ou intra-régionaux.

Les valeurs R^2 pour toutes les équations sont assez élevées pour indiquer que le modèle explique, de façon satisfaisante, les variations au niveau des recettes la tonne-kilomètre. Le R^2 est en moyenne de 0,84 pour les marchandises admissibles et de 0,75 pour les marchandises non-admissibles. On doit également noter que les variables indépendantes de distance et de poids sont très largement significatives et que les variables dichotomiques le sont aussi généralement.

Nos estimations indiquent que les recettes de transport des marchandises non-admissibles à l'intérieur du territoire choisi sont en moyenne égales à 84,6 % de ces mêmes recettes à l'extérieur du territoire choisi, c'est-à-dire 15,4 % moins élevées. Par ailleurs, les recettes de transport des marchandises admissibles à l'intérieur du territoire choisi représentent 89,9 % de ces mêmes recettes à l'extérieur du territoire choisi, c'est-à-dire qu'elles sont seulement 10,1 % moins élevées. Le tableau 3 illustre les recettes des transporteurs et les taux de transport des marchandises payés par les expéditeurs dans le territoire choisi sous forme de pourcentage des valeurs correspondantes dans les autres régions.

Tableau 3
Impact des subventions pour l'intra-régional
(en pourcentage des revenus et des tarifs à l'extérieur du Territoire choisi)

	Revenus des transporteurs (%)	Tarifs payés par les expéditeurs (%)
Marchandises non admissibles	84,6	84,6
Marchandises admissibles	89,9	80,9**
Impact des subventions en pourcentage	6,3*	-4,4***

* *(100 X ((89,9 / 84,6) - 1))*
** *(89,9% X 0.9)*
*** *(100 X ((80,9 / 84,6) - 1))*

Comme le montre le tableau 3, nous estimons la réduction relative des taux de transport des marchandises payés par les expéditeurs à seulement 4,4 % lorsque le taux des subventions est de 10 % aux termes du Programme de subventions au transport intra-régional des marchandises. L'écart semble faire augmenter les recettes des transporteurs de 6,3 % par rapport aux taux de transport des marchandises non-admissibles.

6.1.2 Le trafic intra-régional - une comparaison avec les coûts

Nous avons comparé les écarts au niveau des taux de transport des marchandises admissibles entre le territoire choisi et les autres provinces ou régions aux écarts au niveau des coûts d'exploitation entre ces mêmes secteurs. Il faut répéter que les recettes de transport des marchandises admissibles à l'intérieur du territoire choisi étaient inférieures de 10,1 % à la moyenne des recettes de transport des marchandises admissibles des autres provinces ou régions canadiennes.

La présente partie de notre analyse repose sur une publication de TRIMAC Consulting Services Limited intitulée *«Frais d'exploitation des camions au Canada - 1990»*. À tous les deux ans depuis 1972, TRIMAC produit pour Transports Canada un rapport sur les coûts d'exploitation des transporteurs routiers par province. Cette publication décrit ces coûts pour les camions à deux essieux (à essence et au diesel), les semi-remorques à cinq essieux et les trains routiers à sept ou à huit essieux[6].

Pour calculer les écarts au niveau des coûts entre le territoire choisi et le reste du pays, nous avons pondéré les coûts par tonne-kilomètre pour les deux régions selon la proportion correspondante des recettes dans chaque province. À noter que la présente analyse n'inclut pas la partie du Québec comprise dans le territoire choisi. Le tableau 4 illustre les résultats de notre analyse. Ces résultats sont présentés en pourcentage de la valeur moyenne correspondante dans les autres provinces.

Tableau 4
Impact des subventions pour l'intra-régional
Revenus des transporteurs et tarifs payés par l'expéditeurs
par rapport aux coûts dans l'industrie du camionnage

	Revenus des transporteurs (%)	Tarifs payés par les expéditeurs (%)
Coûts du camionnage	87,0	87,0
Marchandises admissibles	89,9	80,9**
Impact des subventions en pourcentage	3,3*	-7,0***

* *(100 X ((89,9 / 87,0) - 1))*
** *(89,9% X 0.9)*
*** *(100 X ((80,9 / 87,0) - 1))*

[6] *Pour plus d'information voir la publication "Frais d'exploitation des camions au Canada - 1990", Transports Canada, (TP 921F).*

Nous estimons que les coûts d'exploitation dans le territoire choisi sont inférieurs de 13 % aux coûts d'exploitation dans le reste du Canada, mais que les recettes de transport des marchandises admissibles n'y sont inférieures que de 10,1 %. Cela indique que les expéditeurs paient, grâce au programme, 7,0 % de moins pour le transport de leurs marchandises. À l'inverse, l'augmentation des recettes des transporteurs est de 3,3 %.

Ces résultats sont d'une ampleur différente de ceux obtenus précédemment (quand les subventions entraînaient une réduction des taux de transport des marchandises de 4,4 %), mais ils étayent la conclusion selon laquelle une subvention de 10 % réduit les taux de transport des marchandises d'un moindre pourcentage et donc que les transporteurs ne font pas bénéficier les expéditeurs du montant entier de la subvention.

Ces résultats laissent aussi supposer un taux réel de subvention de 10,3 % (de 3,3 % + 7,0 %), au lieu du taux nominal de 10 %.

6.2 Les subventions aux mouvements de sortie

Pour les mouvements de sortie, nous avons effectué concurremment deux analyses des recettes de transport des marchandises :

a) une comparaison des mouvements de sortie à partir du territoire choisi au trafic inter-provincial dans le reste du pays;

b) une comparaison des mouvements de sortie à partir du territoire choisi au trafic d'entrée dans le territoire choisi.

6.2.1 Le trafic des mouvements de sortie du territoire choisi comparé au trafic inter-provincial

Nous avons estimé 35 équations expliquant les recettes. Les marchandises sur lesquelles le modèle reposait représentent plus de 75 % des recettes de camionnage inter-provincial ou inter-régional. Notre analyse économétrique est fondée sur la base de données de l'EOD; tandis que la moyenne pondérée (les résultats moyens) a été évaluée à partir de la base de données de l'ONT. La valeur moyenne du R^2 des équations de tarifs est de 0,947 et les coefficients estimés sont encore significatifs. Le tableau 5 présente un résumé de nos résultats.

Tableau 5
Impact des subventions pour les mouvements de sortie
Les revenus et les tarifs des mouvements de sortie par rapport aux revenus moyens du trafic inter-provincial dans les autres région du Canada

	Revenus des transporteurs (%)	Tarifs payés par les expéditeurs (%)
Territoire choisi	108,6	89,7*
Autres régions du Canada	100,0	100,0
Impact en pourcentage	8,6	-10,3**

* *((1 - ,174) X 108,6%)*
** *(100 X ((89,7 / 100) - 1))*

Nous estimons que les recettes des transporteurs dans le territoire choisi sont supérieures d'environ 8,6 % à celles générées dans les autres régions canadiennes. Nous avons estimé, à partir de la base de données de l'EOD, un taux moyen de subvention à 17,4%, ce qui correspond au taux de subvention moyen effectivement payé pour le Programme de subventions aux mouvements de sortie. Nous en déduisons donc que les taux de transport des marchandises payés par les expéditeurs dans le territoire choisi ne correspondent qu'à 89,7 % de ceux payés dans les autres régions. Il n'existe pas d'évaluation indépendante des taux qui seraient facturés à partir du territoire choisi en l'absence de subvention, étant donné qu'il n'y a pas de trafic non-admissible pour assurer un «contrôle», comme dans le cas de l'analyse intra-régionale. Il n'y a cependant aucune raison de s'attendre à ce qu'ils soient plus élevés dans le reste du pays; les coûts du transport routier des marchandises établis par TRIMAC laissent de plus supposer qu'ils devraient être moins élevés. En se fondant sur l'hypothèse conservatrice que les tarifs seraient, sans la présence de subventions, égaux à ceux payés dans le reste du pays, on est amené à conclure que les expéditeurs bénéficient de réductions de seulement 10,3 %, tandis que les transporteurs reçoivent des subventions de 17,4 %. Cela revient à dire que le taux réel des subventions est de 18,9 % (8,6 % + 10,3 %).

6.2.2 Les mouvements de sortie du territoire choisi comparés aux mouvements d'entrée dans le territoire

Pour cette comparaison du trafic de sortie et d'entrée du territoire choisi, nous avons estimé 15 équations de recettes représentant plus de 55 % des recettes de transport routier des marchandises en provenance et à destination du territoire choisi. Le tableau 6 renferme un résumé des résultats.

Parce que nous avons utilisé un échantillon différent, le taux moyen des subventions (en pourcentage des recettes courantes des transporteurs) est ici de 16,6 % au lieu de 17,4 %. Par ailleurs, nos estimations montrent que les subventions entraînent une augmentation de 6,8 % des recettes des transporteurs. On peut donc en déduire que les taux de transport des marchandises payés par les expéditeurs sont inférieurs de 10,9 % pour les mouvements de sortie par rapport aux mouvements d'entrée.

Encore une fois, mentionnons qu'il n'existe pas d'évaluation indépendante des taux qui seraient facturés pour le trafic de sortie en l'absence de subvention. Cependant, il n'y a aucune raison de s'attendre à ce qu'ils soient plus élevés que pour le trafic d'entrée; on pourrait même s'attendre, dans une certaine mesure, à ce qu'ils soient plus faibles, étant donné que le trafic de sortie est moindre que le trafic d'entrée, ainsi plus susceptible d'avoir du trafic de retour, pour lequel les taux sont normalement moins élevés. À l'inverse, on peut encore une fois supposer que les taux seraient les mêmes et conclure que les expéditeurs bénéficient d'une réduction de seulement 10,9 %, tandis que les transporteurs reçoivent une subvention de 17,7 % (6,8 % + 10,9 %). Ces résultats, s'ils sont légèrement différents, étayent cependant les conclusions d'ordre général auxquelles nous sommes arrivées au tableau 5.

Tableau 6
Impact des subventions pour les mouvements de sortie
Les revenus et les tarifs des mouvements de sortie par rapport aux revenus des mouvements d'entrée

	Revenus des transporteurs (%)	Tarifs payés par les expéditeurs (%)
Mouvements de sortie	106,8	89,1*
Mouvements entrant	100,0	100,0
Impact en pourcentage	6,8	-10,9**

* *(106,8% X (1 - ,166)*
** *(100 X ((89,1 / 100) - 1))*

7.0 Les Conclusions

7.1 Le Programme de subventions au transport intra-régional

Les coûts d'exploitation de l'industrie du camionnage dans la région de l'Atlantique sont 13 % moins élevés que ceux observés dans le reste du pays, ce qui se traduit par des taux de transport des marchandises non-admissibles en moyenne 15,4 % plus

faibles que ceux facturés à l'extérieur du territoire choisi. Si le montant total des subventions versées aux termes de la LSTMRA servait à réduire les taux de transport des marchandises payés par les expéditeurs de l'Atlantique, les recettes des transporteurs de la région seraient alors plus faibles dans les mêmes proportions que celles de leurs homologues de l'extérieur du territoire choisi.

Pourtant, en moyenne, les recettes de transport des marchandises admissibles à l'intérieur du territoire choisi ne sont que de 10,1 % plus faibles que ces mêmes recettes dans le reste du pays, ce qui entraîne des gains de revenus pour les transporteurs entre 3,3 % à 6,3 %. Un examen attentif des données et des résultats économétriques laisse supposer des répercussions équivalant en moyenne à 4,2 % sur les recettes des transporteurs, comme le montre le tableau 7.

Si les recettes des transporteurs sont plus élevées en raison des subventions, il s'ensuit que le taux de ces dernières est plus élevé que le taux nominal de 10 %. Les subventions, si elles représentent 10 % des recettes courantes, constituent environ 10,4 % des recettes qui auraient été réalisées sans le programme; la dernière valeur est le taux réel des subventions.

Cela voudrait dire essentiellement que les expéditeurs obtiennent des réductions d'environ 6,3 % des frais de transport, mais qu'à peu près 40 % (4,2 % / 10,4 %) des subventions ne profitent pas aux bénéficiaires visés (les expéditeurs).

Si l'on se fonde sur ces données, en 1992, 28,5 millions de dollars octroyés aux termes du programme d'aide ont profité aux expéditeurs, tandis que les 19 autres millions de dollars versés en subventions ont servi à accroître les recettes des transporteurs.

7.2 Le Programme de subventions aux mouvements de sortie

Le taux moyen des subventions pour les mouvements de sortie du territoire choisi est de 18,4 %. Notre analyse indique cependant que le programme de subventions entraîne pour les expéditeurs une réduction des taux de transport des marchandises d'environ 10,5 % et pour les transporteurs un accroissement de leurs recettes d'à peu près 7,9 %.

Les transporteurs et les expéditeurs semblent donc se partager les avantages du programme à raison respectivement de 43 % et de 57 %, ce qui laisse entendre qu'en 1992 les transporteurs ont reçu 16,6 millions de dollars, tandis que les expéditeurs ont bénéficié de 22,2 millions de dollars.

Tableau 7
La répartition des subventions estimée entre les transporteurs et les expéditeurs

	Intra-régional	Mouvements de sortie	Total
Subventions totales (millions $)	$47.5	$38.8	$86.3
Subventions aux expéditeurs (millions $)	$28.5	$22.2	$50.7
Subventions aux transporteurs (millions de $)	$19.0	$16.6	$35.6
Subventions aux transporteurs (%)	40.0%	43.0%	41.3%
Taux réel de subvention (%)	10.4%	18.4%	12.9%
Réduction de tarifs aux expéditeurs (%)	-6.2%	-10.5%	-7.6%
Revenus additionnels aux transporteurs (%)	4.2%	7.9%	5,3%

7.3 Les répercussions globales du Programme de subventions

Globalement, les subventions ont totalisé 86,3 millions de dollars en 1992, qui se sont traduits par des avantages de 50,7 millions de dollars pour les expéditeurs et par des recettes additionnelles de 35,6 millions de dollars pour les transporteurs. Cela voudrait dire que la part des subventions reçue par les transporteurs a été de 41,3 % et celle des expéditeurs de 58,7 %. Le taux réel des subventions correspond donc à 12,9 % des véritables coûts du transport des marchandises.

Comme le montre la tableau 8, on peut en déduire que si les recettes des transporteurs étaient supérieures de 5,3 % aux coûts réels de transport des marchandises (c'est-à-dire les coûts qui auraient été encourus sans le programme) et qu'étant donné qu'on a appliqué à ces coûts gonflés des taux nominaux, il y a eu 5,1 millions de dollars de subventions payées en trop en 1992.

Tableau 8
Paiement en trop en subventions
(en millions de dollars)

	Recettes des transporteurs	Coûts réels de transport	Subventions	Subventions fondées sur le coûts réels	Paiement en trop
Intra-régional	475,0	455,1	47,5	45,5	2,0
Myt. de sortie	226,9	209,0	38,8	35,7	3,1
Total	701,9	664,1	86,3	81,6	5,1

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Note: Les opinions exprimées dans ce texte sont celles de l'auteur et ne reflètent pas nécessairement celles de Transports Canada.

Fleet Mix Changes of 5 and 6 Axle Tractor Semitrailers

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1. INTRODUCTION

Relaxation of limits governing the sizes and weights of heavy trucks is usually accompanied by changes in the fleet composition. The magnitude of the change and duration before a fairly stabilized condition is attained is a function of many factors. In general, truck operators select equipment that optimize the allowances of the new and usually relaxed limits. The memorandum of understanding of 1988 has resulted in the introduction of larger and heavier trucks operating on the highways.

This paper reports the trends in truck fleet mix in some provinces in western Canada and compares the physical and operational characteristics of the 5- and 6-axle conventional tractor-semitrailers (i.e. 3-S2 and 3-S3). The paper is directed at investigating the relative productivity and efficiency characteristics of these trucks. The analysis provides possible explanations supported by quantitative information for the shifts in the fleet mix and offers suggestions for future trends in the fleet mix changes. Attributes considered include, average operating gross vehicle weights, average payloads, equivalent pavement loading and dynamic performance characteristics.

2. DATA

Information from truck weight studies on primary highways in the provinces on Manitoba and Saskatchewan between 1989 and 1994 are used in the analysis. There may be some bias towards loaded trucks because some data sets were obtained from studies that were designed specifically to collect traffic weight information. The effect of this bias on fleet mix analysis is expected to be minimal given that the observed percent of empty trucks encountered does not constitute a significant fraction (in the region of 2-3%) of the total truck traffic. The fleet mix

tabulations are therefore considered as representative of the actual situation with little loss of accuracy.

3. FLEET MIX

Table 1 and Fig. 1 show the variation in the fleet mix of heavy trucks observed on the primary highway in the provinces of Manitoba and Saskatchewan between 1989 and 1994. The fleet composition analysis is limited to the more common heavy vehicles, namely: 5, and 6-axle tractor-semitrailers; 7-axle A, B and C-trains; and 8-axle B-trains. The C-trains are less common compared to the A-trains and therefore are not treated separately from the A-trains. Compared to the double trailer configurations, marked changes in the proportion of tractor semitrailer configurations are observed. Among the double configurations however, the 8-axle B-train shows a noticeable increase over the 1989-1994 period with the 7-axle A and B-trains maintaining fairly constant proportion of the truck fleet.

Table 1. Heavy Truck Fleet Mix

Data set	3-S2 (%)	3-S3 (%)	7-A-Train (%)	7-B-Train (%)	8-B-Train (%)
MB-89	69	6	6	11	8
MB-91	71	9	7	7	6
MB-92	68	13	5	6	9
MB-94	58	21	6	6	9
SK-90	75	5	5	8	7
SK-92	67	8	6	8	11
SK-93	56	14	6	7	17

Notes:
MB - Manitoba; *SK - Saskatchewan*

Table 1 shows that in Manitoba, the percent of 3-S2 in the truck fleet shows a downward trend while the 3-S3 percentage is on the increase. The percent of 3-S2 dropped from about 70% in 1991 to about 58% in 1994. Corresponding values for 3-S3 are, 9% in 1989 and 21% in 1994 respectively. Similarly, in Saskatchewan, the proportion of 3-S3 increased from 5% in 1990 to about 14% in 1993 whereas, the proportion of 3-S2 dropped from 75% to 56% in the same period. However, It is not conclusive that there is a one-to-one replacement of 3-S2 by 3-S3 in either province, although the trends are identical.

Fig.1. Heavy Truck Fleet Mix

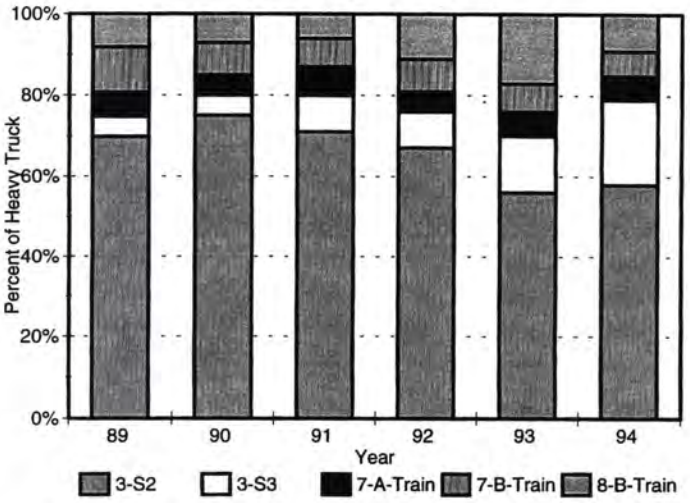


Fig. 2. Changes in Fleet Mix

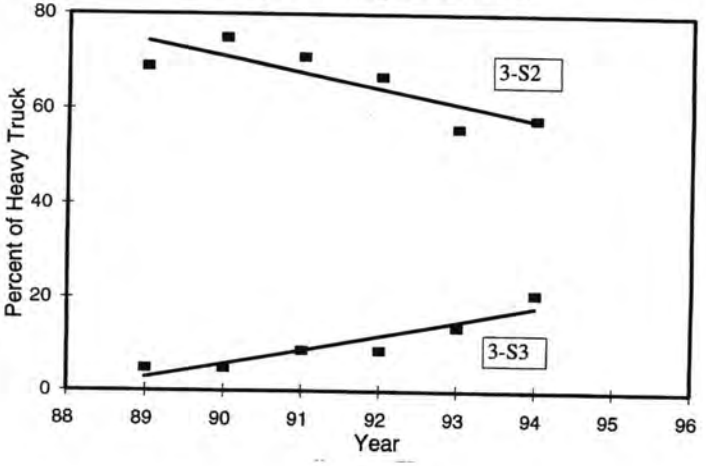


Fig. 2 compares these changes over the period in question for the combined data from Saskatchewan and Manitoba. The figure also shows the linear best lines of fit. It is evident that the 3-S2 is loosing its popularity to the 3-S3 and this is likely to continue for sometime. The slopes of these lines indicate that the rates of change are not the same which confirms that there 3-S2s are not directly replaced by 3-S3s. Extrapolating these lines beyond 1994, the best fit lines intersect at about the year 2000. At this time, the percent of 3-S2 will be less than 40% and the 3-S3 will be over 70% of the total heavy truck fleet.

Based on these rates of change, it could be said that replacement period of one truck type by another is a very gradual process which takes more than 10 years. Explanatory variables for the shifts between these two truck configurations are examined assuming operating costs, freight characteristics and market forces of demand and supply, and operating conditions are identical. The variables considered are those that could be directly linked to the size and weight regulations. It should be emphasized that the analysis presented in this paper does not assume a one to one replacement of 3-S2 by 3-S3.

4. EXPLANATORY FACTORS

Major variables to explain changes in fleet of heavy trucks focusing on the 5- and 6-axle tractor-semi trailers configurations are the dynamic performance measures and operational characteristics. Attributes to assess the stability and control properties of trucks include, roll stability, rearward amplification, load transfer ratio, off tracking, centre of gravity. Threshold values for the 3-S2 and 3-S3 trucks obtained from the vehicle weight and dimension study (Ervin et al. 1986) indicate that these trucks are classified to belong the same category of having adequate or better dynamic performance characteristics. Given that they have comparable dynamic properties, changes in the fleet could be explained on the basis of the operational performance measured by the productivity and infrastructure impacts. Fekpe et al. (1995a) observed that an indication of the operational efficiency of trucks is the ratio between highway pavement loading impact to the average payload. Parameters defining the operational efficiency are discussed below.

4.1 Average operating GVW

Fig. 3 shows the cumulative relative frequency gross vehicle weight (GVW) distribution for the two truck types. The probability density

distributions for the 3-S2 approximates to a normal distribution whereas the distribution for the 3-S3 is skewed towards the weight limit. The figure shows that both truck configurations are loaded to varying extent which can be explained by the fact that tractor semi-trailers are normally used to haul "all commodity" freight, (i.e. a wide range of commodities in both truck-load and less than truck-load quantities where no one commodity dominates). This is unlike the doubles which are normally used for the "weight-based" commodities (i.e. dense commodities moved in truck-load quantities).

The average operating GVW for each truck was calculated as the weighted sum of the average GVW for each class (i.e. the sum of the proportion of trucks in each weight class multiplied by the GVW for the mid-point of that class) and summarized in Table 2. The variation in the average GVWs hence payloads is a clear indication of the range of commodities hauled by these trucks. Some of the data sets exhibit a fairly strong weight-based freight while others are dominated by volume-based freight. The average GVW for the 3-S2 is 30.7 tonnes for Manitoba data, i.e. 78% of the GVW limit; and about 30.0 tonnes for Saskatchewan data i.e. 76% of the GVW limit. The corresponding values for the 3-S3 are 37.2 tonnes for Manitoba (80% of limit) and 36.0 tonnes for Saskatchewan (78% of limit). These figures indicate that the actual average operating GVWs are in the region of 75-80 of the maximum allowable.

Fig. 3. Cumulative GVW Distributions

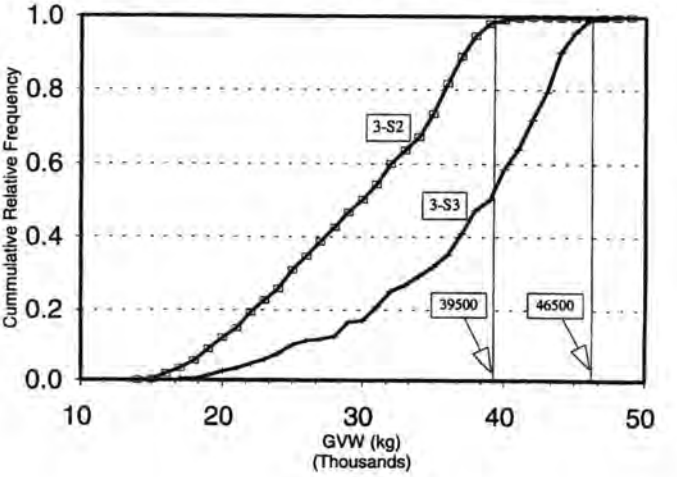


Table 2. Explanatory Variables

Data set	Average GVW (tonnes)	Average Payload (tonnes)	TLF†	Ave/Pot Payload‡ (%)	ESAL/ Payload
	5-axle tractor semitrailer (3-S2)				
MB-89	30.9	15.4	1.82	64.3	0.118
MB-91	32.3	16.8	2.06	70.0	0.123
MB-92	30.4	14.9	1.77	62.1	0.119
MB-94	29.1	13.6	1.61	56.7	0.118
SK-90	30.5	15.0	1.75	62.5	0.117
SK-92	29.4	13.9	1.68	57.9	0.121
SK-93	28.3	12.8	1.60	54.0	0.125
MEAN	30.1	14.6	1.76	61.1	0.120
	6-axle tractor semitrailer (3-S3)				
MB-89	36.2	19.7	2.15	65.8	0.109
MB-91	39.6	23.1	2.81	77.1	0.121
MB-92	36.1	19.6	2.25	65.3	0.115
MB-94	36.8	20.3	2.22	67.7	0.109
SK-90	37.5	21.0	2.50	70.0	0.119
SK-92	36.3	19.8	2.20	66.0	0.111
SK-93	34.4	17.9	2.02	60.0	0.112
MEAN	36.7	20.2	2.31	67.4	0.114

Notes:
MB- Manitoba; SK- Saskatchewan
† - *Average ESAL per truck*
‡ - *Average payload as ratio of potential maximum payload capacity*

4.2 Average Payloads

The average payloads for the two truck configurations were calculated in the same manner as the average GVW, and are shown in Table 2. Average tare weights of 15.5 tonnes for a 3-S2 and 16.5 tonnes for a 3-S3 are assumed in calculating payloads. The average payloads are: for 3-S2, 15 tonnes for Manitoba data and 14 tonnes for Saskatchewan data; corresponding values for 3-S3 are 21 tonnes and 20 tonnes respectively. It is clear the average operating GVW and payloads of the two trucks configurations are very identical in the two provinces. The average payload as a percentage of the maximum potential payload is

61% for the 3-S2 and 67% for the 3-S3.

These results of average GVW and payloads suggest that:

(i) 3-S3 is used for a wider spectrum of commodities, with a clear inclination for weight-based freight compared to the 3-S2;

(ii) 3-S3 is operated at higher GVWs relative to the limit than the 3-S2;

(iii) potential payload weight capacity utilized is higher for the 3-S3;

(iii) since both trucks have the same cubic capacity, the attraction to 3-S3 is more for weight-based operations than volume-based; and

(iv) average payloads are around 60-75% of the maximum possible.

4.3 Operating Efficiency

Fekpe et al. (1995a) defined operational efficiency of trucks as the ratio between highway potential pavement damage measured by the equivalent standard axle loading to the average payload, given adequate stability and control properties. This parameter represents the infrastructure "costs" / payload "benefit" ratio and provides a measure for comparing operating efficiencies of different trucks. Given that annual vehicle distance travelled or utilization could vary between truck types, ESAL-km per payload was suggested as an objective measure in comparing the operating efficiencies from the standpoint of the highway or regulating agency (Fekpe et al. 1995b). In the absence of utilization data however, the ESAL per payload could be used as the best estimate in assessing relative efficiencies.

Fig. 4a shows typical variation of ESAL per tonne payload as a function of the GVW. The curves superimposed represent the hypothetical situation where the GVW is distributed on the axles in the proportion of the axle weight limits. It is noted that the actual axle weight distributions trucks lie mainly above the hypothetical curve suggesting that in reality, the distribution of the weight on the axle units does not follow the ideal curve. This curve therefore represents lower bound values for the ESAL per payload. The hypothetical curves are compared in Fig. 4b and it clearly shows that the 3-S3 imposes lower ESAL per payload than the 3-S2 for the full range of possible GVWs.

Average ESAL per payload or operating efficiency indices are also shown in Table 2. On average, a 3-S2 imposes 0.120 ESAL per tonne payload and 0.114 by a 3-S3. Thus, for the same amount of payload, the 3-S3 has less pavement damage potential than the 3-S2. It could be said that the 3-S3 is a more efficient truck relative to the 3-S2 since both trucks exhibit comparable dynamic performance properties and have the same dimensions. The 3-S3 is attractive because it offers higher and more flexibility in payload handling without sacrificing stability and control properties which are directly linked to safety.

5. CONCLUDING REMARKS

The following observations are made from the foregoing analysis, which may explain to a large extent the increase in the proportion of 3-S3 in the truck fleet:

- 3-S3 truck has identical dynamic performance properties to the 3-S2 configuration;
- 3-S3 is operationally more efficient than the 3-S2 measured in terms of payload handling and potential pavement damage;
- 3-S3 are appears to be more suitable for weight-based commodities than 3-S3 and therefore more flexible in commodity handling;
- not only is the potential payload capacity of the 3-S3 higher but the amount actually utilized is also higher.

Given these attributes, it is expected that the shift to 3-S3 will continue and assuming that the rate of change is maintained, it is likely that the percent of 3-S3 in the heavy truck fleet will be around 70% by year 2000.

Whereas the weight distributions of a newly introduced truck configurations do stabilize within a relatively short period of time, the percent of that truck in the heavy truck fleet takes a relatively longer time to stabilize.

Under NAFTA, long haul operations are expected therefore more productive trucks will be preferred. The 3-S3 configuration offers a clear advantage over the 3-S and shows promise having both high productivity and less pavement damage potential without scarifying stability and control requirements.

Fig. 4a ESAL per Payload Distributions

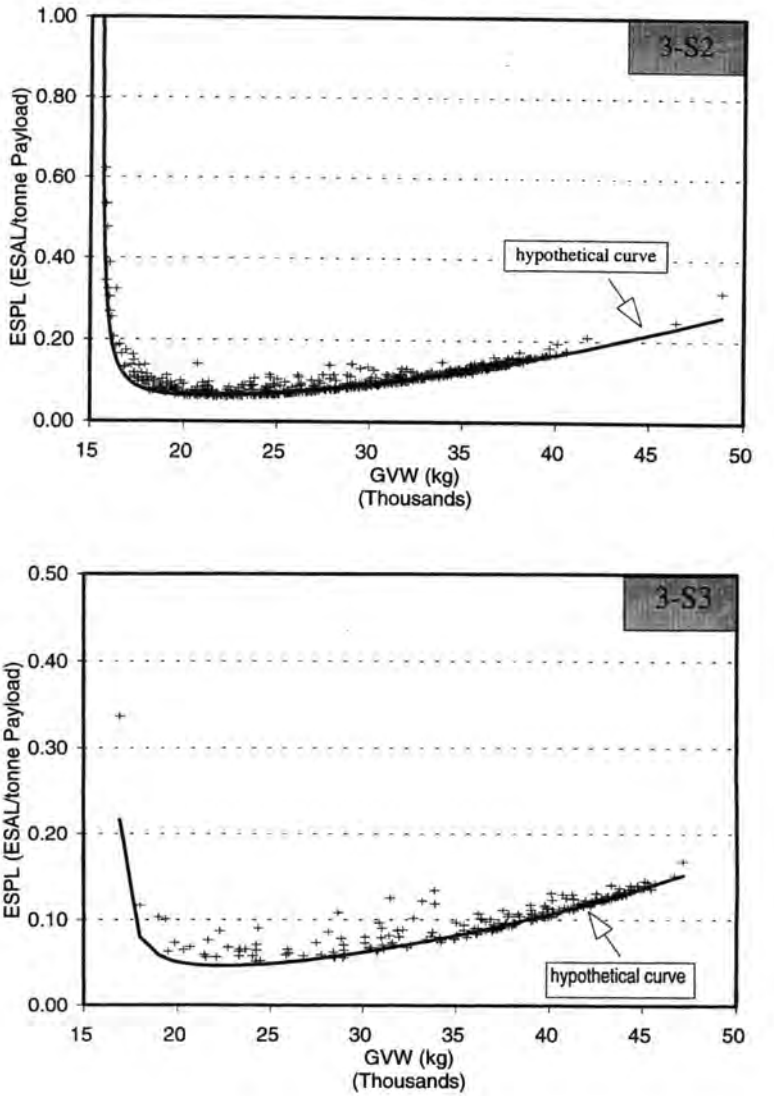
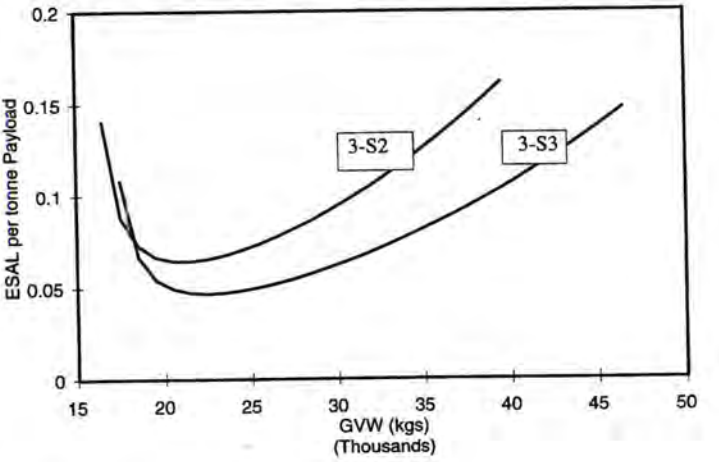


Fig. 4b. Hypothetical ESAL per Payload Distributions



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Information logistique et logistique de l'information dans le transport routier de marchandises

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1. Introduction

Le secteur du transport routier de marchandises est soumis actuellement à des changements importants imposés par l'environnement économique, parmi lesquels nous distinguons l'adoption de la démarche logistique qui exige des entreprises de ce secteur un effort poussé dans la recherche des gains de qualité et de productivité afin de contribuer à la rationalisation des flux des activités économiques.

L'objectif d'organiser l'activité économique selon une logique de chaîne et les principes d'efficacité, lié aux résultats, et d'efficience, lié au processus, fait que la mise en place des systèmes d'information soit indispensable pour traiter les flux des échanges depuis l'approvisionnement, en passant par la production proprement dite, jusqu'à la distribution finale des produits aux consommateurs.

Le transport routier de marchandises est subordonné à cette logique de chaîne et donc appelé à y par la mise de la chaîne de transport et par son intégration à la chaîne d'information logistique.

L'insertion du flux d'information des transporteurs à la chaîne d'information logistique les oblige à faire appel aux nouvelles technologies de l'information et de communication. Ce processus d'informatisation est coûteux et difficile à gérer [GOU 89] du fait que les alternatives technologiques disponibles sur le marché sont offertes à des prix plus ou moins élevés et que l'efficacité des solutions apportées n'est pas toujours garantie.

Cette nouvelle exigence fait que l'information se présente actuellement plutôt comme un facteur de production de l'activité économique du transport [GUI 93] et réclame des entreprises de transport routier de marchandises des nouvelles compétences qu'elles n'ont pas encore maîtrisées.

Dans cette communication, nous traitons de la problématique de l'information dans le transport routier de marchandises, en présentant, dans un premier temps, les aspects théoriques pour préciser la nature de l'information logistique dans le cadre de référence des chaînes logistiques. Ensuite, nous propageons les idées de base de la logistique aux chaînes d'information pour expliciter le processus de production de ces informations, selon une approche fondée sur l'application du juste à temps aux systèmes d'information des transporteurs. Nous finirons avec une analyse globale des enjeux de ces nouvelles exigences dans le secteur du transport routier de marchandises.

2. Méthodologie

La recherche dont les résultats sont présentés ici, a porté tant sur les aspects théoriques que sur la pratique des entreprises de transport routier en France, au Brésil et au Québec.

Ainsi, les enquêtes auprès des entreprises de transport routier de marchandises, basées sur l'entretien personnel, a permis d'identifier les principaux problèmes concernant l'information sur les transports et cerner la problématique dans son ensemble, tandis que la revue de la presse spécialisée, centrée sur quelques articles de revues et journaux, a rendu possible l'élargissement de la compréhension du sujet vers d'autres entreprises qui n'ont pas participé aux entrevues.

Ces connaissances du terrain associées à la recherche bibliographique ont été la base de notre réflexion théorique afin préciser les concepts et les rapports entre la logistique, la chaîne de transport et la chaîne d'information, permettant aussi de produire une architecture de référence pour les systèmes d'information logistique sur les transports

Dans le domaine de l'informatique et de la télématique, l'enquête sur les produits disponibles sur le marché et les recherches des universités [SIM 93] ont permis de caractériser les nouvelles technologies d'information pouvant être utilisées par les entreprises de transport routier de marchandises.

3. L'information logistique dans le transport routier de marchandises

La logistique, dans la recherche de la compétitivité économique par le biais de la synergie globale de l'activité productive, a pour but "la mise en place au moindre coût, d'une quantité de produit, à l'endroit et au moment où une demande existe" [COL 87].

Pour y arriver, elle agit sur les flux de la transformation physique des matières premières en produits finis ou semi-finis afin de les adapter aux caractéristiques, à la quantité et au rythme de la demande. La fluidité des échanges économiques est donc la cible de la logistique pour réussir à satisfaire les besoins des consommateurs.

La chaîne logistique, c'est à dire, l'ensemble des activités visant l'écoulement des marchandises, se compose des actions relatives à l'approvisionnement en matières premières, à la fabrication proprement dite des produits et à la distribution de ces produits sur les marchés.

Compte tenu de sa nature régulatrice, la gestion de la chaîne logistique implique l'adoption d'une approche basée sur l'anticipation, la coordination et le suivi des actions. Cela ne peut se faire que par la mise en place d'un flux d'information permettant de réguler de l'aval vers l'amont les flux physiques de matières premières et de produits.

Ce flux d'information, la chaîne d'information, établit un rapport entre les événements en cours de réalisation et le processus de prise de décision concernant la synchronisation des actions nécessaires à la fluidité de la chaîne logistique.

Ainsi, de façon analogue à la chaîne logistique, la chaîne d'information exige une approche globale de gestion basée sur l'anticipation, la coordination et le suivi des activités d'approvisionnement, de production et de distribution d'informations, autrement dit, la logistique de l'information.

Cela se traduit par l'utilisation des systèmes d'information tenant compte des caractéristiques intrinsèques des informations, de leur traitement et de leur diffusion entre les divers points de la chaîne "juste à temps" de leur utilisation.

La chaîne des transports s'insère dans la chaîne logistique et, par conséquent, dans la chaîne d'information logistique, avec comme but d'assurer la valeur spatio-temporelle des produits au travers des déplacements physiques de matières premières et de produits ainsi

que la mise à disposition des informations nécessaires à la régulation des flux.

La qualité du service de transport devient donc un résultat tant des opérations de transport (et opérations annexes de groupage et dégroupage, de chargement et déchargement, d'emballage, de conditionnement, etc.) que de celles de saisie, traitement et distribution d'informations.

L'information est, pour ainsi dire, considérée de plus en plus comme un facteur de production de l'activité économique des transports dans la mesure où elle est une composante importante de la qualité du service rendu aux clients et une ressource essentielle pour gérer l'opération de transport. Elle sert à anticiper, à accompagner et à suivre le flux de déplacements de marchandises afin de pouvoir réagir convenablement aux aléas de l'environnement.

Si l'on prend en compte les besoins de la chaîne des transports, ces informations peuvent être classées dans les catégories suivantes:

1. Informations sur l'approvisionnement des matières premières, regroupant ici les informations sur les chauffeurs, les tracteurs (ou camions), les unités de chargement (remorque, semi-remorque, conteneurs, caisse-mobiles) et les ressources diverses telles le carburant, les pneus, les pièces de rechange, etc.;
2. Informations sur la production du transport, c'est-à-dire, sur la réalisation des opérations de transport proprement dite, regroupant des informations sur les marchandises transportées, les origines et destinations des déplacements, les ressources utilisées (chauffeurs et véhicules), les trajets, etc. Elles concernent aussi les informations sur le suivi et de contrôle des opérations (conditions climatiques et aléas en cours de route) et sur les opérations annexes de chargement et déchargement, de groupage et dégroupage des marchandises, d'emballage et de conditionnement;
3. Informations sur la distribution du service de transport, concernant les ventes (prix, quantités vendues, qualité de service, etc.), le service après vente, l'évaluation de la qualité de service (respect des délais, litiges, exigences des clients, etc.), les caractéristiques du marché, etc.

Ces catégories peuvent être divisées en d'autres sous-catégories afin de tenir compte des spécificités des opérations, par exemple, le

transport de courte-distance, le transport de longue distance ou bien le transport trans-frontière.

Les informations peuvent aussi être classées par rapport à leur type:

1. informations concernant les véhicules, les tracteurs, les chauffeurs, les clients, le réseau de camionnage, etc.;
2. informations statistiques correspondant aux séries statistiques des opérations de transport;
3. informations réglementaires concernant les normes et réglementations sur la réalisation du transport;
4. informations documentaires destinées à localiser les documents tels que documents de recherches dans le domaine, documents de travail, articles de revues et de journaux etc.;
5. informations graphiques concernant graphiques, cartes géographiques, tableaux, etc.;
6. informations multimédia correspondant à des logiciels, vidéos, filmes en général, bande sonore, etc..

L'autre aspect à prendre en considération est que la remontée de l'information ne concerne pas seulement le niveau de la chaîne logistique des clients et des fournisseurs mais aussi celui des activités de planification macro-économique des systèmes logistiques afin de fournir les éléments nécessaires à l'établissement des politiques (transport, d'aménagement du territoire, énergie, technologie, etc.) visant à l'amélioration de la compétitivité des nations par l'efficacité des systèmes logistiques nationaux.

4. Logistique de l'information

Deux axes d'analyse sont au coeur de la problématique de l'information sur les transports. Le premier réfère au processus de production du transport (présenté auparavant), qui offre la raison de l'existence des systèmes d'information, et le deuxième concerne le processus de production d'information proprement dit.

L'approche que nous présentons ici concerne l'application de l'idée de base de la logistique à la chaîne d'information, ce que nous appelons "logistique de l'information" et qui consiste à fournir un certain nombre d'informations sur le transport, à l'endroit et au moment où une demande existe.

Ainsi, en analysant les systèmes d'information logistique sur le transport sous "une logique de chaîne", on s'aperçoit qu'ils possèdent les modules de base suivants:

1. module d'approvisionnement ou de saisie des données sur les opérations de transport (avant, durant et après ces opérations);
2. module de production d'informations visant à traiter et à améliorer le contenu ou la forme des informations nécessaires à la prise de décision et au suivi des actions qui en découlent;
3. module de distribution d'informations ayant comme but de faire éclater les informations vers les divers points de la chaîne de transport et les mettre à disposition des utilisateurs aux divers stades de la chaîne de transport selon les formes les plus adaptées.

Il faut remarquer que ces systèmes ont des liens étroits avec les systèmes d'informations des clients et des fournisseurs à l'extérieur des entreprises, et, à l'intérieur, avec les autres systèmes d'information, auxquels ils doivent s'intégrer logiquement et physiquement. C'est la raison pour laquelle la mise en oeuvre de tels systèmes s'avère dans la plupart des cas très difficile compte tenu du fait que chacun de ces systèmes présente des façons différentes de saisir, de traiter et de distribuer les informations. De plus, leurs supports physiques ne permettent pas toujours l'échange de données entre eux.

L'autre aspect à prendre en considération est celui concernant les informations nécessaires aux divers niveaux de décision, à savoir:

1. décisions au niveau opérationnel des entreprises de transport;
2. décisions au niveau micro-économique des systèmes logistiques;
3. décisions au niveau macro-économique des systèmes logistiques nationaux.

La mise en rapport des deux axes d'analyse (figure 1), le premier concernant l'information logistique sur le transport et le deuxième concernant la logistique de l'information, montre une architecture de référence des systèmes d'information comme un résultat des croisements des diverses étapes de l'évolution de la chaîne de transport et de celles de la chaîne d'information. Chaque croisement ou fonction du système assure la mise à disposition d'un certain type d'information à un moment donné de l'opération de transport.

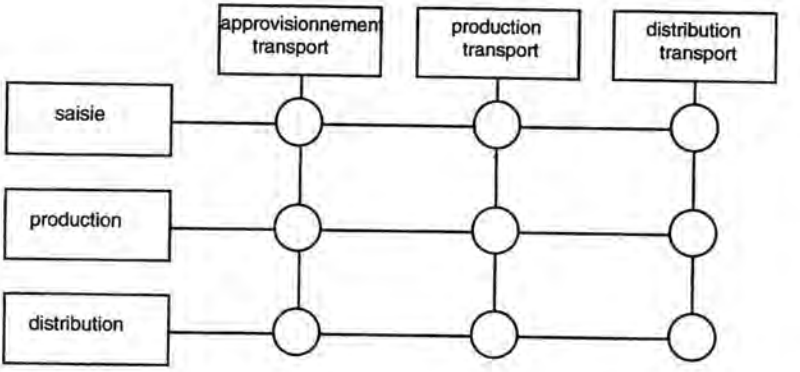


Figure 1- architecture de référence
des systèmes d'information logistique sur le transport

Pour rendre compte des difficultés inhérentes à la production des informations, discutons du cas du croisement "approvisionnement en information X production du transport" concernant la fonction de saisie des données sur la réalisation de l'opération de transport proprement dite.

Du point de vue des besoins de la chaîne de transport, on constate qu'il faudrait suivre, accompagner l'ensemble marchandise-chauffeur-véhicule depuis son départ jusqu'à son arrivée, autrement dit, "émettre", à des moments précis, les informations sur l'état de l'opération afin de pouvoir réagir aux aléas en cours de route et réaliser l'opération telle que prévue.

Étant donné que le but est de présenter la bonne information au bon moment, la question qui se pose est de savoir comment réaliser la saisie d'information sur les divers événements lors de l'opération de transport. Quels faits sont significatifs et lesquels ne le sont pas? Si l'on définit un fait comme étant significatif, de quelle manière va-t-on le saisir physiquement ou bien le décrire?

La complexité de la tâche due à la diversité des informations et au niveau de connaissances requises pour la gestion de la chaîne d'information a entraîné la présence de nouveaux arrivants dans le secteur du transport routier de marchandises, qu'on pourrait appelé "les opérateurs informatiques", dont la mission est de traiter la

fluidité des systèmes d'information tant à l'intérieur qu'à l'extérieur des entreprises.

Ainsi, la satisfaction des besoins de la chaîne d'information exige le recours à l'innovation par le biais des nouvelles technologies d'information et de communication afin de mettre en place les conditions nécessaires à la planification, au suivi et à l'évaluation des opérations de transport.

Plusieurs technologies sont à la disposition des entreprises de transport routier des marchandises. Nous les présentons selon les catégories suivantes:

1. les technologies de saisie des données visant l'enregistrement des faits le long du processus de production du transport, comme les micro-ordinateurs, les ordinateurs embarqués à bord de véhicules, le lecteurs de code barre, les tablettes, l'équipement de repérage des véhicules par satellite ou radio fréquence, les équipements d'instrumentation, etc.;
2. les technologies de communication des données comme les réseaux d'échange des données informatisées (EDI) visant la distribution de l'information entre les divers points de la chaîne de transport tels les réseaux communautaires, les réseaux à valeur ajoutée, les réseaux publiques d'information sur le transport, etc.;
3. les technologies de traitement d'information ayant pour but d'assurer la fiabilité des informations, surtout traiter les informations d'aide à la décision, et concernant essentiellement des logiciels, par exemple, les systèmes d'information de gestion, les systèmes à référence spatiale, les systèmes à base de connaissances, etc.;
4. les technologies de contrôle de processus destinées à l'automatisation des tâches telles la manutention, l'emballage, le conditionnement, le pesage automatique de véhicules, le contrôle de température dans les véhicules, etc.

Parmi ces technologies, l'échange de données informatisées constitue celle qui présente le plus de difficultés à mettre en place du fait qu'elle exige un effort significatif de négociation entre les divers acteurs de la chaîne logistique et de la chaîne de transport afin de parvenir à établir des liens de communication entre eux et garantir la fluidité des informations.

Ces négociations débutent avec l'établissement d'un langage commun entre les différents acteurs permettant de nommer les concepts et les événements du transport selon une même sémantique, de structurer les messages sous une forme compréhensible à tous et de les intégrer aux systèmes d'information des partenaires de la chaîne.

Ensuite, le transfert des informations le long du réseau formé par les acteurs doit respecter les contraintes techniques dues aux caractéristiques physiques des supports d'information.

Enfin, les décisions collectives sur le choix des partenaires et leurs rôles dans le système doivent être prises de façon à éviter que les transporteurs soient réduits à des "ghetto informationnels" des clients ou bien à la dépendance technologique des "opérateurs informatiques".

Si, d'une part, l'échange de données informatisées réclame des actions réfléchies, elle est, d'autre part, l'une des alternatives les plus intéressantes pour obtenir des gains de qualité et de productivité dans l'activité de transport.

En effet, si l'on calcule les coûts de l'usage de "paperasses", on s'apperçoit qu'ils ont un poids très important dans les coûts globaux des entreprises. À titre d'exemple, STOVEN [STO 88] estime que les coûts de traitement des "papiers" peuvent atteindre 7% de la valeur de la marchandise vendue (moyenne). Dans le commerce international ces coûts peuvent être de l'ordre de 10 à 15%. On y ajoute les coûts dus à la non-qualité, résultants des erreurs de préparation des dossiers, des retards et des pertes de documents.

Ainsi, le "trafic des papiers" à l'intérieur et à l'extérieur des entreprises de transport routier de marchandises pourrait, dans une certaine mesure, justifier un nouveau "secteur économique du transport de papiers du transport routier". Heureusement que l'EDI peut remplacer la "chaîne d'information-papier" par la "chaîne d'information-électronique", moins chèr au coût unitaire, plus rapide et de meilleure qualité.

C'est dans les fonctions financières que les résultats positifs de l'EDI sont mis le plus en évidence: la transmission des ordres de transport (la vente du service en direct), la facturation et le paiement.

Sans considérer les applications classiques de l'informatique, un regard plus pratique sur les nouvelles technologies indique qu'un certain nombre d'entre sont plus intéressants à utiliser:

- la liaison en direct avec les clients réguliers pour obtenir plus de rapidité dans la caractérisation de la demande, ce qui peut être fait par l'EDI transporteur-clients;
- l'utilisation des systèmes d'aide à l'évaluation des demandes permettant de tenir compte d'un plus grand nombre de paramètres décisionnels lors de l'acceptation de la demande;
- le repérage des véhicules par satellite afin de localiser les ressources le plus tôt possible et de planifier leur utilisation de façon plus précise;
- la visualisation des informations directement sur les cartes géographiques à l'aide de systèmes d'informations géographiques;
- la réalisation des affectations marchandises-véhicules-chauffeurs à l'aide des systèmes à base de connaissances permettant de générer et d'évaluer les meilleures affectations en termes de coûts, de respect de la réglementation ou de l'usage de ressources;
- la planification des activités des chauffeurs à l'aide de systèmes à base de connaissances capables de planifier au mieux les activités telles que la conduite, le repos, la ronde de sécurité, à partir d'un ordinateur à bord des véhicules;
- l'aide à la conduite proprement dite concernant les systèmes destinés à renseigner le chauffeur sur le trajet à réaliser, les conditions du véhicule, les mesures de sécurité;
- l'enregistrement des donnés sur les marchandises chargées (quantité, poids, genre de marchandises) au moment même du chargement du véhicule afin de permettre l'anticipation des informations nécessaires à la répartition;
- l'identification des marchandises dès le départ avec les codes barres; et
- l'identification des chauffeurs par carte magnétique;
- etc.

Bien que les contraintes logistiques des clients réclament un effort d'innovation plus important des entreprises de transport routier de marchandises dans la réalisation de leur activité productive, plus particulièrement, dans le traitement et la distribution des informations dans ces activités, il faut remarquer que la participation des transporteurs dans les chaînes logistiques entraîne des

investissements significatifs lesquels ne sont pas toujours faciles à réaliser.

5. Conclusion

La problématique que nous avons abordée traite de l'importance de l'information comme élément-clé [MAN 87] de la réussite des entreprises du transport routier de marchandises vis-à-vis du contexte économique actuel, plus particulièrement, celui résultant de l'utilisation de la démarche logistique dans les activités économiques.

La mise en place de systèmes d'information logistique pour le transport dépend de la vision innovatrice des entrepreneurs de ce secteur aussi bien que de leur capacité de négociation auprès des clients et des fournisseurs afin d'assurer l'intégration de ce système aux chaînes logistiques respectives.

Les nouvelles technologies de l'information offrent de nombreuses possibilités pour résoudre les problèmes d'information à l'intérieur des entreprises et à l'extérieur afin d'établir les partenariats essentiels à la fluidité des informations.

Comme on a vu précédemment, la prise en compte d'une démarche logistique de l'information n'implique pas seulement les aspects techniques de son processus de production. Il faut analyser les enjeux de l'information au niveau stratégique du secteur du transport routier de marchandises et au niveau organisationnel de chaque entreprise.

Ainsi, la mise en place des systèmes d'information logistique sur le transport exige des entreprises l'adoption d'une stratégie d'alliances fondées sur l'échange d'information entre les intervenants de la chaîne de transport, ces alliances visant la mise en commun des moyens de communications, des matériels et de personnel spécialisés.

Il exige également un environnement organisationnel plus évolué en termes de capacité d'assimilation des nouvelles technologies par les entreprises et surtout l'adoption des nouvelles formes de gestion qui dépassent celles de l'entreprise traditionnelle ou familiale. Cette exigence de compétences multiples et approfondies dans des domaines différents du transport, comme la télématique, fait apparaître des nouveaux acteurs et peut entraîner des changements importants dans la structure du secteur du transport routier de marchandises qui ne seront pas toujours favorables aux entreprises timides vis-à-vis l'innovation.

De plus, le volume d'investissements nécessaires à la mise en place de la chaîne d'information peut écarter les petites et moyennes (PME) entreprises de transport routier et favoriser la "cartellisation" du secteur aux tour des grandes entreprises de transport ou bien la "vassalisation" des PME dans les circuits d'information des clients [SAV 89].

L'intervention de l'État est importante, surtout dans le transport international ou interrégional, dans la mesure où l'existence des obstacles douaniers (documents) et des divergences dues à la normalisation des échanges d'information peuvent empêcher la négociation entre les partenaires des chaînes d'information. Elle est aussi importante dans la coordination des actions visant la mise en place des plates-formes logistiques [OCD 92] offrant les moyens et les techniques nécessaires pour que les transporteurs puissent trouver la bonne information au bon moment, par exemple celles concernant les frets de retour, les conditions climatiques, l'offre des véhicules, l'état du trafic, etc.

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JUSTE-À-TEMPS ET TRANSPORT DANS LE MARCHÉ NORD-AMÉRICAIN

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1. Introduction

Il est difficile de cibler avec certitude tous les facteurs qui ont contribué au développement des systèmes de transport au cours des dernières années. Si l'augmentation des échanges et la création de blocs commerciaux (blocs asiatique, européen, nord-américain) semblent à première vue expliquer une large part du phénomène, d'autres éléments doivent aussi être considéré. Le développement de modes de gestion axés sur la minimisation du niveau des inventaires, le transport de produits technologiquement avancés et la diversification des produits transportés rendent nécessaire un niveau élevé de sécurité et de flexibilité dans la manutention et l'acheminement. De plus, l'augmentation des exigences des clients oblige les transporteurs à développer des approches qui éliminent les pertes de temps occasionnées par les opérations de manutention, de transmission de documents et de transition d'un mode de transport à un autre.

Aussi, la segmentation des marchés force les entreprises à élargir leurs horizons commerciaux pour maintenir le volume des ventes. Mais la plus grande dispersion géographique des clients soulève alors des problèmes liés à une augmentation des coûts de distribution et des coûts de transport occasionnée par les plus grandes distances séparant les fournisseurs et leurs clients. En effet, toutes les entreprises n'ont pas les moyens de s'installer à proximité de leurs principaux marchés ou clients. Pour cette raison, les échanges commerciaux entre deux partenaires nécessitent l'implantation d'un réseau de transport efficace et suffisamment flexible pour répondre aux attentes des clients. Ces attentes dépendent de plusieurs facteurs (organisationnels, opérationnels, informationnels, environnementaux) et traduisent généralement les aspirations managériales des clients qui tendent vers une réduction constante des coûts relatifs aux stocks, aux opérations de manutention répétitives de même qu'aux pertes de temps. Il s'agit en fait d'assurer à partir de l'achat jusqu'à la livraison chez le client, la circulation continue des marchandises. Pour ce faire, le JàT est une solution qui s'impose de plus en plus et qui permet de mieux synchroniser le cycle approvisionnement/production/distribution. Dans cette communication, nous allons donc examiner l'impact de cette approche sur le transport dans un contexte nord-américain

2. Les principes du juste-à-temps

Le JàT est une philosophie de gestion visant l'éradication de l'inefficience à tous les niveaux (Manoochehri, 1988; Mehra et Inmam, 1992; Landry et Trudel, 1993). Une telle finalité passe nécessairement par l'élimination de toutes formes de pertes, et prend sa source dans la capacité d'une entreprise à réagir rapidement aux variations des conditions environnementales. Une telle flexibilité peut toutefois nécessiter des investissements matériels et immatériels importants pour assurer la diffusion, le traitement et le contrôle rapide de l'information. En fait, l'objectif vise à la coordination et à la régulation des flux physiques via un accès rapide et constant à des informations pertinentes et précises, de même que par des réactions (organisationnelles et opérationnelles) également rapides et précises. La stratégie du JàT intègre 7 principes guidant la démarche vers un niveau de productivité de classe mondiale (Wantuck, 1989) dont l'élimination du gaspillage qui se décompose aussi en 7 éléments (figure 1).

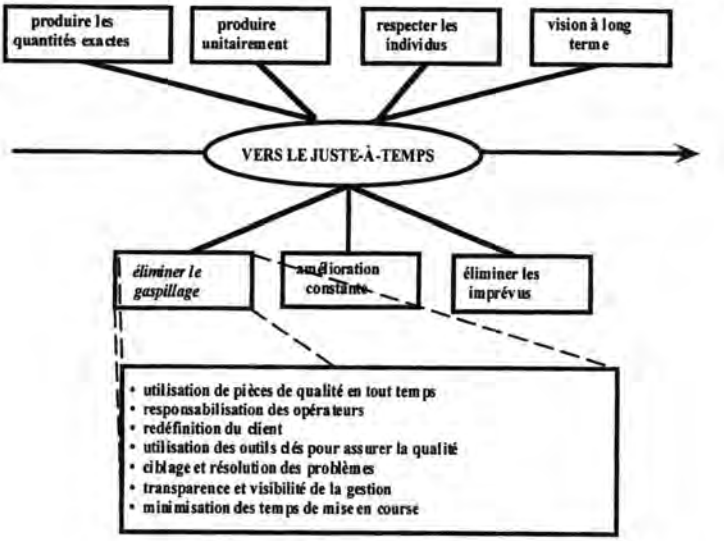


Figure 1. Les principes de la stratégie du JàT

Les éléments de la figure 1 représentent l'enveloppe du mode de gestion JàT; ils ne sont réalisables qu'à partir du moment où ils sont soutenus par une sensibilisation des individus et par une révision des processus de conception, de production et d'approvisionnement. Les éléments de mise en place du JàT ont été regroupés par Gélinas *et al.* (1994) qui, à partir d'une revue de la littérature, propose une grille des facteurs de succès du JàT qui comporte deux axes: les facteurs opérationnels et les facteurs organisationnels. Cette grille compte neuf

catégories qui sont la gestion des approvisionnements, la production, la gestion des stocks, l'aménagement d'usine, la qualité, le management, le marketing, la main d'oeuvre et la formation. Ces catégories regroupent plusieurs facteurs dont les plus pertinents sont les approvisionnements et la production en JàT (facteurs opérationnels), et l'évaluation de l'impact des changements occasionnés par l'implantation du JàT (facteur organisationnel). Parmi les facteurs de succès se rapportant aux approvisionnements, l'aspect transport occupe une place prépondérante et ressort comme étant un des facteurs clés.

3. Les nouvelles exigences logistiques

Les développements de l'économie et de l'offre de transport sont largement dépendants l'un de l'autre (voir figure 2). En réponse à une économie caractérisée par des flux de plus en plus diffus, les grandes entreprises de production et de distribution ont élaboré une démarche logistique de maîtrise et de gestion de la circulation de leurs flux physiques, de l'approvisionnement jusqu'à la distribution. La chaîne logistique synchronise, régularise, règle et suit les marchandises grâce à un système d'information de haut niveau, et doit simultanément rencontrer des objectifs de qualité du service et de maîtrise des coûts. On assiste donc à l'émergence de nouvelles exigences logistiques découlant des trois forces identifiées à la figure 2.

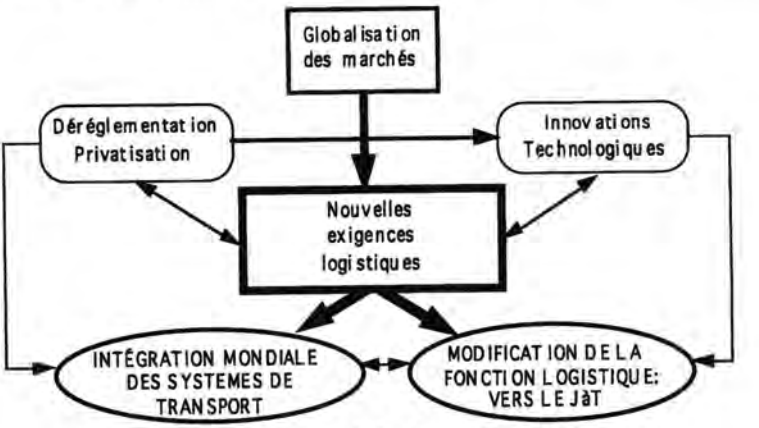


Figure 2: Intégration mondiale des systèmes de transport

Si dans le passé, la seule liberté des usagers était de choisir l'offre qui leurs convenait le mieux, certains transporteurs se sont mis à pratiquer ce que Colin (1987) appelle l'additivité des modes de transport, se plaçant en position d'intermédiaires pour construire des chaînes de transport. Ces transporteurs proposent des services incorporant une valeur ajoutée aux activités traditionnelles de traction, et ils s'intègrent par la suite dans une ou plusieurs

chaînes logistiques, devenant alors les partenaires des expéditeurs. Le rehaussement des exigences des entreprises manufacturières ou commerciales a en quelque sorte obligé ces transporteurs à élaborer des stratégies logistiques favorisant la constitution de chaînes de transport. Ce phénomène conduit à une industrie hiérarchisée à deux niveaux, regroupant d'une part des entreprises traditionnelles offrant des services de traction et d'autre part des entreprises modernistes qui organisent et gèrent les chaînes de transport (Colin, 1987).

La prise en compte des contraintes inhérentes à l'organisation d'une chaîne rend nécessaire l'intégration d'une variété grandissante de missions et d'opérations au-delà du mode et de la traction. Elle nécessite également le développement de technologies telles que le conteneur multimodal qui permet de surmonter les difficultés du passage d'un mode de transport à un autre. Ainsi, on voit apparaître des zones commerciales de fret ou encore des plates-formes multimodales situées au coeur des principaux marchés, favorisant de la sorte les connexions entre transporteurs. Ces entités résultent d'une conception amodale des systèmes de transport qui s'oriente davantage vers la gestion des flux de marchandises plutôt que vers leurs simples déplacements (Colin, 1987).

4. Le juste-à-temps dans une industrie déréglementée

Appuyés par certains et rejetés par d'autres, les mouvements de déréglementation des transports ont perturbé cette industrie autrefois largement protégée. Plusieurs entreprises ont disparu, d'autres ont fusionné, et plusieurs autres ont émergé. Ces nombreux mouvements ont eu des impacts sur les opérations et les exigences des expéditeurs, déjà au prise avec les mouvements de globalisation des marchés et de mondialisation de l'économie (figure 2). Cet assouplissement de la législation, dans le but de favoriser l'innovation et d'augmenter la concurrence sur les marchés, a contribué à l'amélioration de la performance des transporteurs, et par le fait même des expéditeurs. Le tableau 1 présente certains effets de la déréglementation sur le transport JàT.

Selon Larson (1991), la déréglementation dans le transport par camion a contribué à améliorer la flexibilité et l'intégration des relations expéditeurs-transporteurs favorisant par le fait même l'implantation du JàT, par l'harmonisation des procédés et des procédures, la définition d'objectifs communs, la planification et le contrôle conjoint des opérations et la synchronisation d'activités complémentaires ou de soutien. De plus, Beier et Stone (1988) précisent que sans l'augmentation de la flexibilité des relations expéditeurs-transporteurs, il est peu probable que le JàT aurait pu être réalisé avec succès. La déréglementation a de plus contribué à l'augmentation des collaborations entre petits et grands transporteurs, les deux en bénéficiant. Un tel phénomène a permis le maintien de services sur certaines lignes et destinations qui étaient déficitaires pour des firmes de moyenne et grande taille et on assiste, aux États-Unis, à une hausse de la collaboration entre les grands transporteurs ferroviaires et les plus petits (Tremblay, 1988).

Tableau 1. Les effets de la déréglementation sur le transport en JàT

Effets	Conséquences pour le JàT
Baisse des tarifs routiers, aériens et ferroviaires	Les pressions sur les coûts forcent les transporteurs à éliminer l'inefficience (temps, argent, ressources, ...)
	La diminution des tarifs permet aux expéditeurs d'acheminer plus souvent
Augmentation du niveau de concurrence	Augmentation du nombre de transporteurs offrant leurs services (diversification) et infidélité envers ceux-ci (roulement élevé)
	Élévation du niveau de service: diminution des délais de livraison, des pertes et des dommages, augmentation de la fréquence et des localités desservies, et amélioration de la fidélité et de la sécurité des transporteurs
Dynamisme hautement innovateur	Augmentation de la flexibilité et de la disponibilité des technologies
Flexibilité et intégration des relations expéditeurs-transporteurs	Amélioration et harmonisation des procédés et des procédures
	Définition commune des objectifs et des rôles
	Synchronisation d'activités de support, source d'avantages concurrentiels
Utilisation accrue des infrastructures de transport	Encombrement des espaces de circulation et de transition
	Pertes de temps et non respect des délais
	Coûts pour les consignataires lorsque les activités sont perturbées à cause des délais
	Augmentation des risques reliés à la sécurité
	Pressions possibles sur les coûts: utilisation de vieilles flottes, réduction de l'entretien

Si cette flexibilité des relations expéditeurs-transporteurs, qui se traduit par un dynamisme et beaucoup d'innovations dans le transport terrestre, profite un peu à tout le monde, d'autres conséquences du processus de déréglementation ont plutôt favorisé les expéditeurs, parfois au détriment des transporteurs. On peut d'une manière générale constater dans l'ensemble de l'industrie une diminution des tarifs de fret (Quinet, 1990) et une élévation générale du niveau de concurrence. Les résultats d'une telle évolution s'avèrent bénéfiques pour les expéditeurs qui veulent opérer en JàT. Tremblay (1988) fait ressortir que suite à la déréglementation du transport ferroviaire aux États-Unis, il y a eu une diminution des délais de livraison et des pertes et dommages, une augmentation des fréquences et des localités desservies, une amélioration de la disponibilité des technologies adéquates, et une amélioration de la fiabilité et de la sécurité des transporteurs; de fait, on a constaté entre 1980 et 1988 une diminution de 67% des accidents et des déraillements. Les résultats de Bigras (1993b) sur le transport routier abondent dans le même sens.

Si dans l'ensemble, l'assouplissement des normes a favorisé les atteintes des objectifs définis par le cadre opérationnel du JàT, il faut toutefois souligner que certains problèmes liés à la sécurité sont apparus, et s'expliquent par un encombrement de l'espace et une pression sur les coûts obligeant certains transporteurs à utiliser de vieilles flottes de véhicules et à réduire les opérations d'entretien (Quinet, 1990). De même, au niveau du transport routier, un constat de grande infidélité des expéditeurs envers leurs transporteurs contribue à alourdir le fardeau managérial de la distribution physique chez les expéditeurs (Bigras, 1993a).

5. Transporter et livrer juste-à-temps

Le transport JàT touche tant les approvisionnements que la distribution des produits finis. Globalement, le processus peut être guidé par cinq principes (Bradley, 1992): transporter les quantités exactes de marchandises au bon moment, avoir une vision d'ensemble de l'expédition qui assure un contrôle et un suivi constant, maximiser le niveau d'utilisation des ressources, éliminer les pertes, et réévaluer constamment le processus pour une amélioration constante des procédés et des procédures. En fait, il s'agit d'être compétitif dans un environnement dynamique, en optimisant l'utilisation technologies de l'information adéquates comme l'EDI (deRoulet, 1993), en implantant une logistique efficace, en devenant de plus en plus flexible, en anticipant mieux les besoins de la demande, en développant des relations étroites qui favorisent la rapidité et la fréquence des livraisons, et en adoptant un style de gestion flexible et compatible avec ces objectifs (Muller, 1994). Pour y arriver, Sadhwani *et al.* (1987) ciblent les aspects vers lesquels les entreprises manufacturières doivent orienter leurs efforts en ce qui concerne leurs interrelations avec l'environnement externe: acheter, transporter et livrer JàT.

Dès lors, la planification des expéditions, tant au niveau des achats que des ventes de produits finis, doit être détaillée et inclure des informations telles la quantité et le volume des pièces, la dimension des conteneurs, la capacité des remorques, ainsi que la localisation et les heures d'opération des fournisseurs. Elle doit de plus favoriser la coordination des achats de matières premières et les livraisons de produits finis (deRoulet, 1993). Pour qu'il soit efficace, l'approvisionnement JàT doit s'effectuer avec un nombre restreint de fournisseurs, les ententes étant basées sur le long terme et l'exclusivité. Il doit de plus permettre l'achat et la livraison en petits lots, encourager les fournisseurs à effectuer un contrôle statistique préventif de la qualité et permettre l'atteinte d'un haut niveau de spécialisation des fournisseurs qui peuvent ainsi mieux bénéficier de l'expertise de recherche et de développement des grandes entreprises (Sadhwani *et al.*, 1987).

Pour atteindre un haut niveau d'efficacité, il est nécessaire que les parties impliquées (fournisseurs, transporteurs et clients) connaissent et comprennent les objectifs poursuivis ainsi que l'importance de leur rôle respectif dans l'ensemble du processus. L'interaction entre les divers intervenants concernés

par un même projet et la représentation commune qu'ils se font d'un problème sont essentielles pour le résoudre au mieux, faisant ainsi ressortir l'importance des connaissances partagées dans la planification, le pilotage et la régulation des flux (Ponssard et Tanguy, 1993). L'évaluation du niveau de performance logistique d'une entreprise est basée sur l'établissement de liens solides, la mise en oeuvre d'un puissant partenariat fournisseur/client, la planification logistique à long terme, l'intégration des différentes fonctions dans le processus de planification, la mise en place de programmes d'amélioration continue de la qualité, l'implication et la mobilisation du personnel, l'utilisation des systèmes d'information comme aide à la coordination intra et inter-organisationnelle et le recours actif à des indicateurs de performance au niveau des coûts et de la qualité du service (Paché, 1994).

Le développement de relations étroites avec un nombre restreint de transporteurs peut favoriser l'efficacité et l'efficience des opérations de transport car ces relations permettent d'éliminer certains effets provenant de tarifs élevés, d'une mauvaise planification des besoins ou d'une sous-utilisation des ressources disponibles . De plus, ces formes de partenariat permettent de mettre sur pied des itinéraires bouclés sur une base journalière ou hebdomadaire, le transporteur devenant alors une extension du fournisseur. Elles peuvent aussi favoriser la détermination des procédures compatibles avec une mise en tension des flux, la conception des conditionnements compacts plus autonomes en surface d'entreposage, et la normalisation des unités d'expédition (Paché, 1994). Cela présente de plus l'avantage de donner accès à des services qui nécessitent très peu de supervision et peut même à la limite s'avérer un outil marketing pour l'entreprise.

Pour perfectionner le rendement du système, la sélection du ou des transporteurs doit prendre en considération les exigences du fournisseur, la valeur et la qualité du transporteur de même que les attentes des clients. Le fournisseur, à cause des exigences particulières de ses clients requiert des livraisons fréquentes et fiables, aux points d'utilisation. Pour sa part, le client face au transporteur recherche généralement des contrats exclusifs à long terme, des horaires stables, l'implantation de changements graduels ainsi qu'une communication étroite basée sur un transfert rapide d'information de qualité, mais également des livraisons fréquentes et fiables. Il faut donc évaluer le niveau d'assurance qualité et responsabilité du transporteur, sa capacité et sa volonté d'amélioration continue des services de même que la rapidité avec laquelle il transmet les bonnes informations. Lieb et Miller (1988) ont ciblé les six principaux critères à considérer dans le choix d'un transporteur: la proximité du terminal, l'étendu du réseau routier desservi, le prix, la capacité de retracer en tout temps les expéditions, la qualité des réponses aux besoins à court terme de même que la disponibilité d'équipements spécialisés.

Évidemment la distance entre le fournisseur et le client influence la longueur des délais de livraison, mais la qualité des réseaux routiers nord-américains et l'accès à des chaînes de transport structurées intégrant plusieurs modes (intermodal) accélèrent le mouvement des marchandises, amenuisant ainsi les effets négatifs de la grande distance. Toutefois, si les exigences des clients

sont supérieures aux délais de livraison imposés, il est toujours possible de déménager une partie des opérations de fabrication ou de conception en ramenant ces dernières sur un site à proximité du ou des clients. Cette fragmentation du processus de production contribue toutefois à rajouter des étapes additionnelles dans le transport et à faire augmenter les coûts qui y sont reliés.

L'élimination des pertes de temps, dans le but de diminuer les délais, passe notamment par la qualité des technologies utilisées comme le recours à des boîtes réutilisables, standardisées et qui sont suffisamment flexibles pour être combinées avec d'autres types sur une même palette (Wantuck, 1989), de même que par le support des manufacturiers et des clients lors de l'accueil du transporteur et des opérations de manutention (Bradley, 1992). Ce support peut aussi s'avérer très pertinent dans la conception des itinéraires. Ainsi, si le fournisseur et le client connaissent l'itinéraire, ils pourront plus facilement prévoir à la minute près l'heure d'arrivée de l'expédition ce qui facilitera le transit des marchandises et le retour du transporteur.

De même, les capacités technologiques d'une entreprise à expédier en charges complètes (par des opérations efficaces de consolidation) favorise l'atteinte des objectifs du JàT car l'expédition de charges partielles augmente les coûts de transport et les délais de livraison. Dans certaines situations, deRoulet (1993) propose d'établir des points intermédiaires de transfert où se concentrent les expéditions en charges partielles destinées à la consolidation, et d'utiliser à nouveau des petits transporteurs locaux ou régionaux pour effectuer la portion finale chez le client, l'expédition étant alors divisée en trois parties. La capacité de chaque point de vente à absorber le contenu d'un seul véhicule en provenance d'un entrepôt ou d'une plate-forme simplifie la matrice origine-destination. La difficulté principale ne tient plus par conséquent dans l'optimisation des tournées, mais dans un meilleur usage des capacités en amont de la séquence de traction terminale (Paché, 1994). La régularité des horaires basés sur une demande stable est donc nécessaire à la prévision et à la consolidation des lots en charges complètes.

Mais au-delà de l'utilisation optimale de l'espace d'expédition, les fournisseurs et les clients doivent aussi prendre conscience de l'importance des opérations de chargement et de déchargement qui peuvent à l'occasion s'avérer onéreuses du fait de leur lenteur, d'un manque de planification ou encore d'une mauvaise utilisation des ressources disponibles. À cet effet, l'harmonisation des technologies, jumelée à un niveau élevé de sécurité et de qualité, favorise l'ensemble de ces opérations. Wantuck (1989) met en évidence l'importance des fenêtres de livraison qu'il convient de localiser afin de maximiser le rendement par une diminution des distances (donc des opérations de manutention) entre les points de chargement et de déchargement, et les points d'utilisation. C'est ainsi que les marchandises doivent être livrées exactement là où elles sont transformées, assemblées ou vendues.

Finalement, selon une étude de Lieb et Miller (1988), il semblerait que le JàT modifie les habitudes modales de transport des expéditeurs car après son

implantation, ces dernières utilisent moins le train et davantage la camion et l'avion. Toujours selon cette étude, plus des trois quarts des expéditeurs diminuent le nombre de transporteurs avec qui ils transigent, et 73% d'entre eux rapportent qu'ils négocient des contrats spécifiques pour favoriser l'atteinte de leurs objectifs de livrer sur une base journalière en petits lots. Évidemment, de telles exigences créent une pression à la hausse sur les coûts du transport. Une étude de Raia (1990) procure aussi des résultats intéressants: 41% des expéditeurs n'ont constaté aucun changement dans la structure des coûts, 22% ont noté une diminution (moyenne de 17%) alors que 37% des répondants ont vu leurs coûts augmenter (augmentation moyenne de 19%).

6. L'ALÉNA et le transport juste-à-temps des marchandises

L'accessibilité à un marché nord-américain de plus de 365 millions de consommateurs représente une opportunité pour les entreprises manufacturières canadiennes. Considérant toutefois qu'à l'heure actuelle, les tarifs douaniers canadiens sur les produits du Mexique sont très faibles et que la majeure partie de la compétition entre le Canada et le Mexique se déroule sur le marché américain, la véritable problématique pour les firmes canadiennes tient davantage de leurs capacités à distribuer aux bons endroits sur les marchés cibles américains et mexicains, des marchandises de qualité. En effet, si la concurrence au sein des marchés régionaux repose principalement sur la productivité des entreprises (en terme de coûts) ainsi que sur leur capacité à offrir les meilleurs prix à qualité égale, l'internationalisation des structures économiques régionales aura comme principales conséquences d'augmenter les distances entre les fabricants et les marchés qu'ils desservent et de hausser le niveau de concurrence sur l'ensemble des marchés. L'augmentation du commerce entre le Canada et le Mexique, en considérant la tendance actuelle, créera des impacts certains sur le transport des marchandises (tableau 2).

La libéralisation des échanges devrait amener les équipes dirigeantes des firmes à adopter une stratégie d'internationalisation de leurs achats et à exacerber la concurrence sur les marchés des fournisseurs et des sous-traitants, adoptant une approche intégrée (*Global Sourcing-Just-in-Time*: Fawcett et Birou, 1992). De plus, un certain nombre d'entreprises vendront leurs produits sur des marchés de plus en plus éloignés (augmentation des échanges interrégionaux-internationaux). Ce constat prévisionnel (Proulx, 1993) fait ressortir un obstacle pour le JàT. Un tel éloignement contribue à l'allongement de la durée des expéditions, à l'augmentation des coûts qui y sont reliés et accentue les problèmes liés à la prévision et à la planification des besoins. De plus, l'évaluation et le contrôle de la performance des transporteurs mexicains sera plus difficile et l'augmentation de l'incertitude causée par la faiblesse des infrastructures mexicaines accentuera les problèmes de douane, de fausses promesses, de corruption, de prix excessifs et de chantage.

Étant donné le nombre important d'acteurs impliqués dans l'ensemble du processus, le recours à des technologies permettant une diffusion rapide d'informations de qualité ne s'avère plus un facteur de succès, mais bien une

condition de succès. Un nombre important d'acteurs n'assure pas automatiquement l'atteinte des objectifs et la satisfaction des exigences des clients. Ainsi, le transport sur de longues distances nécessite un support logistique constant et de haut niveau. Les diverses composantes d'un réseau de distribution ne possèdent pas nécessairement toutes les ressources et l'expertise pour planifier en fonction des prévisions et gérer les imprévus. Le recours à des intermédiaires du transport autres que les transporteurs peut favoriser le succès de l'ensemble de l'opération et faciliter l'accès à une certaine expertise à moindres coûts (Trunick, 1993). Les expéditeurs devraient donc adhérer à des chaînes de transport constituées, en plus des transporteurs, de transitaires et d'agents d'expéditions, chacun s'avérant une constituante de la chaîne de valeur de la distribution (Porter, 1986). Dans certaines industries en France, il semblerait que les prestataires logistiques aient supporté les changements organisationnels de leurs clients et spécialement leur transition vers des systèmes de livraison JàT (Lalonde et Maltz, 1992).

Tableau 2. Les implications de l'ALÉNA sur le transport des marchandises

Impacts de l'ALÉNA	Implications sur le transport
Stratégie d'internationalisation des achats et de la distribution	Allongement des délais de livraison
	Augmentation des coûts
	Accentuation des problèmes liés à la prévision et à la planification des livraisons
Accentuation de l'externalisation de certaines activités logistiques	Alourdissement managérial et risque que les procédures dominent sur le processus
	Importance des noeuds, source de valeur ajoutée et d'économies (choix des bons terminaux et des bonnes technologies)
Augmentation du nombre de transporteurs offrant leurs services	Élévation du niveau de concurrence
	Diminution des tarifs
	Dynamisme et innovation
Évaluation et contrôle difficile des transporteurs	Les très grandes distances peuvent compliquer grandement l'évaluation et les contrôles des performances
	Elles peuvent rendre dépendant les expéditeurs vis-à-vis les transporteurs qui ont développé une expertise et des connaissance spécifiques par rapport à un ou quelques produits

L'externalisation de certaines activités logistiques, dont le transport et les activités connexes exercées aux entrepôts et aux plates-formes, dépend de deux critères (Aertsen, 1993). L'expéditeur doit en premier considérer le degré de spécificité des actifs, c'est-à-dire les besoins particuliers en matériels de manutention et d'entreposage (en fonction des produits et des marchés non

standards), alors que le deuxième critère est l'évaluation des performances. Dans les faits, si la spécificité des actifs est élevée, l'entreprise a intérêt à internaliser ses moyens logistiques alors qu'elle peut les externaliser si les spécificités sont faibles, peu importe le niveau de mesurabilité des performances.

Mais la décision doit aussi reposer sur l'analyse des coûts de transaction (Williamson, 1985) liés à l'externalisation, et considérer non seulement les économies reliées à l'activité sous-traitée mais également déduire de ces économies les coûts logistiques supplémentaires. Si les activités de traction doivent d'une part respecter des normes qui limitent les gains (raccourcissement des délais, limite des charges, etc.), certaines activités de soutien, telles que remplir les documents, négocier certains contrats, et effectuer un suivi constant des expéditions, peuvent d'autre part s'avérer des sources importantes d'économies de temps et d'argent pour l'expéditeur.

S'il est entendu que la majorité des entreprises ont accès aux mêmes services de tractionnariat et que les coûts sont les mêmes, il semble évident que les avantages devront être acquis à partir des activités de soutien que seul un nombre restreint d'opérateurs possède. Paché (1994) fait ici référence à des éléments ayant une forte valeur ajoutée pour les prestations informatiques, les opérations liées à la rupture de charges, les opérations liées à la livraison terminale et la gestion proprement dite, avec comme activité principale les opérations de manutention des marchandises. De plus, si l'intégration des activités de distribution de l'entreprise dans ces chaînes de transport vise principalement l'amélioration de l'efficacité des opérations, elle peut parfois se traduire par un alourdissement managérial important du fait de la diversité des services offerts et des efforts consacrés au développement de relations à avec les différents acteurs. Un tel investissement ne doit en aucun cas amenuiser le dynamisme stratégique et opérationnel de la firme car la recherche d'avantages concurrentiels dans les activités de distribution pourrait alors résulter en une baisse d'efficacité organisationnelle, les procédures (coûts de transaction) prenant alors le dessus sur le processus.

Chose certaine, les échanges commerciaux entre les pays membres de l'ALÉNA augmenteront au cours des prochaines années, tant en ce qui concerne les produits que les services. C'est ainsi qu'on peut soulever l'hypothèse que l'ALÉNA contribuera à l'augmentation du nombre de transporteurs routiers qui offriront des services transfrontaliers. S'il est difficile à l'heure actuelle de prévoir avec certitude l'évolution des structures de l'industrie, les résultats de l'étude de Bigras (1993b) nous portent à croire que l'augmentation du nombre de transporteurs devrait favoriser une diminution des tarifs et une amélioration de la qualité des services. Cela favorisera ainsi l'atteinte d'un niveau de performance supérieur et l'atteinte des objectifs du JàT en terme de qualité et de fiabilité du service. Plus le marché des transporteur sera concurrentiel, plus ils évolueront vers des prestations de services de niveau supérieur (innovations constantes) qui contribueront à l'atteinte des standards définis par les expéditeurs et les clients.

Si, pour le JàT, l'augmentation de la fréquence des expéditions influence les coûts du transport, les acheminements sur de longues distances peuvent aussi nuire à l'évaluation et au contrôle de la performance des transporteurs, estompant par le fait même les retombées favorables de la présence d'un nombre élevé de fournisseurs de services de transport et de la flexibilité que cela procure aux utilisateurs de ces services. En effet, s'il est relativement aisé de mettre fin à une entente avec un transporteur et de le remplacer par un autre pour des livraisons régionales ou provinciales, les ressources et l'expertise que nécessitent des expéditions vers la Californie, les Maquiladoras ou Mexico peuvent parfois forcer les expéditeurs à prolonger une entente avec un transporteur peu performant. Pour les transporteurs routiers canadiens qui veulent pénétrer avec succès le marché mexicain, il est vital d'établir des alliances stratégiques avec des transporteurs mexicains qui ont une connaissance complète de la culture commerciale mexicaine et dont les opérations couvrent l'ensemble du marché mexicain (Cooper, 1993).

7. Conclusion

L'industrie des transports est constamment soumise aux pressions économiques et son évolution dépend largement de la conjoncture, des flux commerciaux, mais aussi de sa capacité et de sa volonté à rencontrer les exigences de plus en plus élevées des expéditeurs. Ainsi, les courants modernes de gestion – comme le JàT – orientés sur l'élimination des pertes et des délais, et sur l'utilisation optimale des ressources et des espaces créent une forte pression sur les transporteurs. Des exigences de plus en plus strictes en découlent; elles supposent un niveau élevé de fiabilité et de qualité, mais surtout la livraison de quantités exactes de marchandises à un moment précis en un lieu précis, de manière à éliminer l'immobilisme des marchandises et les opérations redondantes de manutention qui s'avèrent très onéreuses et une source importante de gaspillage.

Précédant l'ALÉNA, la déréglementation de l'industrie des transports a eu certains effets qui, dans l'ensemble s'avèrent positifs en ce qui concerne le mode de gestion JàT. La baisse des tarifs et l'augmentation du niveau de concurrence ont permis aux expéditeurs d'acheminer leurs marchandises plus souvent sans qu'il n'y ait, semble-t-il, une dégradation dans le niveau de service de la part des transporteurs. La déréglementation a également contribué à accroître la flexibilité au niveau des livraisons. Les expéditeurs peuvent maintenant tirer profit de la modification des champs d'action des transporteurs (surtout les petits transporteurs régionaux) afin de mieux synchroniser les livraisons et d'utiliser de façon efficiente les compétences d'entreprises qui organisent et gèrent les chaînes de transport.

D'un autre côté, il est moins certain que l'intégration des activités économiques des pays impliqués dans l'ALÉNA ait des conséquences aussi positives en regard du JàT. Bien sûr, l'augmentation du nombre de transporteurs va continuer d'être un élément de stabilisation pour les tarifs et d'accroissement de la concurrence. Mais l'internationalisation de l'approvisionnement et de la

distribution (Global Sourcing) risque aussi de soulever de nombreux défis compliquant certains aspects logistiques. L'allongement des délais de livraison, l'incertitude liée à ces délais d'où une difficulté accrue au niveau de la planification ainsi que la complexité de l'évaluation et du contrôle des performances (à cause des grandes distances) constituent trois types d'éventualités potentiellement nuisibles au JàT. Les entreprises devront relever le défi d'opérer dans un environnement politique et législatif différent, avec des pratiques d'affaires diverses et une culture totalement distincte (Mexique), et devront également s'assurer d'apporter un support managérial constant de haut niveau.

Jusqu'à maintenant, les expéditeurs nord-américains ont surtout bénéficié d'une élévation du niveau de concurrence et d'une diminution des tarifs qui ont suivi la déréglementation des transports. Ils n'ont que très peu personnalisé leurs relations pour répondre à leurs besoins. Mais l'ALÉNA entraînera le développement de réseaux de transport obligeant les firmes exportatrices à les intégrer pour bénéficier d'une capacité supérieure concernant leur logistique. Cette intégration risque-t-elle de s'effectuer au détriment d'une certaine flexibilité managériale ou stratégique? Les risques de détérioration devront alors être évalués en regard des coûts de transaction, car l'externalisation des services ne doit en aucun cas contraindre les expéditeurs à une baisse de productivité ou d'efficience dans un cadre opérationnel (JàT) ou l'objectif principal est une mise en tension parfaite du flux de marchandises.

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Linking Transportation Infrastructure Investments and Economic Growth: On the Causality Trail

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Linking Transportation Infrastructure Investments and Economic Growth: On the Causality Trail

Mark Lynch, Linda DeBenedictis

I. Introduction

The scale and efficiency of Canada's transportation infrastructure plays an integral role in the rate of economic growth. Transportation allows Canadian products to compete in the international marketplace through the movement of goods and people in a safe, efficient manner. Effective transportation infrastructure permits the strategic location of industries relative to domestic and export markets through a cost effective transportation system.

Historically, the long run trend of government and industrial policies and practices interacted to produce increases in productivity, technological advances, and innovations which, upon adjusting for business cycle fluctuations, produced several decades of robust economic growth. The combined impact of stagflation, increasing deficits, and globalization have now constrained the ability of the nation to invest in transportation infrastructure. Combined with the current fiscal crisis facing provinces and the nation as a whole, the possibility exists for further reductions in investments in transportation infrastructure which may ultimately impact Canada's economic status vis-à-vis the rest of the world. As government central agencies evaluate competing projects and programs vie for shrinking resources, accurate evaluation of each and every projects costs and benefits will be crucial in ranking and selecting investment opportunities which exhibit the greatest return for the investment. For many years, benefits accruing through incremental growth in GDP due to transportation investment have been ignored.

II. The Link Between Infrastructure Investment and Economic Growth

The linkage between investments in transportation infrastructure and its impact on economic growth has been the subject of research for a number of years. Yet the subject is mired in controversy over the magnitude which transportation infrastructure investments impact economic growth, functional forms chosen to model the relationship, and long term impacts on investment and employment. One fact can be stated with certainty - past research suggests a positive impact between investments in transportation infrastructure and the nations rate of growth.

Existing U.S. transportation investment policy is based upon linkages between transportation investments and economic growth established by David Aschauer in his article, "Is Public Expenditure Productive?" (*Journal of Monetary Economics, (1989)*). Aschauer argues that public expenditure, particularly those on 'core' infrastructure, have a significant impact on productivity growth. Aschauer links public capital stock (relative to investment flows) to productivity growth, through an analysis of recent U.S. productivity slowdowns relative to declining public capital spending on transportation infrastructure. Aschauer estimates the elasticity of productivity (output per unit of private capital), with respect to the ratio of public to private capital stocks, approximates 0.39. Alternatively, a 1% increase in the ratio of public to private capital stocks increases productivity by 0.39%. A second study by Aschauer (1991) concludes that between 5% and 22% of the productivity slowdown experienced in the United States resulted from a decrease in the magnitude of the nations public capital stock. Aschauers' results suggest that public expenditures on transportation investment can be used as a significant tool to increase productivity, stimulate private investment and promote growth in the national economy. Table 1 summarizes recent research in this area.

Table 1: Current Research

Author	Coefficient	Productivity Measure	Infrastructure Measure
Aschauer (1989)	0.390	output	non-military investments
Wylie (1994)	0.517	output	aggregate investments
Transportation Policy Branch (1994)	0.078	output	government transportation investments

The Transportation Policy Branch of the Ministry of Employment and Investment, Province of British Columbia, in a paper delivered to the Canadian Transportation Research Council (May 1994) entitled "Applied Economics-Linking Transportation Policy and Economic Growth" (1994), examined the model utilized by Aschauer incorporating Canadian and Provincial data in an effort to estimate the impact of investments in transportation infrastructure on Canadian growth. Both models, Aschauer's and the Transportation Policy Branch, produced a positive relationship between transportation investments and growth in productivity, although results differed in magnitude between the two studies. A large portion of the discrepancy between the estimates can be attributed to differing data definitions used in the analysis and the accuracy of this data over time. However, the fact that these studies produced results indicating a positive and statistically significant relationship between economic growth and investment cannot be ignored. These studies imply that deficient infrastructure investment leads to slower productivity growth.

III. Current Debate on Evaluation Methodologies

Recent studies estimate production functions to model the relationship between productivity growth and infrastructure investment. The conclusions reached in these studies must be viewed with caution due to inherent problems which emerge from estimated production functions:

- Macroeconomic time-series are usually non-stationary. The underlying random process that generates the series is variant with respect to time. Estimated coefficients are not constant over time and may lead to misinterpretation.

- Production function analysis is based on the assumption that causation runs from public capital investment to growth, rather than in the other direction. The possibility of reverse or dual causality is not addressed.

- Infrastructure investment decisions based on erroneous information may be costly. Resources invested in infrastructure are non-malleable having no alternative use once the investment is made. Ill-informed investment decisions may lead to inefficiencies adversely affecting long term real variables such as employment, inflation, and alternative investment decisions.

IV. On the Causality Trail

If we abstract ourselves from the debate regarding the *scale* of impact between transportation infrastructure investment and economic growth, the question of causality may be addressed by the construction of an econometric model which integrates fluctuations over the short term with long term dynamics. The purpose of this paper is to develop a methodology which will address the casuality issue. Specifically:

- do high levels of economic activity lead to greater levels of public investment in transportation infrastructure;

- do greater levels of public investment in transportation infrastructure lead to higher levels of economic activity; and

- does dual causality exist.

V. Short Term Versus Long Term Dynamics

Time series data used by researchers in estimating the impact of public infrastructure investment on economic growth are imbedded with random properties causing the series to fluctuate over time. Random properties include events which occur with uncertainty. Researchers engaged in modeling the relationship between economic growth and transportation infrastructure assume a-priori the existence of a relationship between regressors (dependent and independent variables). This assumption restricts the ability to model the relationship using all relevant information. Fiscal policies based on erroneous results may have de stabilizing effects.

Macroeconomic data series are characterized by short term and long term relationships. The short term relationship explains how data series over the short run fluctuate due to changing conditions known commonly as "extraordinary events." Long run relationships focus on how the series move over the longer run. In the transportation community, a long run relationship may be characterized as a ten year capital plan. By taking short and long term relationships into account, we will be able to make inferences on the causal relationship between growth and transportation infrastructure.

VI. Stationarity

In order to construct our model, we must first address the concept of stationarity. A stationary time series is characterized by short term random shocks which, absorbed by the time series, cause the series to return to its long run mean over a period of observations (Figure 1(a)). Inversely, a non-stationary time series does not have a constant mean towards which these shocks are absorbed. The data series tends to drift over time as shown in Figure 1(b).

Figure 1(a)

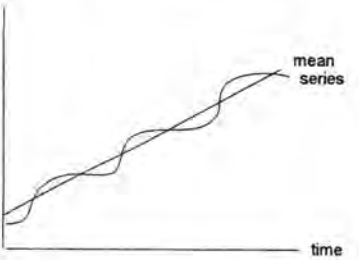
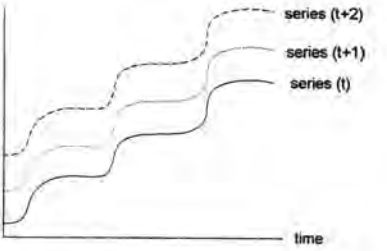


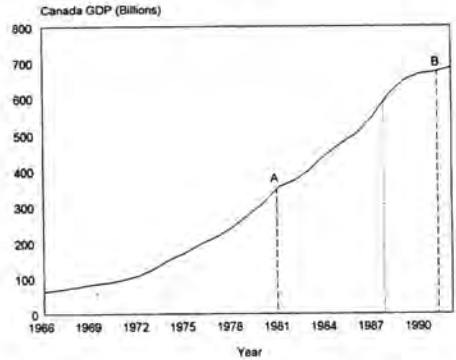
Figure 1(b)



The concept of stationarity has a significant role in the development of infrastructure/investment research and the interpretation of estimated coefficients as constants. A constant is fixed over time. If data elements are found to be non-stationary, the interpretation of these coefficients as constants is misleading and may lead to erroneous results.

For example, we examine the case of gross domestic product (GDP) for Canada between 1966 and 1992 (Figure 2). GDP has been steadily growing over time. However, the process generating each data point is an independent function of technology, industrial structure, and political/social values at each point in time. For example, the Canadian-U.S. Free Trade Agreement and the North American Free Trade Agreement aided Canada in the transition to a more open economy. In addition, a shift in political agendas occurred following the defeat of the federal conservatives and the election of the liberal government. These two events impacted the generation of individual observations of GDP. Subsequently, the process generating observations prior to 1988 (say 1981 at point (A) in Figure 2) is significantly different from the process generating GDP post 1988 (say 1991 at point (B) in Figure 2). Consequently, not only is GDP increasing over time, but the entire series is drifting as demonstrated in Figure 1(b).

Figure 2 : Canada GDP, 1966-1992
Process Generating Point A and B



To illustrate this point, suppose we have a time series such that

$$Y_t = \{y_1, \ldots, y_n\} \qquad (1)$$

where Y_t represents a times series at time t comprised of data observations y beginning in time period '1' and ending in time period 'n'. The process generating

each observation is influenced by economic, political and social realities occurring in each time period such that:

$$y_t = \text{function of economic, political, social variables} \qquad (2)$$

where y_t represents an observation at time period t. Economic variables include, but are not limited to the business cycle, inflation, employment, and interest rates. Political variables include the nature of the political party in office, public opinion, and political decisions. Social variables refer to the prevalent ethics and morals of society at time period 't' which influence y_t through individual tastes and preferences. As a result, the process generating observation y_t may be different than the process generating an observation at period y_{t+n} due to the differing impact random events have over time. If so, the data series Y_t, is referred to as non-stationary with respect to time.

Use of non-stationary series in econometric modeling leads to coefficients which violate the basic assumption that they are constant. Any attempt to estimate coefficients using non-stationary data may be equivalent to attempting to hit a moving target. Violation of this basic assumption may lead to false inferences and inaccurate model structures. In order to correctly model any relationship a stationary process before the data is used in analysis. The transformation involves differencing the data until the series is deemed stationary.

VII. Transformation of a Time Series Through Differencing

A time series found to be non-stationary requires differencing to render the series stationary before it can be utilized in modeling. Differencing a time series generates rates of change over time which allow analysts to examine rates of growth as opposed to absolute numbers. The degree of differencing is in turn dependent on the nature of the non-stationary process generating the data. First difference of the data is calculated as

$$\Delta Y_t = Y_t - Y_{t-1} \qquad (3)$$

where Y_t represents the series at time period t, Y_{t-1} represents Y in the previous time period and ΔY_t represents the change in Y_t over the two time periods.

The second difference of the data is

$$\Delta^2 Y_t = (Y_t - Y_{t-1}) - (Y_t - Y_{t-1}) = \Delta Y_t - \Delta Y_{t-1} \qquad (4)$$

where Δ^2 is the second difference operator.

Each data series must be tested for stationarity. Stationarity is based on the concept of unit roots. A unit root represents a common factor. If unit roots are present, the series is deemed non-stationary. In order to test for stationarity, we apply the 'Augmented Dicky-Fuller Test' for unit roots presented by Dicky and Fuller (1979, 1981). The Dicky-Fuller test statistics are obtained from regressing Y_t on past values of Y_t such that

$$Y_t = f(\text{lags of } Y_t, \text{ augmentation terms}) \qquad (5)$$

where the augmentation terms are additional lags of Y_t. Several tests must be conducted on each time series to test for stationarity.

1. Test the null hypothesis that the data is non-stationarity against the alternative hypothesis that the data is stationary:

   H_0:I(1) [data is non-stationary]
   H_a:I(0) [data is stationary]

   If we reject the null hypothesis (non-stationarity) the data series is stationary and can be used for modeling in its present form. Alternatively, if we accept the null hypothesis of non-stationarity, the researcher must establish the number of unit roots present. If multiple unit roots exist, first differencing the data is necessary but may not be sufficient.

2. If we accept H_0, the series is I(1). The second step is to test the following

   H_0:I(2) [data is non-stationary with two unit roots]
   H_a:I(1) [data is non-stationary with one unit root]

   If we accept H_0 that the series is I(2), we need to determine if three unit roots are present. This process of hypothesis testing should be continued until the researcher accepts the alternative hypothesis, H_a over H_0.

VIII. Cointegration

Simply stated, cointegration describes the relationship between more than one time series over the long run. For example, in Figure 3(a), the trend of two time series may by growing at approximately the same rate over the term. The series are moving in tandem (a long run relationship exists) and the series are said to be cointegrated. If the two time series are growing at significantly different rates, the series grow apart over time (Figure 3(b)) and the series are said *not* to be cointegrated.

Figure 3(a)

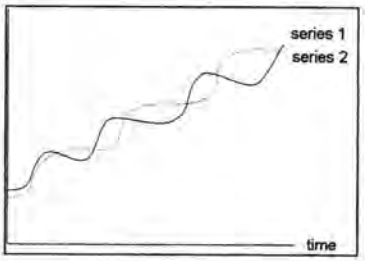
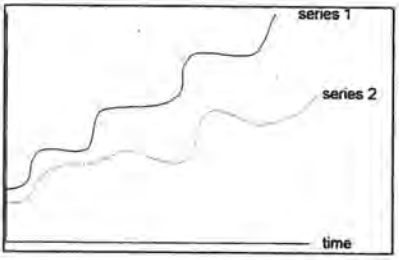


Figure 3(b)



IX. Integrating the Concepts of Stationarity with Cointegration

Differencing the data to correct for non-stationarity removes essential information contained in the long run relationships between time series. In order to reincorporate the long term relationship between variables back into our model, we need to test that long run relationship information has been lost as a result of differencing the data. To accomplish this, the variables are tested for cointegration in the context of the model. If the series are found not to be cointegrated, then there is no long term relationship between the variables that needs to be reincorporated into the model. However, if cointegration is found, an error correction term needs to be included in our model to reincorporate the long term dynamics that were lost by differencing the data. The resulting model will incorporate short term fluctuations with long term dynamics.

X. Model Construction

Recent studies have used production functions to estimate the impact of infrastructure investment on productivity. Production theory states that output (Y) is a function of labour (L) and capital (K). That is

$$Y = f(L, K) \tag{6}$$

where capital can be disaggregated into private and government capital (K_p and K_g respectively) such that:

$$Y = f(L, K_p, K_g) \tag{7}$$

which assumes causality runs from capital investment to output.

The purpose of this paper is to examine the causality relationship between infrastructure investment and productivity growth. We construct a Vector Autoregressive Model (VAR) in which capital, labour and output are interrelated as follows:

$$Y = f(L, K_p, K_g) \tag{8}$$

$$L = f(Y, K_p, K_g) \tag{9}$$

$$K_p = f(Y, L, K_g) \tag{10}$$

$$K_g = f(Y, L, K_p) \tag{11}$$

In turn, each of the variables are a function of their past values such that:

$$Y = f(Y_{t-1}, Y_{t-2}, \ldots, Y_{t-n}) \tag{12}$$

$$L = f(L_{t-1}, L_{t-2}, \ldots, L_{t-n}) \tag{13}$$

$$K_p = f(K_{p_{t-1}}, K_{p_{t-2}}, \ldots, K_{p_{t-n}}) \tag{14}$$

$$K_g = f(K_{g_{t-1}}, K_{g_{t-2}}, \ldots, K_{g_{t-n}}) \tag{15}$$

where t is the present and n denotes n previous periods.

The VAR model is based on the assumption that the observed value of the data today is dependent on past observations. The data series are differenced the appropriate number of times to make them stationary before they are used to construct the model. The model is constructed using lags of the data series. The number of lags of any one series appearing in an equation is chosen by using Akaike's (1973) information criterion (AIC) as a guide. The AIC criterion involves choosing the lag length (q) to minimize the function:

$$AIC(q) = \ln \frac{e'e}{T} + \frac{2q}{T} \tag{16}$$

where ln represents the natural log, e is the vector of residuals, e' is the transpose vector, T is the sample size, and q is the lag length.

For instance, to construct the public capital equation, consecutive lags of the public capital variable are included as independent variables to the point where

the AIC is minimized. Once the lags for public capital are chosen, they are fixed and consecutive lags of private capital are added until the AIC is minimized. Similarly, consecutive lags of labour and productivity are included. Lags for each of the four equations are chosen using this method. Our model now assumes the following form:

$$Kg_t = \alpha_0 + \sum_{i=1}^{e} \alpha_{1i} Kg_{t-i} + \sum_{j=1}^{q} \alpha_{2j} Kp_{t-j} + \sum_{m=1}^{r} \alpha_{3m} L_{t-m} + \sum_{n=1}^{h} \alpha_{4n} Y_{t-n} + \varepsilon_t \quad (17)$$

$$Kp_t = \beta_0 + \sum_{j=1}^{q} \beta_{1j} Kp_{t-j} + \sum_{i=1}^{e} \beta_{2i} Kg_{t-i} + \sum_{m=1}^{r} \beta_{3m} L_{t-m} + \sum_{n=1}^{h} \beta_{4n} Y_{t-n} + \eta_t$$

$$L_t = \lambda_0 + \sum_{m=1}^{r} \lambda_{1m} L_{t-m} + \sum_{i=1}^{e} \lambda_{2i} Kg_{t-i} + \sum_{j=1}^{q} \lambda_{3j} Kp_{t-j} + \sum_{n=1}^{h} \lambda_{4n} Y_{t-n} + \omega_t$$

$$Y_t = \gamma_0 + \sum_{n=1}^{h} \gamma_{1n} Y_{t-n} + \sum_{i=1}^{e} \gamma_{2i} Kg_{t-i} + \sum_{j=1}^{q} \gamma_{3j} Kp_{t-j} + \sum_{m=1}^{r} \gamma_{4m} L_{t-m} + \nu_t$$

where Kg is the public capital stock, Kp is the private capital stock, L is the labour variable, Y is the proxy for productivity growth, t denotes time and i, j, e, m, n, q, r and h are indexes which specify the lag lengths (which may differ across equations). The coefficients are α, β, λ and γ. The symbol $\sum_{l}^{u}$ is the summation sign which sums the terms from the lower (l) to the upper (u) value. The variables ε, η, ω and ν are the error terms. The model must be iterated through several runs to ensure proper specification.

Conducting a Regression Specification Errors Test (RESET) test proposed by Ramsey (1969) allows us to determine if the model is properly specified. Once the model is properly specified, normality, heteroskedacity and autocorrelation may be tested and corrected for in the context of the model to ensure that the estimators are unbiased, consistent and efficient.

XI. Incorporating Long Term Dynamics

Differencing the data to correct for non-stationarity destroys the long run relationships between the series. To incorporate the long term relationship between variables back into the model we need to test for cointegration. If the series are found not to be cointegrated, then there is no long term relationship between the variables that needs to be corrected for in the model. If cointegration between the series is found, an error correction term needs to be included in the model to reincorporate the long term dynamics that were lost by differencing the data. The resulting model will incorporate short term fluctuations and long term dynamics.

Johansen's procedure (1988, 1992)is used to test the system of equations for cointegration between the variables. The hypothesis of no cointegration is tested against the alternative that the variables are cointegrated. If the variables are found not to be cointegrated, there is no long-run relationship between the variables that needs to be re-incorporated into the model.

If the null hypothesis is rejected, there exists cointegrating vector(s) among the variables. The number of cointegrating vectors needs to be determined as well as their components (which variables are cointegrated). The cointegrating vector(s) is (are) used in the formation of an error correction term added to the model to incorporate the long term dynamics.

For example, if public capital (K_g) and productivity (Y) are found to be cointegrated, the appropriate error correction term is constructed by regressing Y on K_g and retaining the residuals, (e_t). The lag of the residuals, e_{t-1} is the error correction term which is added to the equations containing lags of Y and K_g in the model (17).

XII. Causality

The VAR model can now be used to test for causality between variables. The interest is in the relationship between public capital investment and productivity. To test if public capital investment affects productivity, the null hypothesis that the public capital coefficients in the productivity equation are jointly equal to zero, $\gamma_{21}=...=\gamma_{2e}=0$, is tested against the alternative that the variables are jointly significant. That is:

H_0: $\gamma_{21}=...=\gamma_{2e}=0$ [coefficients are jointly insignificant]
H_a: H_0 is false [coefficients are jointly significant]

If the public capital coefficients are jointly significant (reject H_0) then public capital investment affects productivity. Otherwise, we conclude that public capital investment does not have a significant impact of productivity.

Reverse causality can be tested by testing the null hypothesis that the productivity coefficients in the public capital equation are jointly equal to zero, $\alpha_{41}=...=\alpha_{4h}=0$, against the alternative that the coefficients are jointly significant. That is:

H_0: $\alpha_{41}=...=\alpha_{4h}=0$ [coefficients are jointly insignificant]
H_a: H_0 is false [coefficients are jointly significant]

If the productivity coefficients in the public capital equation are found to be jointly significant (reject H_0) then it can be concluded that productivity affects public capital investment. Otherwise, we conclude that productivity does not have a significant impact on public infrastructure investment.

If both tests are significant, there is dual causality between productivity and capital investment. Similar causality testing can be done for other variables in the model.

XIII. The Next Step - Data Assembly

In order to test our theoretical model on casuality, we are interested in four data series: public capital stock (K_g), private capital stock (K_p), labour (L) and a proxy for productivity (such as GDP (Y)). Due to the lag structure of the model and the testing techniques used, data requirements are extensive. A minimum of 145 observations are required to ensure the model is estimated correctly. This large data set allows for the incorporation of up to eight lags for each equation and takes into account the use of seasonal dummy variables (if seasonal data used).[1]

XIV. Conclusions

The purpose of this paper was to establish a methodology to addresses the causality issue between infrastructure investment and productivity growth. Through the construction of a Vector Autoregressive Model which incorporates both short and long term dynamics, we will be able to test for causality between infrastructure investment and productivity growth. Our theoretical model has several advantages and disadvantages.

Advantages:

- Our model addresses the issue of non-stationarity. The data series are tested for unit roots and cointegration at the zero and seasonal frequencies. An appropriate lag filter is used to make the data stationary before it is used in the development and analysis of the model. This eliminates the problem of spurious regressions. Cointegration is taken into account thereby incorporating long-term dynamics as well as short-term relationships.

[1]The methodology presented in this paper is for annual data (base case). The methodology for seasonal data is merely an extension of the base case.

- Causality is not assumed a priori. Causality testing allows us to conclude if the relationship between capital infrastructure investment and productivity is bi-directional or uni-directional. If the relationship is uni-directional testing allows us to say something about the direction of the causality.

- The model may be used as a short-term forecasting model capable of forecasting private and public capital investment, labour and productivity growth.

Disadvantages:

- The methodology for model development and testing is time intensive.

- Extensive data requirements. A minimum of 145 observations are needed to ensure the model can be estimated. This takes into account the seasonal dummy variables (if quarterly data is used) and allows for eight lags of each series to enter each equation.

- Does not produce an elasticity measure so cannot be directly compared to a production function approach. Although the degree of significance in the causality tests give an indication of the strength of the relationship between public capital and productivity.

XV. Further Research

- Compilation of adequate data series - labour, productivity growth, public and private capital time series must be collected (preferably in the form of quarterly unadjusted data) consisting of a minimum of 145 observations.

- Model testing and implementation.

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NATIONAL TRANSPORT PLANNING IN AUSTRALIA

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NATIONAL TRANSPORT PLANNING IN AUSTRALIA

Derek Scrafton

1. INTRODUCTION

Traditionally in Australia, as in Canada, the private sector has played a major role in transport, mainly through the ownership and operation of cars, vans, buses, trucks, aircraft, ships and some railways.

In Australia, and I suspect in North America, pressure groups, private entrepreneurs, construction companies, and some governments argue that more transport infrastructure is desirable, or essential. Others, particularly those involved in regional planning and economic development prepare wish-lists of infrastructure proposals or beat a drum for their favourite project. At the same time financiers say there are private funds available which could be made available for investment in infrastructure, including transport, and go on to seek out and promote specific projects.

If all these three elements in the community are accurate and synchronous, we should expect to see a steady stream, if not an explosion, of construction activity as available finance is matched to projects. There is certainly not an explosion in Australia, though traditional federal, state and local government and private investment in infrastructure and equipment is increasingly being supplemented by the private sector becoming involved in innovative financing of public projects, including roads and public transport.

One reason a major increase in infrastructure investment is not occurring is that private investment requires a return and is expected to carry some risks so the infrastructure must be at least worthwhile, and preferably necessary. In the case of public

provision of transport infrastructure over many years there were examples of poor investments, where economic evaluations were non-existent or poor, where the financial and economic disbenefits were over-ridden by political decision-making, or where cost estimates were hopelessly low. In addition, environment and community groups can point to several such projects that were not justified in terms of environmental or social impact.

Another reason the response to calls for more investment in transport is less than some might wish, is that infrastructure is only one element in the span of activity that is required to create a service, without which of course transport is irrelevant. The most important element is demand; another is efficient operation of the organisation; and a third is the institutional framework, particularly the pricing regime and the existence or absence of economic regulation.

Given some poor performing transport investments in recent years, and the continuing calls for more investment in all modes, the Commonwealth Government set up the National Transport Planning Taskforce (NTPT) in late 1993 to assess the national scene in transport and the infrastructure needs for transport into the 21st Century.

The Taskforce was to have a national outlook and be forward looking, to try to present the "big picture" within which investment in infrastructure is being considered and to determine whether changes were needed in the future. This paper summarises the background and work of the NTPT, and outlines its major findings and recommendations, emphasising the specific topics of data, evaluation, and the significance of national priorities. The paper draws on my membership of the Taskforce, on my experience in South Australia, and from working with the federal Industry Commission on its Urban Transport Inquiry in 1993, and with the Economic Planning Advisory Commission as a member of its Taskforce on Private Investment in Public Infrastructure, which reported in March 1995.

2. BACKGROUND

The National Transport Planning Taskforce presented its report - entitled Building for the Job : Australia's Transport Network - to

the federal and state Ministers of Transport in December 1994 (NTPT, 1994). The Taskforce consisted of two private sector members and one from the public sector, and was supported by a team of researchers based in Canberra. There were two thrusts to the Taskforce's work: a program of research, and extensive consultation with the transport industry and users.

Both the content and process of the Taskforce's work changed during the 15 months of our existence. Initially the Taskforce was to concentrate on long distance freight i.e. essentially road, rail, coastal shipping and domestic air freight. It will be obvious to all of you involved in transport that if you are considering investment in new facilities or equipment, you must consider local as well as long distance (indeed "interstate" is almost irrelevant except to lawyers and to governments collecting revenues!) and passenger needs alongside those of freight. So while the Terms of Reference had to be adhered to by the Taskforce, the emphasis was on national transport in its broadest sense.

The process changed for an equally practical reason. Our initial intention, given the Terms of Reference, size of team and timeframe, was to put the emphasis on a program of research shared between an in-house team, the Bureau of Transport & Communication Economics (BTCE), and transport and economics consultants, to be followed by consultation with the transport industry, users, and shippers. It didn't work out that way at all.

At a very early stage the NTPT, which consisted of Ian Webber (Chairman, Mayne Nickless), Lance Hockridge (BHP Transport) and myself, learned that the data we would require to make an assessment of the performance of the national transport system (even just for long-distance freight) simply does not exist - certainly not in a useable form for road and rail transport. A cynic might not be surprised, as good data might disturb existing financing arrangements for transport in Australia, based as they are on traditional cost-sharing arrangements between governments.

After considering the lack of data with our team (which consisted of professionals seconded from the Commonwealth and three State Departments of Transport, with an adviser from the private sector) and senior staff of BTCE and federal DoT, the Taskforce decided to place more emphasis on the consultation process. This turned out, fortuitously, to be a smart thing to do because we very quickly

learned the major problems with the current transport system, and where companies saw their transport needs for the next twenty years or so. In particular, shippers and carriers alike emphasised that you can not separate long distance domestic transport from local, regional, metropolitan and even international transport.

The consultation process consisted of a mix of written submissions and direct discussions. We received 113 written submissions and held discussions with 76 organisations*, 58 of which had previously or did subsequently provide us with written submissions. The discussions covered all modes of transport suppliers, industrial and commercial shippers, academics, trade associations, individual companies, government departments, consultants, and private users. The conversations were frank and indeed much commercially confidential information was given to the Taskforce to support lines of argument, in exchange for a promise of non-attribution in the Report, unless we specifically sought release from that condition.

The Taskforce report was released in December 1994. The Terms of Reference called for a Report by 31 March 1995 and, given the data problems I outlined above, it may seem curious for the Taskforce to report early. The reason was a change of responsible federal Minister during 1994 - Senator the Hon. Bob Collins commissioned the Taskforce, but in a Cabinet reshuffle soon after, Hon. Laurie Brereton MP became Minister for Transport. At the same time a change was made in the date of bringing down the federal budget in Australia from August to May, commencing 1995. The changes resulted in a requirement to finish the Taskforce's work by the end of 1994, which in turn meant the research tasks had to be shared amongst several groups, done quickly, and assembled after the release of the main report**.

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* See Annex B of the National Transport Planning Taskforce Report (NTPT 1994)

** Volumes 2 & 3 of the NTPT report contain the research studies.

3. RESEARCH

The biggest single research task was that undertaken by the Bureau of Transport and Communications Economics on Adequacy of Transport Infrastructure (BTCE, 1994). This was a major effort, drawing on separate data and demand forecasts by State agencies and sub-consultancies. In the next year or so there will be much debate in Australia about the methodology, findingsand implications of this report, but let me say in over twenty years of working with the BTCE I have never known the organisationmove so fast as they did in responding to the NTPT. The work will have given the organisation a new momentum, which the Taskforce's recommendations seek to maintain.

At the same time as NTPT was taking place, a parallel Review of the National Highway System (NHS) was going on in Commonwealth DoT, using a consultant team led by Arup Transportation Planning (1995). The findings of the NHS Review were a major input to NTPT, but a timing problem arose when NTPT had to move faster than the NHS Review, so BTCE had some patching to do, another unforeseen task.

Three economic consultancies were let. The first, to the Centre of International Economics, was for an input-output model to indicate the importance of transport in the economy (CIE, 1994), to re-state the data and counter the effect of those who are prone to throw in the kitchen sink when assessing the importance of transport, something I recall from working in Canada many years ago. The second, undertaken by Kinhill Economics (1994) and economists from the University of Queensland, was to give the Taskforce an independent evaluation of the post-Aschauer debate on the macro-economic effects of transport infrastructure, which has been latched on to by many in the cause of regional development.

Thirdly, a report on Evaluation and Decision-making for Transport Infrastructure Investment, was undertaken by Professor Peter Abelson of Macquarie University (Applied Economics, 1994). This was a review of the extent to which government agencies - railways, ports, airports and roads - make use of economic analysis in their deliberations. The survey makes remarkable reading. Suffice to say whilst most governments or agencies have

a manual for economic evaluation, the extent to which it is used varies enormously within and between agencies, governments, between projects and over time. Lack of transparency, and alleged confidentiality of evaluation reports leave much to be desired in the public arena in Australia.

Three other studies were undertaken on specific topics which emerged as significant during the Taskforce consultations:

a) Arup Transportation Planning (1994): a study to outline the current status and use of information and communications technology in transport (in Australia and internationally), and to describe the potential of Intelligent Transport Systems (IVHS) to improve the efficiency of Australian transport and logistics.

b) DJA Maunsell Pty. Ltd. (1994): a study to examine developments in the separation and control of rail infrastructure and rail operations in Europe, North America, and Japan, identifying the policy objectives, regulatory arrangements for oversight, and key issues emerging from these developments.

c) Thompson Clarke Shipping Pty. Ltd. (1994): a report in the capabilities of coastal shipping to compete with road and rail transport, using a financial model to assess a number of coastal general cargo services.

In addition the Secretariat, assisted by consultants and students in some cases, prepared position papers on the following topics:

- taxes and charges paid by the transport industry (Travers Morgan, 1994);
- urban freight;
- case studies of major transport firms and users.

4. FINDINGS

The Taskforce report combines the findings from the consultation process with the output of the research. This section summarises the importance of freight transport in the Australian economy, highlights the major weaknesses in the national transport system, and describes the findings in relation to establishing priorities for investment in transport.

a) The Significance of Freight

The best way to focus the significance of freight transport is to say that without the ability of the products of farming, mining and manufacturing to reach their domestic and international markets, a nation would have essentially a subsistence economy. Australia's freight lifelines are long and thin, but whereas Canada's are elongated east to west, Australia's are a long thin strip around the coast of an island continent.

The transport sector in Australia accounts for 4.2% of GDP ($A15.8 billion)***, with freight transport alone accounting for 2.6% ($A9.8 bn.). Road made by far the largest contribution to freight transport, followed by rail, sea and air. Whilst air transport accounts for almost 1% of GDP, it is obviously mostly passenger business. The contributions of the four modes to employment follow a broadly similar pattern to their contribution to GDP.

If we look at the costs of transport paid by individual industries, we find that road transport services are an important component of most industries' cost structures, requiring $2 to $4 of road transport to produce $100 worth of output (for rail the range is 20c to 70c, sea less than 25c, and air less than 10c). However, these are industry averages, and for some products the transport costs are a much higher proportion e.g. steel (16%), manganese steel (20%), talc (40%).

CIE modelled the macroeconomic effects (on GDP and real consumption) of improved productivity in transport. As you would expect from the earlier data, the greatest potential benefits come from improvements to road transport.

*** One $ Aus. was approximately $1 Can. in March 1995.

In their report CIE went on to describe the nature of the transport task in domestic freight, and stressed the significance of serving the market through reliable, timely and efficient service maintaining or increasing modal split. Ken Ogden of Monash University, an authority on urban freight transport, reminded the Taskforce that "Transport is part of the logistics chain, not the central part, just one of the parts."

b) Weaknesses in the System

The most significant transport problem identified by the Taskforce was the poor performance of the National Rail Corporation and its future in the national freight network. This was partly a timing problem, as the Corporation was only formed in 1991 to superimpose a single national freight operator on the (almost completed) standard gauge rail network, which is still owned by five governments (four state railways plus Australian National) and which has to interface with broad and narrow gauge state networks. While in Canada you have some problems with rationalisation of CN and CP, the finances of VIA Rail, and the future for regional railways and short lines, the rest of the world also grapples with its own challenges with a transport technology that some say has a great future, but one wonders at what price?

In marine transport the main problem is that the reforms promised on the waterfront and over the water still have a long way to go. While users acknowledged that substantial changes had been made in stevedoring, shipping, towage, grain handling and port authorities themselves, there remain big gaps between best Australian and overseas practice. For example, while internal efficiencies are being made in port authorities, most of the benefits have gone to state treasuries, not to users.

Road and air transport had fewer but similar problems - effects of regulation, impact of curfews, urban congestion, and levels of taxes and charges. Generally there is still much work to do in the transport reform process in Australia - an interesting finding as the Taskforce was predicated on seeking intermodal benefits on the assumption that modal reforms were well on the way.

c) Establishing National Priorities

One of the specific terms of reference was for the Taskforce to report on methods for determining priorities for national transport infrastructure assessment, and on the net economic costs and benefits of such infrastructure.

Whilst the Taskforce recognised the role that environment, safety, technological change and energy use considerations will influence where we invest in transport in the future, the biggest single determinant will continue to be demand. Changes in the distribution of population and industry, with a strong emphasis on the eastern coastal strip between Cairns and Sydney, will intensify pressure on infrastructure in this zone (e.g. Pacific Highway, rail links, Port of Brisbane). Improvements in this region will reduce the transport disparities that already exist between east coast Australia and the rest of the country, but will worsen the debate between the east coast and north and/or west on such issues. On a modal basis, the Taskforce found no evidence that rail or coastal shipping would make much of a dent in the growth of road freight transport.

A major finding of the Taskforce was that the current level of expenditure on infrastructure is not deficient in aggregate terms, nor is there a case for increased spending to stimulate growth. Quoting the report, the idea of spending money on infrastructure to generate economic activity "does not provide a sound basis for policy formulation on infrastructure investment". The Taskforce "considers careful selection, evaluation and implementation of individual projects is the only sure method of ensuring appropriate investments are made".

We went on to make some very specific statements about modal investments. On the basis of our consultations and the BTCE's analysis of the adequacy of transport infrastructure we reported the following findings:

- much of the nation's road, rail, sea and airport infrastructure, if appropriately maintained, will have adequate capacity to handle demand over the next twenty years;
- the average annual level of road investment and maintenance required for intercity corridors over the twenty year period is broadly equivalent to National Highway System allocations in recent years;

- past road spending patterns for new works will need to change to meet capacity shortfalls in higher growth areas;
- investment is required to lessen congestion problems on strategically important urban road links, mainly in Sydney, Melbourne and Brisbane;
- a case exists for continuing rail infrastructure investment, mainly to address deficiencies in east coast corridors;
- there is underutilised berth capacity at most Australian seaports and only relatively small investment is required over the next twenty years; and
- airport investment needs will be driven by passenger demand with terminal expansion accounting for two-thirds of estimated required expenditure.
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The BTCE also found that on the major intercity corridors, investment in rail is not expected to have any significant effect on investment needs for roads. Even if rail could capture the entire growth in intercity freight, this would delay timing of economically justifiable road projects by less than five years. Moreover, this shift would have minimal impacts on the social costs of roads. It would reduce Australia's carbon dioxide emissions by less than 0.2 per cent and road accidents by an estimated 0.3 per cent.

One of the strategic changes the Taskforce emphasised was a rethink of the way we spend our road funds. As I said earlier, the quantum is not out of kilter, but the distribution is. Whilst some do not like the National Highway system funding process, something similar is needed in all States (i.e. priorities based on need) to make the necessary shifts in investment from local to arterial roads and from rural to urban roads, that have been called for by many researchers and planners since the days of the Commonwealth Bureau of Roads in the late 1960s/early 1970s. (The Bureau was abolished because its findings ran counter to political expediency.)

On railway spending, the Taskforce was presented with one view that said: don't throw good money after bad. From that position things could only improve! The Taskforce view is that Australia has embarked on a new concept for freight railways including the National Rail Corporation (NRC), open access, and more private ownership of infrastructure and/or equipment; we must give these

new developments a chance to work. However, as the BTCE cautioned, the railways must concentrate on investments to improve service quality and reduce operating costs, not on expanding capacity, otherwise the cost to the taxpayer will be very high.

Both road and rail transport demands highlight the need to concentrate on the urban interface, emphasised by the fact that all trade through capital city ports, 95% of air freight, and a high proportion of long distance road freight, also use the urban links. I suspect this is the same in Canada, given the high levels of urbanisation and the significance of major ports.

To summarise the findings: why do we need a national approach? Mainly because investment decision-making is fragmented by mode and fragmented by level of administration. It is the system as a whole that is important, not just bits of it, and the current division of responsibilities for transport results in consideration of investment in infrastructure on an inconsistent basis.

5. RECOMMENDATIONS

The Taskforce believes that changes need to occur, most of them quickly. I intend to comment briefly on each of our recommendations, and can elaborate on those of particular interest in the discussion session.

1. Commonwealth, State and Territory Governments negotiate (and seek endorsement of the Council of Australian Governments) to establish a framework for national strategic transport planning in Australia - a National Transport Infrastructure Network. Primary attention should be given to investments of national economic significance.

2. Road, rail, port and airport infrastructure investments and their funding arrangements should be considered within a framework that allows intermodal, network and corridor considerations to be evaluated transparently.

Simply put, recommendations 1 and 2 are a call to replace the National Highway System with a National Transport Infrastructure Network covering all modes, with evaluation of proposals for new or improved links to include cross-modal comparisons in the same

corridor, including terminals. To transfer this to the Canadian scene, any expenditure in any one mode in the Quebec City to Windsor corridor would require an investment in any one mode to be evaluated against a similar investment in one or more of the other three.

3. The Bureau of Transport and Communications Economics should continue to refine and build upon the review of national strategic transport infrastructure undertaken for the Taskforce, with similar reviews being undertaken every five years.

5. The Bureau of Transport and Communications Economics coordinate the collection, maintenance and reporting of data necessary for national strategic decision-making in transport.

These two recommendations (3 and 5) are a plea for the data collection started in the NTPT and NHS exercises to be continued. Without such data, the evaluation called for in other recommendations will be less useful, maybe invalid, or even impossible to undertake. From a research point of view, these are the most important recommendations.

4. State and Territory Governments must ensure they have in place integrated metropolitan transport plans, which identify the infrastructure and traffic management systems required to ensure the efficient movement of freight necessary for the economic development of each metropolitan region.

Recommendation 4 integrates the urban transport planning needs into the national network. Given that much current private sector involvement in public infrastructure is in urban roads, this is an important proposal.

6. All governments endorse the use of rigorous economic analysis, supplemented with social and environmental statements for all major transport investment decisions, and make these results publicly available.

This recommendation (6) is the underpinning for most of the others. Whatever other decision processes are used, and whatever you think of the weaknesses of CBA, do the evaluation, make your findings publicly available and supplement the economic analysis

with any other evaluations you prefer to use e.g. family impact studies, environmental impact statements, regulatory impact statements, multi-criteria analysis etc. In this recommendation of the Report we are supporting the main recommendations of the Applied Economics Study, viz.:

- there should be greater use of cost benefit analysis, supplemented by a statement of social and environmental impacts, for evaluation of large transport projects;
- governments should not only establish evaluation guidelines but should also establish rules for the application of these guidelines;
- evaluations should assess a reasonable number of alternatives;
- evaluations should generally be made from a national rather than sub-national perspective;
- asset maintenance and disinvestment strategies should also be evaluated;
- post project evaluations should be carried out and there should be a review of the marginal rates of return in each transport sector;
- methods for developing defensible and consistent weights in multi criteria analysis studies should be examined; and
- community service obligations should be consistently defined so decision-makers can make informed choices about whether or not to adopt projects for community service obligation reasons.

The remaining recommendations in the report cover the broader environment in which transport infrastructure decisions have to be made. The first group (7, 8 and 9) cover the links between investment in infrastructure and efficient operation: competition, policy, taxes and charges, and rail access.

7. Commonwealth, State and Territory Governments implement competition policy reforms proposed by the National Competition Policy Inquiry to enhance the competitive framework for provision of transport services in Australia andthus provide better services at lower costs.

8. Owners of track infrastructure develop systems to allow open access to the rail network including separate accounting for the costs of maintaining and operating track infrastructure.

9. All governments ensure transparency in setting of taxes and charges on freight transport. In setting taxes, governments should consider the consequences for competition between modes. The current review of road taxes and charges by an Australian Transport Council working group should be extended to cover the relative impact of taxes and charges on all transport modes.

Number 10 pulls together the link between pricing for infrastructure in such a way that congestion prices and environmental prices are transparent.

10. All governments develop mechanisms for pricing for the use of transport infrastructure which reflect the costs of efficient provision of that infrastructure and take into account congestion and environmental factors in a transparent way.

Recommendations 11, 12 and 13 all relate to regulatory links between governments and the transport business.

11. Governments should implement the National Road Transport Commission's recommendations for nationally consistent road transport regulations and charges by July 1995.

12. Rail organisations implement a set of consistent rail safety and operational standards and practices with support as necessary from governments.

13. The Australian Local Government Association develop guidelines for local government, including an arbitration procedure, to ensure industry and user input into decisions affecting freight transport.

Hopefully 11 and 12 will be in place in the near future (the NRTC is responsible for developing national regulations for road transport), but the local government planning recommendation is also high priority, so the situation facing urban freight movements does not worsen, and opportunities for improved urban freight transport are not lost. I suspect this conflict between local planning priorities and the needs of commerce and freight transport also exists in North American suburbs.

The last three recommendations (14, 15 and 16) relate to improving performance in the total transport system.

14. Commonwealth, State and Territory Governments commit to the coordination (including adoption of national standards) and application of Intelligent Transport System technology in Australia.

15. The Bureau of Transport and Communications Economics, in conjunction with State agencies, transport companies and users, develop and publish performance indicators of intermodal freight performance.

16. Regular assessments and reports of transport reform implementation, including the recommendations of this report, be prepared and published by the Australian Transport Council and the Council of Australian Governments. These assessments should draw on the work of the Bureau of Transport andCommunications Economics, in conjunction with State and Territory agencies, transport providers and users.

6. CONCLUSION: NEXT STEPS

The National Transport Planning Taskforce report is an attempt to set out, in a rational and persuasive way, what Australia needs to do to establish an effective transport network, to create a system in which each mode operates at maximum efficiency and with a high degree of complementarity within the competitive environment.

Remember it was a Planning Taskforce, not one to identify specific projects. As I said in my introduction, there are plenty of wish-lists for spending, and in our report we stress there are no special cases that should be exempt from our recommendations - not high speed trains, not any airport, nor any railway line.

The first step is for the recommendations to be considered as appropriate by the National Transport Policy Framework (NTPF) groups on pricing, infrastructure, competition policy and ITS. The NTPF is part of the machinery of the Australian Transport Council, the group of Commonwealth, State and Territory Ministers of Transport meeting twice a year to discuss national issues. I can't believe any of our recommendations will be rejected; hopefully the NTPF groups will be able to improve on some of them, put flesh on the NTPT bones, and monitor implementation.

From the Taskforce recommendations, I would like to see speedy identification of the National Transport Infrastructure Network, a commitment to investment in the Network corridors on a demand basis (not on historical shares), more emphasis given to freight and business travel in metropolitan planning, publication of economic analyses, and greater transparency of subsidies. I expect there will be a gradual commitment to road pricing (area-wide as well as on individual roads) in at least one metropolitan area - Sydney is the obvious case. Finally, Australians must resist the corporatisation of government agencies in a way which can thwart the Taskforce's recommendations for (and taxpayers' entitlement to) transparency.

So there's lots to be done. The Taskforce set out its recommendations in a simple and forthright way. There are no excuses for not getting on with the changes that need to be made to turn Australia's fragmented transport system, which the Taskforce found works pretty well, into a national network capable of providing efficient service well into the next century.

I hope this Australian model is of some interest to those of you involved in national transport policy and planning in Canada.

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THE USE OF GAMBLING FOR INFRASTRUCTURE FINANCING

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Abstract/*Résumé*

As fiscal pressures continue, governments at all levels are searching for new ways to fund needed infrastructure improvements. Expanding the revenues from various forms of gambling is an option that has been frequently considered. Only rarely, however, are proposals supported by a comprehensive analysis. This paper reviews the principal costs and benefits that are relevant in evaluations of gambling expansion proposals. Recommendations for researchers and policymakers are presented and discussed.

Les gouvernements cherchent tous des ressources pour améliorer l'infrastructure. Mais l'environnement fiscale devient de plus en plus difficile. Donc, plusieurs ont libéralisé la réglementation du jeu pour en obtenir des impôts. Souvent, l'importance d'une analyse compréhensive des conséquences a été negligée. Cette rédaction résume les coûts et les bénéfices principaux, et décrit les recherches dont on a besoin. On présent aussi des conseils pour les gèrants des projets.

Introduction:

Increasingly, North American policymakers are becoming aware of the consequences of neglected infrastructure. In 1993, Canada and the United States were the two G-7 nations with the lowest levels of public investment (Bergamini, 1993). Some economists argue that this has been a major cause of the economy's faltering productivity, profitability, and private sector capital formation (Aschauer, 1991; Bergamini, 1993).[12]

As fiscal challenges intensify (often due to budgetary "offloading"), many governments can be expected to turn to expansion of various forms of gambling in order to fund infrastructure projects. The taxes generated by gambling are

regressive (Borg, Mason & Shapiro, 1991). Yet the immense attraction for politicians lies in the fact that the degree of perceived coercion is much lower than other forms of taxation. After all, those who dislike "sin" taxes are free not to participate.

The purpose of this paper is to demonstrate that financing infrastructure improvements with expanded gambling may not be an optimal choice. This purpose will be fulfilled by outlining the relevant benefits and costs, with a particular focus on casinos. Recommendations are presented.

Benefits:

Industry promoters argue that gambling revenues are an easy way to finance needed projects. They are also eager to remind decision-makers about additional benefits, such as "new" jobs (Goodman, 1994, Padavan, 1994). In Vancouver, for example, it was suggested that up to 15,000 permanent jobs would be created by the now-defunct *Seaport Centre* proposal.[2] With a 125,000 square-foot casino, a cruise ship terminal and hotel/convention centre could be provided "at no cost to the taxpayer". An estimated $256 million annually in new taxation revenues would accrue to various levels of government (Vancouver Port Corporation, 1994:5).

Revenues: At first glance, experience suggests that these estimates might be reasonable. For example, the *Casino de Montréal* generated $36 million in profits after three months of operation (Petrowski, 1994). The temporary casino in Windsor generated over $73 million in provincial win taxes between May, 1994 and January, 1995 (O'Neil, 1995).

The net benefits, however, are much less. It is necessary to distinguish between "new" tax revenues and simple transfers. Taxes from a casino can be considered as a contribution to the economy, but only after that portion that would have otherwise been collected elsewhere has been deducted (City of Vancouver, 1994; Coopers & Lybrand, 1993; Goodman, 1994).

In many Canadian contexts, the ability of casinos to generate net benefits is marginal. At the *Casino de Montréal*, as many as 95% of the visitors are from within the province (MacIsaac, 1994:38). In Ontario, a study by Coopers and Lybrand (1993) revealed that at four out of seven proposed casino sites, the local population would provide the majority of visitors and spending. Only Niagara Falls, Ottawa, and Windsor were found to have the potential to draw revenue from out-of-province visitors. Even in these cities, the longer-term economic

contribution of casinos is threatened as neighbouring jurisdictions reduce or eliminate gambling restrictions.[3]

Often, promoters argue that a casino will attract tourists and keep local gamblers at home. These claims have some merit. In Windsor, for example, a recent study found that 41% of the U.S. visitors would not have come without the casino (Ernst & Young, 1994). Indeed, for some tourists, the availability of a casino may connote a positive "image of diversity and lifestyle choice". But for others, the image conveyed may be inconsistent with "family values" (e.g. City of Vancouver, 1994:7).

Keeping some local gamblers' dollars at home has favourable balance-of-payments implications. However, for most consumers, the choice of vacation destination is a function of many desires besides access to gambling. Travel to destinations such as Reno or Las Vegas may be an inexpensive way to escape harsh Canadian winters, win a temporary reprieve from childcare responsibilities, or enjoy an impressive selection of performing artists. Consumers with objectives such as these high on their minds are unlikely to change their plans simply because a casino is available locally (Vancouver Board of Trade, 1994:19).[4]

Jobs: A new mega-casino can rapidly become a major local employer. Additional jobs may arise in the provision of ancillary services such as transportation, accommodation, and rehabilitation.[5] However, anecdotal evidence suggests that many of these jobs come from other employers. For example, in Atlantic City, New Jersey, 100 of the town's 250 restaurants have closed since 1978 - the year casino operations began (Corelli, Nemeth & Driedger, 1994). Petrowski (1994a) observed that a substantial number of businesses closed following the début of the *Casino de Montréal* because of declining sales.

The impact of *Casino Windsor* on existing businesses is difficult to gauge. An Ernst and Young (1994) evaluation claims that "a number of business have increased their sales through aggressive marketing", and argues that the casino caused a dramatic increase in hotel/motel occupancy rates (Exhibit 5).[6] But it concedes that "a number of businesses need to adjust their expectations of the casino as well as their business strategies".[7] One restaurant owner has predicted that when it is completed, the new permanent facility will "put downtown Windsor out of business" (O'Neil, 1995).

Very few studies have examined how casino "cannibalization" of consumer spending impacts jobs in existing businesses (Goodman, 1994). One scholarly study was performed by Grinols (1994). Using employment data from six Illinois cities in which riverboat gambling was introduced, the author concluded that "the data are unable to show any net effect on unemployment and very little net effect

on employment as a result of gambling in the communities where it has been introduced". He concludes that "claims of substantial employment benefits from riverboat gambling should, therefore, be questioned" (Grinols, 1994:11).[8]

Costs:

Crime: Anecdotal evidence suggests that expanded gambling is associated with increases in various forms of criminal activity (Horrobin, 1993; Illinois State Police, 1992; Ryan, Connor & Speyrer, 1990:40). The Canadian evidence is scant. In particular, the crime-related consequences of casinos are difficult to assess with much confidence because they are all relatively new. In Windsor, the overall crime rate has dropped, but there have been dramatic increases in spousal abuse, fraud, embezzlement, counterfeiting and prostitution (O'Neil, 1995).

Very few high-quality studies are available on casino-crime relationships (Illinois State Police, 1992: 2,15; Ryan, Connor & Speyrer, 1990). To date, two fairly similar approaches have been used in research. In *cross-sectional studies*, the researcher compares crime rates in areas with and without a specified form of legalized gambling for a common time interval. For example, a document by Promus Companies (1994) reviewed crime rates for several U.S. cities, adjusted for the number of visitors. The authors concluded that figures for Atlantic City are not significantly different from other non-casino metropolitan areas that entertain a significant number of tourists and other visitors (p. 10). Another casino company executive argued that because Orlando, Florida (the home of Disney World) and Atlantic City both attract a similar number of visitors, the higher crime rates in Orlando indicate that "there is nothing about casinos themselves that attracts criminals" (Citizens' Research Education Network, 1992:55).

An overwhelming limitation of cross-sectional studies is that differences in crime rates between one city and another may be attributable to a host of variables (Federal Bureau of Investigation, 1993:v). For example, in some communities, citizens may be more willing to report incidents they see than in others. Prevailing unemployment rates, police force strength and drug abuse rates are among the numerous factors that may be relevant in explaining differences in crime rates between one jurisdiction and another.

The second approach that has been used is the *time-series study*. This typically involves the comparison of crime rates in the same city before and after casinos are introduced. For example, in response to the Atlantic City-Orlando comparison described earlier, one citizens' group argued that in Orlando, crime rates were increasing long before the opening of Disney World. In Atlantic City,

on the other hand, the jump did not occur until after casino legalization (Citizens' Research Education Network, 1992: 55).

The key limitation of time-series studies is that it is difficult to isolate the effects of changes in gambling availability from other changes that may have occurred. For example, if a casino opens at the same time as a new police chief is hired, it is difficult to isolate the effects of either event. Another difficult issue is selecting the appropriate time period for study. Simple one-year pre- and post-comparisons may be misleading if the antecedents of criminal behaviour related to gambling have longer "incubation periods". As the time period studied increases, however, so does the risk of faulty conclusions because of extraneous factors.[9]

In one of the better studies, Friedman and his colleagues (1989) combined the features of both cross-section and time-series studies. They performed an analysis for an eleven-year period, using crime figures for 64 communities in the Atlantic City region. After removing the effects of population, unemployment, wealth, and density, the authors found that burglaries, vehicle thefts, and crimes of violence were higher in communities with greater accessibility to casinos. Because these increases were over and above the increases for the entire region, the authors concluded that "they could have been caused by the casinos in the form of spillover of crime from Atlantic City" (Friedman, Hakim & Weinblatt, 1989:621).[10]

Some forms of crime may be more closely associated with gambling than others. To some extent, increases in ambient or "street crime" will be associated with <u>any</u> new facility that attracts large numbers of patrons. In other cases, the gambling-crime relationship may be more intimate. For example, the sheer volume of cash that is circulated in a casino may make it vulnerable to money-laundering activities (City of Vancouver, 1994; Eisenberg, 1979; Vardzel & Block, 1994:13). Loansharking, property crime or cheating are predictable consequences of pathological gambling (Lesieur, 1987; Padavan, 1994), as the next section will discuss.

Lastly, some have argued that expanded gambling will benefit the community by reducing illegal gambling activity.[11] Considerable doubt surrounds the validity of this claim (Kaplan, 1984:101; Lehne, 1986:30). As Goodman (1994) suggests, organized crime remains an active provider of gambling products in its own market niche. Expansion increases the number of people who gamble, and provides organized crime with access to a larger consumer pool (Rose, 1986: 9). In the words of one former Chicago mobster,

> there always existed one solid constant - any new form or expansion of legal gambling always increased our client base. The stooges who approved Las Vegas nights, off-track betting, lotteries, etc. became our unwitting front men and partners. . . the publicity gave people a perception of gambling as healthy entertainment (Goodman, 1994:90).

Pathological and problem gambling: Many people who gamble can do so wisely. Unfortunately, this is not always the case. Pathological gambling is the repeated failure to resist the urge to gamble, resulting in disruptive patterns that impair the ability to function in personal, family, and occupational roles (Murray, 1993:792). Problem gambling, on the other hand, is a broader term which "refers to all of the patterns of gambling behaviour that compromise , disrupt or damage personal, family, or vocational pursuits" (Volberg, 1993:ii).[12]

Available evidence suggests that where more forms of gambling are legal, problem and pathological gambling increase (Goodman, 1994:60; Volberg, 1994:239). Unfortunately, a great deal remains to be learned about these disorders in Canada. In a study of Edmonton residents, Bland and his colleagues (1993) found that the lifetime prevalence of pathological gambling in the population was 0.42%. Three-quarters of the pathological gamblers identified in the study were men - a finding consistent with other studies. The authors describe several reasons why the rate they found may be understated. Another Alberta study conducted during the same year found that lifetime problem gamblers make up 8.5% of the province's adult population (Wynne Resources, Ltd., 1994).[13,14] In a final study of interest, Volberg (1993a, 1994) found that rate of probable pathological gambling was significantly higher in Native Americans than in the general population of the state.

The incremental social costs of problem and pathological gambling are relevant in evaluations of gambling expansion proposals. These costs may take a wide variety of forms. One is the cost of prosecuting and incarcerating those who commit crimes in order to support their gambling habit. Another is increased healthcare costs, including treatment for problem and pathological gamblers.[15]

Addiction may also lead to consequences that are sometimes difficult to measure in dollars, such as marital breakdown, bankruptcy, poverty, and suicide ("Governments ignore", 1994). It is also likely to have an adverse impact upon worker productivity and/or job performance (e.g. Lesieur, 1989:237-8; Overman, 1990; Stuart, 1991).[16] In summing up social costs, Grinols estimated that for every $40 collected through a casino win tax, the average cost to the private sector in addicted gamblers' lost job productivity, criminal activity and legal services is about $200.[17]

A final consequence of problem gambling that should be pointed out is its possible effects upon children.[18] Jacobs (1989) found that children of problem gamblers were at much greater risk than their classmates. They experienced almost twice the incidence of broken homes caused by separation, divorce, or the death of a parent before they had reached the age of 15. Almost half rated their overall quality of youth as "poorer than most", in contrast to only 27% of the children who had admitted to no problems of gambling among their parents (p. 227). These findings suggest that expanded gambling might compromise the ability of educational institutions to generate needed attitudinal and behaviourial outputs in their students, and ultimately, the quality of Canada's future workforce.[19]

Overall estimates of the social cost per problem and pathological gambler cover a wide range, because of varying definitions and measurement methods between studies. At the low end, Goodman (1994) applied a figure of $13,200 (U.S.). A high estimate was found by University of Manitoba researcher Neil Tudiver, who estimated that each "compulsive" gambler costs society $56,000 ("Governments ignore," 1994). In the United States, it has been estimated that pathological gambling cost society $80 billion in 1988 (Politzer, Yesalis & Hudak, 1992:24).[20]

It is common for proponents to promise funding for treatment programmes, hot-lines or similar responses to problem or pathological gambling. The efficacy of these measures is far from consistent (Filteau, Baruch, & Vincent, 1992:88-9; Gambino, 1989).[21]

Miscellaneous costs: A number of miscellaneous consequences are likely to be associated with expanded gambling, all of which have cost implications. For example, a large casino in a downtown area may generate traffic congestion beyond what the local infrastructure is capable of handling. If people divert their spending to gambling from local charities, the ability of these organizations to provide needed services is reduced, and the government may ultimately be forced to take over the responsibility for them. Expanding gambling will also require additional law enforcement personnel and a regulatory bureaucracy (Horrobin, 1993).

The "Goodman" study:

In a pioneering effort to summarize available evidence, Goodman (1994) reviewed fourteen American studies on the economic impact of casinos. Of these, he found that only four could be considered "mostly balanced" or "balanced". In

the remainder of the studies, the typical shortcomings were severely overstated (i.e. gross) benefits and understated or omitted costs.

A frustrating reality that is evident from the Goodman study is the dearth of objective, scholarly research. Of the studies he reviewed, none were published in a refereed journal. Many were funded by pro-gambling constituencies. An exhaustive search of published literature failed to reveal any additional studies that would have been pertinent to his review.

Not surprisingly, Goodman's study infuriated the gambling industry lobby. A report by The Promus Companies, Inc. (1994) vigorously disputes the author's classification of studies into "balanced" and "unbalanced" categories because not all of the projects had been built; nor had Goodman himself compared predicted with actual effects. These complaints are of limited relevance for what was a fairly straightforward literature review.

Recommendations for research:

Additional studies on the costs and benefits of gambling are sorely needed. An interdisciplinary approach including fields such as business, economics, medicine, and law would help ensure that meaningful estimates for both favourable and unfavourable consequences are included in analyses.

A particular need exists in the area of healthcare infrastructure, where at least one Canadian province (British Columbia) uses gambling as a funding mechanism. If a given project can only be funded by increasing the incidence of problem and pathological gambling, it is possible that cancelling the project will be the better way to serve the welfare of the population (e.g. Robinson, 1993).

Research is also needed to evaluate the usefulness of primary strategies designed to prevent problem and pathological gambling. The efficacy of treatment practices commonly advocated by the gambling industry (such as counselling and telephone hot-lines) needs to be more firmly established.

Many of us are aware that there are limits to what regulation can achieve. Interestingly, regulation is touted by gambling industry advocates and policymakers alike as an easy way to reduce or eliminate adverse consequences. Researchers should encourage a more sober set of expectations. Invariably, diverse and conflicting public policy goals will be at work, such as maximizing the tax proceeds generated by gambling while protecting citizens from practices that encourage them to spend more than they can afford. The nirvana of

"scientific regulation" was never achieved in transportation, and it is no more likely to be achieved in games of chance.

Using gambling for infrastructure financing:

At times, financing certain types of infrastructure with gambling dollars may be economically feasible. The following recommendations may encourage sound analyses and decision-making.

(1) Determine the feasibility of the project. The decision-maker should begin his/her evaluation by applying benefit-cost analysis to the project being considered. Where several decision-making units are dependent on the same capital resource "pool", it is appropriate to apply a consistent set of criteria and assumptions across various competing projects.

(2) Consider alternatives. Because capital rationing will be an ongoing reality for governments everywhere, alternatives to new infrastructure should always be considered. As Helm and Thompson (1991) point out, "there appear to be greater opportunities for the more direct use of congestion charges - for road space or airspace slots, for example - or for the unbundling of purchasers according to preferences on price/quality stability - for example, contract and spot markets in airport slots. . ." (p. 245).

It also bears repeating that gambling proceeds are only one way to finance needed projects. Other forms of taxation and user charges also deserve thoughtful consideration.

(3) Use benefit cost analysis wisely. As Helm and Thompson (1991) point out, the economic theory of infrastructure investment and pricing is complex. Sound project appraisals require that external costs and benefits be considered, including those that are hard to measure (Luskin, 1994; Mills, 1994).

In the case of gambling, some of the consequences of problem and pathological gambling can be measured, and should be included as relevant costs. Examples include reduced productivity at work, divorce, changes of residence, or loss of job (Rice et al., 1990: 37). For other costs, valid methodologies and reliable measures remain to be developed. When meaningful figures cannot be calculated for certain types of costs, the decision-maker should recognize the limitations of benefit-cost analysis and the subjective nature of the decision being made.

Assumptions are inevitable in making the requisite calculations. Many of these may be highly debatable in the case of gambling (British Columbia Central Credit Union, 1995:2). When possible, the analyst should determine how sensitive projections are to changes in underlying assumptions. For projects requiring prolonged outlays or maintenance, the viability of future revenue projections are a special concern. Experience suggests that gambling-derived revenues become increasingly unstable and are likely to decline over time (Goodman, 1994; Rose, 1986).[22]

(4) Conserve community goodwill. Agencies who wish to attract infrastructure-related funding should maintain a clear focus on the merits of the project. Promotion of a specific financing mechanism seems unwise if it is a controversial one.

In Vancouver, Port Corporation management was ernest in its desire for a new cruise ship terminal (e.g. Stark, 1994). Unfortunately, some very diligent community-relations work (e.g. Stark, 1994; Tessier, 1991) was lost as a result of the casino débacle. Some goodwill could have been saved if the Corporation's management had limited itself to articulating the case for the cruise ship facility, which has now been delayed significantly.

(5) Design a fair process for community input. Finally, a fair and comprehensive consultation process is needed for large infrastructure projects. Consultation can enhance the legitimacy and quality of the decisions (e.g. Breyer, 1982:350), although it is not without problems. In the case of gambling, it is likely that there will be a severe power and resource imbalance in favour of pro-gambling constituencies because of the immense potential for private profit.

In Vancouver, the *Seaport* promoters spent about $1 million on promotion-related activities. The intensive polling and advertising campaign began well before opposition groups could mobilize. The time advantage was a strategic one and created a "bandwagon" effect that was extremely difficult to challenge. The poorly-funded coalition of church and citizens' groups that opposed the project was easily labelled "anti-jobs" and "anti-tourism" until it could demonstrate to the media that many of the developers' figures were overstated, and that important social consequences had been ignored.

The local government promoted a more constructive dialogue by providing several opportunities for citizens to participate in a formal "casino review". Throughout the summer of 1994, a highly-publicized series of public meetings was held around the city, and planning staff met with all who wished to be heard. Written and telephone comments were also solicited. Most importantly, the City authored and circulated a paper that presented a balanced discussion of the

benefits and costs of casinos (City of Vancouver, 1994).[23] On the whole, the City's response provides an excellent example for others who may face this issue in the future.

Conclusion:

Industry promoters, governments and vested interests have not encouraged sound appraisals of gambling expansion proposals. The ability of complex regulations and treatment programmes to mitigate the adverse social consequences is uncertain.

The infrastructure funding challenges facing Canadian governments can be met by developing realistic policy objectives, together with financing mechanisms that do not generate more problems than they solve. The research community has an important role to play in determining whether gambling is the best way to raise needed resources across varying time horizons.

Using the proceeds of legalized gambling to finance economically feasible projects is one of several options available to decision-makers. Optimal financing choices require fair, comprehensive analysis. Given Canada's limited research and experience with gambling, and the politically explosive nature of the debate, wise decision-makers will contemplate a broad set of goals and outcomes before they roll the dice.[24]

Endnotes

1. Aschauer (1991) demonstrated by simulation that the performance of the U.S. economy might have been greatly improved by an increased investment in public capital. Productivity growth rates, returns on nonfinancial corporate capital and private investment are among the variables that he concludes would have been significantly higher.

2. A later evaluation by KPMG Consulting (1994) forecasted that the net additional employment would range between 7,400 and 12,300 jobs (p. 26).

3. In August, 1994, voters in Detroit approved a non-binding referendum to allow casinos in that city; another major casino development is planned for Chicago. In Quebec, the government is considering plans for several more casinos. By the year 2000, 95% of all Americans are expected to reside within reasonable driving distance of one or more casinos (Popkin & Hetter, 1994).

4. In British Columbia, Macaulay (1994) estimated that the gaming public would reduce expenditures in Las Vegas by approximately 20 percent (about $6.8 million) as a result of introducing a domestic casino industry (pp. 6-7).

5. Saskatchewan, Alberta, Manitoba and Nova Scotia have allocated a combined total of about $3.5 million for treatment programmes. Ontario has allocated $1 million, while Quebec does not offer any funding (Downey, 1995).

6. That the casino accounts for a portion of this increase is a very reasonable claim. The possible influence of other causes (e.g. improved provincial/national economies) should not be overlooked.

7. At present, the direct employment impact of the Windsor casino is approximately 2,300 staff positions (Ernst & Young, 1994). Some of these positions are legitimately "new". But other positions have simply been transferred to the casino from elsewhere.

8. Grinols was formerly Senior Economist on President Reagan's Council of Economic Advisors.

9. For example, the review by Filteau, Baruch and Vincent (1992) describes the progressive nature of pathological gambling (Custer, 1984). There are three phases which are labelled "win", "loss" and "desperation". A one-year period may be too short to fully capture this evolution.

10. Additionally, the authors note that before 1978 (the first year of the period covered by the study), there was no difference in crime between the accessible and inaccessible groups of communities (p. 621).

11. For example, one of the stated rationales for the proposed introduction of video-lottery terminals in British Columbia is that this will facilitate the removal of illegal gambling machines (e.g. Lee, 1995).

12. Mental health professionals prefer the term pathological gambling over others (such as compulsive or problem gambling) because it incorporates several assumptions that are basic to the medical model. Two important assumptions are that pathological gambling is a chronic and progressive disorder; another is that there are distinctions between pathological and social gamblers (Volberg, 1993).

13. Volberg, an American medical sociologist, has conducted studies on pathological gambling in several American states. In summarizing extant studies, she reports that lifetime prevalence rates of problem and probable pathological gambling range from 1.7% in Iowa to 6.3% in Connecticut (Volberg, 1993:ii).

14. In British Columbia, a similar study yielded a rate of 7.8% (Gemini Research, 1994: 41). 25% of the B.C. respondents reported that they knew someone "who they would consider a compulsive gambler or a gambling addict" (p. 33). Much remains to be learned about the accuracy of measures for identifying problem and pathological gamblers (Walker, 1992:159-61).

15. As Murray notes in his review, one of the difficulties in research and treatment is that of cross-addiction of alcoholism and gambling (Ciarrochi, Kirschner & Fallik, 1993; Haberman, 1969; McElroy et al., 1992; Murray, 1993: 800). In one study, 39% of the sample (who were

patients in a gambling treatment programme) met criteria for alcohol or other drug abuse (Ramirez et al., 1983).

16. Volberg defined "bailout costs" as money given to problem or pathological gamblers by family and others in order to cover gambling expenses and living needs. These do not represent a direct economic loss to society in the same way that lost income or criminal justice expenses do (Goodman, 1994:63), and are less appropriately classified as social costs.

17. To be successful, Grinols suggests, a casino must move as many of these costs as possible out of its own community (Kassenaar, 1994).

18. The prevalence of pathological gambling among high-school and college-age youth appears to be significantly higher than the adult rate. Howard J. Shaffer of the Harvard University School for Addiction Studies has stated that in the next decade, "we will face more problems with youth gambling than we'll face with drug use" (Goodman, 1994:92).

19. Recent studies confirm the overall finding that the best predictor of school performance is the quality of the home from which the student comes (Bunke, 1994:23).

20. The cost of alcohol abuse in the U.S. has been estimated at $115 billion (Politzer et al., 1992:25).

21. In the alcoholism field, there is a far greater availability of empirical research. There is no single treatment approach for alcoholism that is effective for all persons. In some cases, those who receive formal treatment have worse problems afterwards (Anderson, 1993:265).

22. An examination of the financial statements for the British Columbia Lottery Corporation reveals that after adjusting for inflation, revenue to the provincial government increased by a modest 14% between 1987 and 1993. Advertising expenses, on the other hand, increased by 84%, while prize payouts increased by 45%.

23. A poll conducted by the city revealed that 63.8% of the respondents opposed major casinos in Vancouver. This contrasts sharply with the developers' assessment of public opinion.

24. As Grinols (1994) writes, "(i)ndependent estimates suggest that were the entire nation to allow all forms of gambling, the costs would equal 0.5 percent of GDP annually" (p. 8).

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THE ECONOMIC IMPORTANCE OF RAIL TRANSPORTATION FOR SELECTED INDUSTRIES IN CANADA

Michael Moore and Stephen Long

I. Introduction

This paper is based on a wider and more detailed body of research that was done at Industry Canada on the subject of rail transportation and related issues, and their importance for certain industry sectors (viz. aluminum, automotive, chemicals, fertilizers, pulp and paper, and steel). The purpose of the work was primarily to assess the dependence of the six subject industries on the rail mode as a means of transporting goods, both inputs and outputs. The results of this research are intended to help transportation policy analysts, researchers and others who are involved in the future of the rail network in Canada. In addition, research is being done on other competitiveness factors affecting the economic performance of these industries. The views expressed in this paper are those of the authors and do not necessarily reflect the views of Industry Canada.

The rail industry in Canada is in the process of major structural change. A variety of influences have necessitated this restructuring and caused the railways to re-examine their niche in the Canadian transportation system. These include new competitive pressures, through which trucking and U.S. railways have become serious competitors with Canadian rail transportation. In order to remain competitive, the major railways have undertaken a number of measures to restructure their operations, including the utilization of advanced technologies and rationalization of the rail network. Rail rationalization could have a significant impact on the manufacturing and processing sectors in Canada and the consequences are likely to vary between companies and industries.

The next section describes some recent trends in the railway sector and the forces of change that are driving railway companies to restructure their operations. Section III explains some of the concerns of shippers - the industries that utilize the services of railway companies to transport inputs into their production processes or to bring their finished goods to market. The methodology and data sources are described in Section IV and a summary of the main findings is presented in Section V. Some conclusions are offered in the final section.

II. Railway Trends: The Carriers' Perspective

The railways operating in Canada can be categorized into four types:

- Transcontinental railways operate extensive networks across Canada. CN North America and CP Rail System provide a range of freight transportation services and some passenger services. Combined they account for over 90% of the industry's total freight traffic.

- Regional, short line and terminal railways operate lines in a specific area of the country. Most are connected to the main lines of the transcontinental railways while others run from a mine or plant directly to a terminal for export by ship. These railways provide freight transportation services and some passenger services.

- U.S. railways operate small amounts of track in Canada linking shippers to their extensive networks south of the border.

- Passenger railways operate primarily on CN and CP track to provide inter-city passenger, tour and commuter services for passengers.

CP Rail System is an operating division of private-sector Canadian Pacific Limited. It has almost 20,000 kilometres of track in Canada and over 10,000 kilometres of track in the U.S. CN North America is a commercial Crown corporation. It has over 28,000 kilometres of track in Canada and over 3,000 kilometres of track in the U.S. Together, these two railways serve some 25,000 shippers in virtually every sector of the Canadian economy. Resource bulk commodities, much of them concentrated in the west, account for more than half of their workload. Some 40% of Canada's exports, including manufactured goods and resource products, depend on rail transportation.

Canadian railways are under stronger pressure than ever from their main competitors - trucking and U.S. railways.

- Trucking's share of the transportation market has grown steadily. On a tonnage basis, trucks account for about 40% of the surface transportation market, compared to 60% for rail. On the basis of revenues ($), however, trucks comprise 60% of the surface transportation market (versus 40% for rail), because they have captured the major share of goods that move at higher freight rates. Trucks have some natural advantages, such as greater flexibility than rail. They also operate on publicly financed highways and often offer lower prices. It is in the transportation of finished goods, centered in the east, where trucks have made their deepest inroads.

- U.S. railways are strong competitors for Canadian freight. For example, some 60 per cent of import/export containers transported between the West Cost and Eastern Canada move via the U.S. port and railroad system.

Moreover, the customers of Canadian rail services are facing intense global competition and they are putting additional pressures on the railways to improve the reliability and cost effectiveness of their services. In response to these pressures, the railway companies in Canada have taken steps to restructure their operations and to improve their long-term profitability. They are investing in new facilities, freight cars and locomotives, and adding new technology that lowers costs and improves services. Many of the new investments are in intermodal rail-truck systems that combine the advantages of long-haul rail movement with local distribution by road.

Two major difficulties for the Canadian railways are their relatively higher cost structure and lower productivity compared to U.S. railways.

- High cost structure - The Canadian rail network is heavily underutilized. More than 90% of CN and CP's Canadian tonnage is carried on only 40% of the track. This means that 60% of the track has to be kept maintained in order to carry only one-tenth of total traffic. U.S. railroads have significantly higher track utilization. The Canadian track network has been substantially reduced in recent years to match demand more closely. Some low density branch lines have been transferred to lower cost short line railways or removed from the network all together. Kilometres of road operated were reduced by 13% between 1988 and 1993.

- Low productivity - Canadian railway labour costs are substantially above those of the trucking industry and they take up a larger share of revenues than for U.S. railroads. However, railway labour productivity in Canada is improving: total tonnes originated declined by 9% between 1988 and 1993, but the workload was handled by 24% fewer employees. In addition, railway management structures have been pared and organizations have been redesigned from top to bottom.

With extensive mileages of low and medium density track still in their systems, both railways will continue to rationalize their existing networks. Some of this trackage has the potential to be more effectively operated by short line railway companies, if they can operate with lower cost structures. The remainder of this trackage has too little traffic to sustain a short line.

III. Railway Trends: The Shippers' Perspective

Most shippers are facing intense competition, both at home and abroad. They are demanding more efficient and lower cost transportation services from the railway companies. Especially in the resource-based sectors, where transportation costs can be as much as 40% of the delivered price of industry output, railways play a major role in determining the competitiveness of these industries.

Shippers' concerns have been focused largely on the need for preserving competition in rail service because competition provides the market discipline necessary to drive rate and service improvements. The National Transportation Act, 1987 (NTA 1987) strengthened competitive provisions for shippers, giving them additional dispute resolution mechanisms and better access to competing railways. They would not want the competitive access provisions to be weakened or negated, i.e. competitive line rates, final offer arbitration, and interswitching. In the shippers' view, these provisions are a necessary counterbalance to confidential contracts.

Most shippers believe that rail rationalization will inevitably result in less physical plant and that this argues for a strengthening of existing competitive provisions; for example, by harmonizing federal and provincial regulatory provisions respecting competitive access, and by facilitating running rights and effective access by short line railways and U.S. railroads to federally regulated Canadian railroads. Most short line railroads would likely come under the jurisdiction of provincial governments and traffic originating on a provincial railway is not subject to NTA 1987. Provincial short lines could not expand their operations to compete with federal railways since running rights and joint track usage are not available to them without the consent of the railway owning the infrastructure. Also, U.S. railroads face significant barriers to entry because compensation for running rights usually includes a fixed contribution to the capital costs of a line, which could be prohibitive.

Some shippers are concerned that an accelerated pace of abandonment of low and medium density lines could have a negative impact on the competitiveness of their business operations. In some cases, intermodal competition with trucking is not a realistic alternative. In other cases, plants are "captive" to rail as a result of geography or due to the volume of the products to be moved. Sometimes, customer requirements may dictate use of the rail mode, or shippers prefer to use rail rather than the highway mode for safety reasons, because the product is classified in the "dangerous goods" category. Short line railways may be a possible solution in some cases.

IV. Methodology

The research was focused on six manufacturing and processing industries, namely: aluminum, automotive, chemicals, fertilizers, pulp and paper, and steel. These industries, plus wood products, are the largest industrial users of rail transport services. (The wood products industry was not included in the study because it is composed of many small-scale operations, which made it impracticable to collect data on this sector and analyze it within the time allotted for the project.) With the exception of automotive, they are all resource-based industries. Some details on rail freight traffic in these industries are presented in Tables 1 to 8.

A variety of sources were used, including information from Statistics Canada, the Railway Association of Canada and Transport Canada, and "corridor" rail traffic data for 1992 from the major railways (through the auspices of the National Transportation Agency). In addition to these sources, shipper information was received in confidence from individual companies (through their respective trade associations) on establishments that utilize rail services. Also, interviews and discussions were held with representatives from the railways, trade associations, companies and federal officials.

A detailed assessment was conducted for each of the selected industries. A number of factors were considered, including:

- industries' employment and shipments,
- share of establishments' outbound shipments that use rail and other modes of transport,
- share of establishments' inbound shipments that use rail and other modes of transport,
- traffic density of rail lines being used and whether they are main lines or branch lines,
- number and location of firms' production sites,
- location of major markets for goods being shipped,
- volume of products shipped,
- types of products shipped, and
- proximity to and availability of alternative modes of transport.

As stated earlier, the reason for this research was not to analyze the possible discontinuance of any individual branch lines, although the results and background work could be useful for this purpose. Rather, the focus was on assessing the dependence of the six subject industries on the rail mode as a means of transporting goods, both inputs and outputs, and by extension, the degree to which these industries could be impacted by a loss of rail service.

The shipper surveys were conducted on a sampling basis by the respective trade associations. In most cases, the returns encompass over two-thirds of industry shipments. The results were extrapolated to cover the entire industry for each of the six sectors included in the research. No claims were made about the accuracy of the returns.

V. Findings

This section provides a summary of the general results of the industry-by-industry analysis.

- ***Aluminum***

- The aluminum industry is dependent on the availability of rail service.
- Over 90% of the aluminum rail freight traffic (on a tonnage basis) is from origin points in Canada to U.S. destinations.
- About two-thirds of the outbound shipments of aluminum are shipped by rail.
- Over three-quarters of the industry's inbound shipments (such as alumina and chemicals) are transported by rail.
- Many of the aluminum rail shipments travel on medium density lines from remote locations in northern Québec to distant markets in the United States.
- Some aluminum plants are located on branch lines.
- Many aluminum plants do not have good highway access.

- ***Automotive***

- The automotive industry is dependent on rail for the delivery of finished vehicles from motor vehicle assembly plants in southern Ontario to destinations all across North America.
- Approximately 90% of the finished vehicles are shipped by rail.
- Almost two-thirds of the automotive rail freight traffic (on a tonnage basis) is between points in Canada and the United States.
- High density track is used most often, although some automotive parts move by rail on medium density track.
- Trucks are used to bring in most inbound shipments; although rail is used for some essential bulk inputs, such as body metal and plastics.
- Automotive assembly plants are located near excellent highway access.

- ***Chemicals***

- The chemicals industry (especially commodity chemicals) is a major user of the rail system.
- About 70% of outbound shipments (on a tonnage basis) are sent by rail; for example, from Alberta to Ontario or British Columbia, and from plants in Ontario and Québec to the United States and to maritime ports for shipment overseas.
- About 60% of the rail freight traffic (on a tonnage basis) in this sector is domestic; most of the remainder is from origin points in Canada to U.S. destinations.
- Many chemical products, such as sodium chlorate, chlorine, hydrochloric acid, caustic soda, sulphuric acid and benzene, are shipped by rail.
- Except for some shipments to remote locations, such as aluminum plants and paper mills in northern Ontario and northern Québec, most rail shipments travel on high density lines and most plants have good highway access.
- In many cases in this industry, trucking is not a realistic alternative to rail service because of the large volumes and long distances, the type of product (e.g. hazardous chemicals), the specialized equipment needed to carry them, and customer requirements at the receiving end.
- An estimated 80% of the chemicals industry's current outbound rail shipments would not be able to be transferred to trucks.

- ***Fertilizers***

- The fertilizer industry (i.e. potash and chemical fertilizers) is a major rail user.
- About one-half of the rail freight traffic (on a tonnage basis) in this sector is domestic and most of the remainder is from origin points in Canada to U.S. destinations.
- About two-thirds of fertilizer shipments are delivered by rail; mostly from Alberta and Saskatchewan, south to the United States, east to Ontario, or west to Vancouver (for export by water).
- The average rail haul distance in this industry is about 2,000 km compared to about 800 km for trucks.
- Most fertilizer shipments travel on medium or high density track.
- Most fertilizer complexes have good highway access.
- Some of them are located on branch lines.
- An estimated 95% of the fertilizer industry's current outbound rail shipments would not be able to be transferred to trucks because of the large volumes, long distances and specialized handling requirements, and in some cases, for safety reasons.

- ***Pulp and Paper***

- The pulp and paper industry is dependent on the availability of rail service.
- Almost 60% of the rail freight traffic (on a tonnage basis) in this sector is from origin points in Canada to U.S. destinations.
- About one-half of inbound shipments and about one-half of outbound shipments travel on railway lines.
- The outbound shipments comprise mainly of pulp, paper and paperboard sent from remote locations in northern Ontario and northern Québec to domestic markets in Ontario and Québec and to export markets in the United States.
- There is also a sizable amount of product shipped from Alberta and British Columbia to central Canada and to the United States.
- An estimated one-quarter of the industry's inputs are hazardous chemicals, which are shipped by rail.
- Some of the paper mills in northern Ontario and northern Québec are on medium density rail lines and do not have good highway access.
- An estimated 95% of the pulp and paper industry's current outbound rail shipments would not be able to be transferred to trucks because of the large volumes, long distances and specialized handling requirements.

- ***Steel***

- Of the six industries that were studied, the steel industry is the least dependent on rail as a mode of transport.
- About 40% of outbound shipments and about 15% of inbound shipments travel by rail.
- However, the situation varies between companies; some steel companies are very dependent on rail, particularly for inbound shipments.
- Most of the outbound shipments by rail transport in the steel industry consist of steel sheets, coils and bars, and various other steel products.
- The inbound rail shipments comprise mainly of steel scrap, alloys, refractories, lime, acids and other materials.
- Most steel production is in Ontario and Québec, and most of the industry's shipments by rail are to other destinations in Ontario and Québec, or to U.S. customers.
- About 70% of rail freight traffic (on a tonnage basis) in the steel sector is domestic and about one-quarter is from origin points in Canada to U.S. destinations.
- A large part of the industry's inputs (i.e. iron and coal) are shipped by water.
- Most rail shipments in this industry travel on medium or high density lines and most steel plants have good access to other modes of transport.

VI. Conclusion

The findings of this research should be helpful to transportation policy analysts, researchers and others who are involved in the future of the rail network in Canada. All of the six industries examined in the research are major users of the rail mode and could be impacted negatively by a loss of rail service. The consequences would vary considerably from industry to industry and from company to company within each industry.

In these industries, rail transport is often the only cost effective method of transporting goods. Because of the weights and quantities of materials involved, and the long distances travelled, trucking as an alternative mode of transport is not a realistic solution for many companies that use rail services, even if the appropriate equipment were available. In some cases, e.g. certain chemical products, trucking is not a viable alternative for rail because of safety reasons, and in other cases, customer requirements make trucking an impracticable alternative.

An important lesson to be learned from this research is the *strategic* importance of rail in weaving together the industrial fabric of the Canadian economy, especially in the resource-based sectors that ship large quantities over long distances. An example of this inter-industry linkage is the relationship between the chemicals and paper industries, and the railways' role in that. Various hazardous chemicals are used in the paper-making process, such as chlorine or hydrogen peroxide. Not only are most of these materials shipped by rail from chemicals plants to paper mills, but many of the input ingredients to produce these chemicals are also shipped by rail, and a large share of paper companies' outputs (e.g. newsprint) is sent by rail to markets in the United States.

The findings also underscore the dependence of some key industries in the Canadian economy on efficient rail transport services in order to maintain and improve their profitability. Some of these industries (e.g. pulp and paper, automotive, chemicals and fertilizers) are major foreign exchange earners and rely on rail carriers to deliver their products to major export markets.

Table 1

Truck/Rail Market Share: Selected Industries
(Percent, Tonnage Basis)

Industry	Outbound/Inbound	Truck (%)	Rail (%)
Aluminum	Outbound	35	65
	Inbound	20	80
Automotive	Outbound	10	90
	Inbound	85	15
Chemicals	Outbound	30	70
	Inbound	n/a	n/a
Fertilizers	Outbound	35	65
	Inbound (1)	n/a	n/a
Pulp and Paper	Outbound	50	50
	Inbound (2)	50	50
Steel	Outbound	60	40
	Inbound (3)	65	35
All Industries		40	60

Source: Industry Canada estimates based on information from shippers

Notes:

1) Most fertilizer and petrochemical plants are located at the site of the resource. Pipelines are also an important mode of transport for inbound shipments in these sectors.
2) Of the total inbound rail shipments, in the pulp and paper sector, 25% are estimated to be in the "dangerous goods" category.
3) An estimated 60% of the inbound shipments in the steel industry are by water.

Table 2

Rail Freight Traffic: Selected Industries
(Thousands of Tonnes, 1992)

Industry	Domestic Traffic	Canada to U.S. Traffic	U.S. to Canada Traffic	Total Traffic
Aluminum	64	743	2	809
	(8%)	(92%)	(neg)	(100%)
Automotive	1,225	1,292	788	3,306
	(37%)	(39%)	(24%)	(100%)
Chemicals	6,257	3,265	1,310	10,832
	(58%)	(30%)	(12%)	(100%)
Fertilizers	7,508	6,588	518	14,614
	(51%)	(45%)	(4%)	(100%)
Pulp and Paper	4,944	6,956	404	12,303
	(40%)	(57%)	(3%)	(100%)
Steel	2,314	836	179	3,328
	(70%)	(25%)	(5%)	(100%)

Note: Totals may not add due to rounding.
Source: Based on data from the National Transportation Agency

Table 3
Rail Freight Traffic by Origin and Destination: Aluminum
(Percentage Distribution, Tonnage Basis, 1992)

Domestic Traffic

	Destination				
Origin	West	Ontario	Quebec	Maritimes	Total
West	3	neg	--	neg	3
Ontario	1	--	--	--	1
Quebec	1	3	83	10	96
Maritimes	neg	--	--	--	neg
Total	4	3	83	10	100

Canada to U.S. Traffic

	U.S. Destination				
Can. Origin	Central	Northeast	South	West	Total
West	neg	neg	neg	--	neg
Ontario	--	--	neg	neg	neg
Quebec	23	36	40	neg	100
Maritimes	--	--	--	--	--
Total	23	36	40	neg	100

U.S. to Canada Traffic

	Canadian Destination				
U.S. Origin	West	Ontario	Quebec	Maritimes	Total
Central	--	2	24	--	26
Northeast	--	54	4	--	57
South	1	--	16	--	16
West	--	--	--	--	--
Total	1	56	44	--	100

Note: Totals may not add due to rounding
Source: Based on data from the National Transportation Agency

Table 4
Rail Freight Traffic by Origin and Destination: Automotive
(Percentage Distribution, Tonnage Basis, 1992)

Domestic Traffic

	Destination				
Origin	West	Ontario	Quebec	Maritimes	Total
West	2	11	13	2	28
Ontario	30	10	13	9	62
Quebec	2	neg	neg	1	3
Maritimes	2	1	2	2	7
Total	36	22	28	15	100

Canada to U.S. Traffic

	U.S. Destination				
Can. Origin	Central	Northeast	South	West	Total
West	neg	--	neg	--	neg
Ontario	26	11	37	26	99
Quebec	neg	neg	neg	neg	1
Maritimes	--	--	--	--	--
Total	26	11	37	26	100

U.S. to Canada Traffic

	Canadian Destination				
U.S. Origin	West	Ontario	Quebec	Maritimes	Total
Central	11	43	15	1	70
Northeast	--	7	3	neg	10
South	2	11	6	1	19
West	--	neg	neg	--	neg
Total	13	61	24	2	100

Note: Totals may not add due to rounding
Source: Based on data from the National Transportation Agency

Table 5
Rail Freight Traffic by Origin and Destination: Chemicals
(Percentage Distribution, Tonnage Basis, 1992)

Domestic Traffic

	Destination				
Origin	West	Ontario	Quebec	Maritimes	Total
West	52	10	3	neg	65
Ontario	2	12	8	2	23
Quebec	neg	2	6	3	11
Maritimes	neg	neg	neg	1	1
Total	54	24	17	5	100

Canada to U.S. Traffic

	U.S. Destination				
Can. Origin	Central	Northeast	South	West	Total
West	11	4	8	10	34
Ontario	16	15	6	neg	37
Quebec	7	14	8	neg	29
Maritimes	neg	1	neg	neg	1
Total	35	33	21	11	100

U.S. to Canada Traffic

	Canadian Destination				
U.S. Origin	West	Ontario	Quebec	Maritimes	Total
Central	4	5	10	1	19
Northeast	neg	2	2	neg	5
South	7	47	8	1	62
West	6	3	4	neg	14
Total	17	58	23	2	100

Note: Totals may not add due to rounding
Source: Based on data from the National Transportation Agency

Table 6
Rail Freight Traffic by Origin and Destination: Fertilizers
(Percentage Distribution, Tonnage Basis, 1992)

Domestic Traffic

	Destination				
Origin	West	Ontario	Quebec	Maritimes	Total
West	57	14	2	neg	73
Ontario	neg	neg	neg	neg	--
Quebec	neg	neg	1	neg	1
Maritimes	neg	1	2	22	25
Total	57	15	5	22	100

Canada to U.S. Traffic

	U.S. Destination				
Can. Origin	Central	Northeast	South	West	Total
West	70	2	11	16	99
Ontario	1	neg	neg	neg	1
Quebec	neg	neg	neg	neg	neg
Maritimes	neg	1	neg	--	1
Total	71	3	11	16	100

U.S. to Canada Traffic

	Canadian Destination				
U.S. Origin	West	Ontario	Quebec	Maritimes	Total
Central	9	16	2	neg	27
Northeast	neg	1	2	--	4
South	4	28	19	1	53
West	10	4	2	neg	16
Total	23	49	25	2	100

Note: Totals may not add due to rounding
Source: Based on data from the National Transportation Agency

Table 7
Rail Freight Traffic by Origin and Destination: Pulp and Paper
(Percentage Distribution, Tonnage Basis, 1992)

Domestic Traffic

	Destination				
Origin	West	Ontario	Quebec	Maritimes	Total
West	38	1	2	1	42
Ontario	4	12	3	1	20
Quebec	2	10	17	3	31
Maritimes	neg	2	2	3	7
Total	44	25	23	8	100

Canada to U.S. Traffic

	U.S. Destination				
Can. Origin	Central	Northeast	South	West	Total
West	14	5	4	2	25
Ontario	16	7	4	2	29
Quebec	12	17	8	2	38
Maritimes	1	5	1	neg	7
Total	44	34	16	6	100

U.S. to Canada Traffic

	Canadian Destination				
U.S. Origin	West	Ontario	Quebec	Maritimes	Total
Central	1	5	2	neg	8
Northeast	neg	2	5	11	18
South	4	31	24	2	61
West	7	3	3	--	13
Total	12	41	34	14	100

Note: Totals may not add due to rounding
Source: Based on data from the National Transportation Agency

Table 8
Rail Freight Traffic by Origin and Destination: Steel
(Percentage Distribution, Tonnage Basis, 1992)

Domestic Traffic

	Destination				
Origin	West	Ontario	Quebec	Maritimes	Total
West	8	7	1	neg	16
Ontario	27	24	8	2	61
Quebec	2	19	neg	1	22
Maritimes	neg	neg	neg	neg	1
Total	37	50	9	3	100

Canada to U.S. Traffic

	U.S. Destination				
Can. Origin	Central	Northeast	South	West	Total
West	16	neg	3	7	25
Ontario	26	10	20	2	58
Quebec	11	4	1	neg	15
Maritimes	--	1	neg	--	1
Total	53	14	24	9	100

U.S. to Canada Traffic

	Canadian Destination				
U.S. Origin	West	Ontario	Quebec	Maritimes	Total
Central	6	7	2	neg	15
Northeast	1	6	3	1	12
South	23	30	9	1	63
West	8	1	1	--	10
Total	38	45	14	3	100

Note: Totals may not add due to rounding
Source: Based on data from the National Transportation Agency

ECONOMIC AND FINANCIAL ASPECTS OF BUYING AND OPERATING SHORT LINE RAILWAYS IN CANADA

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I. Introduction

This paper is based on background research done by KPMG for Industry Canada on the subject of short line railways in Canada. The purpose of this work was primarily to examine the economic and financial structures of the short line industry in Canada, as well as some other competitiveness factors affecting the performance of short line railways. The results of this research are intended to help potential investors, including shippers, who are interested in acquiring track, that might otherwise be abandoned, and in forming a short line railway company. The views expressed in this paper are those of the authors and do not necessarily reflect the views of Industry Canada.

Short lines can sometimes be a viable alternative to loss of rail service. Short line railways are often better able to focus their marketing efforts on specific local customers. Also, because they usually employ fewer workers doing many different tasks, and at a lower base wage and benefit level, short line railways can operate with a lower cost structure than main line railways. This permits them to successfully run previously unprofitable lighter density lines.

While there is no generally accepted definition of short lines in Canada, they are usually short segments of lighter density railway whose primary function is to be a feeder to main line carriers. In the United States, short lines are defined as railways with less than 350 miles of track and less than US $40 million in annual revenues, and regional railways as those with 350 miles or more of track and earning between US $40 million and $250 million annually. For purposes of our discussion, a Canadian short line railway is defined in this paper as any railway that is not a Class I railway: CP Rail System, CN North America and VIA Rail are the Class I railways in Canada. This definition includes some regional railways (e.g. BC Rail) and terminal/switching operations (e.g. Essex Terminal Railway).

The next section in this paper provides a short overview of short lines in Canada and the United States. Sections III and IV describe, respectively, some of the institutional and legislative issues, and economic and financial factors, that are relevant to Canadian short line railways. The process of selling and buying a short line, and the key success factors for operating a profitable short line railway company in Canada, are outlined in Sections V and VI. A summary and conclusions are presented in the final section.

II. Growth of Short Line Railways in North America

In the United States, the short line industry grew quickly in the 1980's as main line carriers rationalized their networks. Over half of the 450 independent short lines and regional railways in the United States were formed since implementation of the Staggers Act in 1980. Since then, at least 265 new short lines and 13 new regional railways were created in the United States. About 25% of U.S. rail trackage (some 44,000 miles) is no longer operated by Class I carriers. Some entrepreneurs own several rail lines. For example, RailTex owns 24 short lines in many geographic regions, including two in Canada.

Short lines have not developed at the same pace in Canada, although activity has increased recently. They were slow to start following implementation of the National Transportation Act, 1987 (NTA 1987). However, since 1992 seven new lines have been formed and Algoma Central Railway was recently purchased by Wisconsin Central. In addition, potential operators and investors have shown an interest in pursuing other short line opportunities.

For discussion purposes, short lines in Canada are classified in this paper under two broad headings: historic short lines and new short lines. Table 1 lists the historic short lines operating in Canada. These railways operate in Nova Scotia, Labrador, Quebec, Ontario, Manitoba and British Columbia. They handle a mixture of products, including coal, forest products, sulphur, chemicals, petroleum, mining products, grain, manufactured goods and intermodal traffic. At least four of them also handle passenger traffic (i.e. Algoma Central, Ontario Northland, BC Rail, and Quebec North Shore and Labrador Railway).

Table 2 lists the new Canadian short lines created since 1986. These short lines carry a range of commodities and are located in seven Canadian provinces. Some of Canada's most recent short lines have been acquired by Canadian interests (e.g. Société des chemins de fer du Québec and New Brunswick Southern Railway). Others are operated by U.S. firms (e.g. RailTex and Iron Road Railways).

Table 1
Historic Short Lines in Canada

Short Lines	Location
Algoma Central Railway (Wisconsin Central)	Ontario
Arnaud/Wabush Lake Railway	Quebec
Asbestos and Danville Railway	Quebec
British Columbia Railway	British Columbia
Devco Railway	Nova Scotia
Essex Terminal Railway	Ontario
Greater Winnipeg Water District Railway	Manitoba
Napierville Junction Railway	Quebec
National Ports Corporation	Quebec
Ontario Northland Railway (and Nipissing Central)	Ontario, Quebec
Quebec North Shore and Labrador Railway	Quebec, Labrador
Quebec Cartier Railway	Quebec
Roberval and Saguenay Railway	Quebec
Romaine River Railway	Quebec
Southern Railway	British Columbia
Thurso and Small Nation River Valley Railway	Quebec

Note: Includes some regional and terminal railways.

Table 2
New Canadian Short Lines

Short Lines	Formed	Location
Central Western Railway	1986	Alberta
Port Stanley Railway	1988	Ontario
Southern Rails Cooperative	1990	Saskatchewan
Goderich & Exeter Railway (RailTex)	1992	Ontario
Cape Breton & Central Nova Scotia (RailTex)	1993	Nova Scotia
Grand Forks Railway Company	1993	British Columbia
Société des chemins de fer du Québec	1994	Quebec
Windsor & Hantsport Railway	1994	Nova Scotia
Canadian American Railroad Co.	1995	Quebec
New Brunswick Southern Railway	1995	New Brunswick

III. Institutional And Legislative Issues

Institutional and legislative issues can have a significant impact on the success of a short line. Some of the Canadian historic short lines and all of the new short lines are regulated by provincial instead of federal rail legislation.

A. Federal Legislation

NTA (1987) contains provisions for the establishment of short line railways. A railway owner may sell track to anyone authorized to run a railway and a railway may offer to purchase a line proposed for abandonment by another railway. Both transactions require approval by the National Transportation Agency. CN Rail requires Federal Cabinet approval prior to transferring a line.

The following outlines relevant provisions of NTA (1987):

- Section 158 permits a Class I carrier to sell, lease or transfer a rail line to any other company, whether within the legislative authority of Parliament or not, without an abandonment proceeding. The National Transportation Agency must approve the conveyance agreement unless it determines that the agreement is not in the public interest or the short line is not authorized to operate the line.

- Section 174 requires the National Transportation Agency to permit the sale or lease of a branch line, for which an abandonment application has been received, to another company authorized to operate it unless the Agency determines that it is not in the public interest to do so. In ordering such a transfer the Agency can, if necessary, determine the price to be paid (not less than net salvage value).

- Both Sections 158 and 174 state that the railway company which conveyed the line shall not have any obligations under the National Transportation Act in respect of operation of the line unless it resumes ownership or control; that the short line assumes all legal obligations for the line, including agreements with VIA Rail if such agreements exist; and where the short line is not within federal jurisdiction, then the obligation of being "for the general advantage of Canada" is removed, as long as VIA Rail does not operate on the line.

Plans are underway to streamline NTA (1987) to encourage the transfer of uneconomical branch lines to short line operators, thus reducing costs to the main line railways, while retaining the competitive access provisions for shippers.

B. Provincial Legislation

Table 3 highlights the current status of relevant provincial regulations regarding short lines. Many of them are outdated and are under review. Some provincial governments have passed legislation specifically for the establishment of short line railways in their province. Prospective operators must file a certificate showing that their company complies with all safety requirements. In many provinces, federal safety norms are applied to provincially-regulated short line railways.

C. Labour Issues

Improved labour productivity has been an important factor in the success of many U.S. short lines. Labour expenses, including wages, fringe benefits and pensions, can comprise up to 50% of a main line carrier's operating expenses. Average labour rates in the Class I rail industry are the highest in the transportation sector. In addition, some labour contracts do not allow a lot of flexibility in work rules. To be successful, many short line operators claim that they need the advantage of lower wage rates and more flexible work rules.

Some unions are concerned that creation of new, independent short lines could mean a loss of jobs for their members. Therefore, they are sometimes prepared to be more flexible with short line operators. The conclusion of two recent negotiations, involving the Algoma Central Railway and the Goderich & Exeter Railway, included changes to work rules and lower pay scales.

CN announced in March 1995 that it had reached an agreement in principle with its unions to set up an "internal" short line in northern Quebec. When the agreement is ratified, the 1,855 kilometre internal short line will operate as a semi-autonomous profit centre, using CN infrastructure and equipment. The employees will operate under flexible work rules and new remuneration policies (i.e. change from mileage to hourly based pay and a gain-sharing program).

Successor rights is a key issue for some potential short line operators. Their ability to negotiate new contracts with workers is affected by successor rights, i.e. the legal requirement that pre-existing labour agreements apply to the new employer. The intent of successor rights is to protect employees from ownership changes that circumvent existing collective agreements. (These rights are provided in the Canada Labour Code.) Some provinces have enacted labour laws providing for successor rights when an enterprise shifts from federal to provincial jurisdiction (i.e. British Columbia, Saskatchewan and Ontario). Some railways and potential short line operators believe that this application of successor rights could have a dampening effect on the growth of short lines.

Table 3
Provincial Legislation for Short Lines

Province	Current Status of Provincial Legislation
British Columbia	Railway Act of British Columbia of 1979. Operating certificate outlines sections of the Act that apply to short lines. Authority to operate is obtained from the Minister of Transportation and Highways. BC Rail comes under this Act.
Alberta	Railway Act of 1980. The Act is under revision. The Central Western Railway was incorporated under a special act and the government of Alberta contracts with the federal government for safety inspections.
Saskatchewan	Railway Act of Saskatchewan of 1989. It is a comprehensive railway act. Short lines request an operating authority certificate from the Minister of Transport. The Southern Rails Cooperative is governed by this Act.
Manitoba	Manitoba Railway Act of 1990. It was first enacted in 1913 and little change has been made to it since. New legislation is currently being drafted.
Ontario	Railway Act of 1950. It is not well suited to short lines. New railways that operate in Ontario do so under the auspices of the Ontario Municipal Board (e.g. Goderich & Exeter Railway).
Quebec	Railway Act of 1991 and Land Transportation Safety Act. New short lines must be incorporated by a special act passed by the National Assembly. The Quebec Railway Act is currently being revised.
New Brunswick	Shortline Railways Act of 1994. It governs operation of short lines.
Nova Scotia	Nova Scotia Railway Act of 1989. Minor changes may be made in 1995.

IV. Economic And Financial Aspects

This section compares the economic and financial aspects of short line versus main line railway operations. While the specific situation of every railway company is obviously different, most short lines share some common characteristics; the same can be said for the Class I railways.

A. Economic Factors

Among the most important economic factors that a prospective short line operator must consider are: likely traffic volumes in the future, the threat of competition, and the availability of capital.

1) Realistic Traffic Assessment

Probably the most important factor for a short line's success is an adequate traffic base; yet this is a difficult one for many potential short line operators and investors to estimate. A realistic assessment of future traffic is an absolute necessity before proceeding towards acquisition of a short line.

The potential operator or investor needs to consider several factors in order to judge future traffic levels, such as:

- realistic documentation of shipper support, including their use of rail in the recent past;
- commodity analysis of traffic that could move over the line considering the demand outlook for each commodity, its susceptibility to competition from other commodities, other locations and other transportation modes, and the likelihood and impact of a downturn in demand for each commodity; and
- threats and opportunities specific to the line in question, such as the likelihood of temporary or permanent plant closures, labour disruptions at shippers' sites, intramodal and intermodal competition, expanded output by existing shippers, and the chance of additional traffic.

2) Intramodal and Intermodal Competition

Major railways are most successful and competitive at long haul movements of bulk commodities. For shorter hauls, especially of non-bulk commodities, they face strong competition from trucks. Short line railways also face competition from trucks, depending on the commodity carried. Their lower cost structure and generally better service make short lines better able than major railways to compete against trucks for branch line movements.

Some short lines face competition from marine carriers. For example, the Goderich & Exeter Railway carries some 10% of the total salt traffic from Goderich; the other 90% is carried by water. For bulk movements of low value, non-time sensitive commodities located close to port facilities, marine carriers often have a competitive advantage.

Short lines may also face competition from other railways. For commodities that can move over the road, especially in trailers or containers, the connecting Class I carrier may attempt to bypass a short line by collaborating with truckers for the short haul movement. Short lines need to work out agreements to ensure that the marketing efforts of connecting carriers are supportive, rather than opposed to the short line's interests. Also, depending on location relative to other railways and the competitive access provisions of the National Transportation Act, shippers might be able to obtain a competitive line rate from another railway, or be eligible to have traffic interswitched to another railway.

3) Capital Requirements

The size of the property to be acquired and the types of assets to be owned by a short line, versus leased or contracted on a short-term basis, will determine the capital requirements for a short line railway. A short line's capital requirements will include the following items:

- transaction price to acquire the track and roadway, buildings, and other assets from the selling railway;
- equipment such as trucks and cranes, as well as spare track material to maintain the track and roadway;
- when the company is ready to begin operations, it will need an infusion of start-up capital to ensure an adequate cash flow;
- in addition, a short line will need access to a pool of working capital to cover the ordinary fluctuations in its cash flow; and
- cost of any rolling stock that it may own.

Short line operators may acquire capital from a variety of sources, such as:

- Senior Debt - Financing of short line railways is still a relatively new phenomenon for Canadian lending institutions. A first choice may be to approach Canadian Schedule I banks with exposure to similar financing opportunities through their U. S. based subsidiaries. Alternatively, U. S. banks operating in Canada are another source. Companies could also approach specialized term-lending institutions.

- Unsecured Debt/Equity - Venture capital groups have supported recent Canadian short lines. They require a high return on their equity contributions. If management wishes to retain a controlling share of the company, they should approach potential groups that specialize in taking minority stakes in companies.

- Management Equity Contribution - As in all types of acquisitions, the management group must make some type of equity investment. This is required in order to prove to lenders and other investors the extent of their commitment to the commercial transaction. Management is usually offered shares at a discount value compared to outside investors.

- Government Funding - Assistance may be available from federal, provincial or municipal governments.

B. Financial Comparisons

Table 4 compares typical income statements for Canadian versus American Class I and short line railways. These profiles were prepared by KPMG based on their extensive experience with the railway business in Canada. To facilitate comparisons, revenues and expenses are expressed as a percentage of total operating expenses.

The table shows that short lines are able to achieve a lower operating ratio than main line carriers (total operating costs as a percentage of revenues). While operating ratios will vary from year to year for any company, the ratios in the table may be considered broadly representative. The table also demonstrates that the labour cost component (including pensions and benefits) for short lines is a considerably lower proportion of total expenses than for Class I railways.

The revenue and cost components of Table 4 are discussed in more detail below.

1) Revenues

Most moves handled by Canadian Class I railways originate and terminate at locations they serve; in other words, the same railway handles the entire haul. Some short lines also handle shippers' entire hauls from rail origin to rail destination. This gives them the advantage of being fully responsible for setting rates and collecting all the revenue. Other short lines, on the other hand, depend on their connecting carriers for all of the traffic that originates on the short line. Many short lines fall somewhere between these two extremes.

Table 4
Financial Comparison (% of Operating Expenses)

	Class I		Short Line	
	Canada	**U.S.**	**Canada**	**U.S.**
Revenues	111	118	120	125
Operating Expenses				
Transportation:				
Crew Labour	18	14	10	n/a
Fuel/Power	10	7	10	9
Others	9	17	2	n/a
Subtotal	37	38	22	38
Equipment	22	21	24	20
Ways & Structures	15	12	20	14
Depreciation	7	9	7	7
General & Administration	19	20	27	21
Total Operating Expenses	100	100	100	100
Ratios:				
Labour Costs/Operating Expenses	47	44	24	39
Operating Expenses/Revenues	90	85	83	80

- **Revenue-Sharing with Connecting Carriers:**

Where short lines exchange traffic with a connecting carrier, the shipper is usually billed one rate for the entire haul (i.e. a joint rate). Thus, the short line and connecting carrier need to agree to a method for sharing the revenue. There is no universal rule governing the procedure for sharing revenues between a short line railway and the main line carrier to which it connects. Relative length of haul (i.e. the portion of the move handled by the short line expressed as a percentage of the total trip distance) is an important factor. Other factors will also have an important bearing on the results, such as:

- the fact that work performed by the short line railway (i.e. way freight/switching operations on low density lines) is inherently costly and would be avoided by the main line carrier;
- the main line carrier's need to cover costs and achieve a worthwhile contribution;
- responsibilities for car supply (main line vs. short line carrier); and
- duties performed in customer servicing, promotion/marketing, billing and revenue settlements (main line vs. short line carrier).

Ultimately, division of revenues would result from negotiations in which each party weighs the relevant factors and seeks to achieve a favourable result.

- **Interline Agreements with Other Carriers:**

Revenue-sharing agreements are only one part of a comprehensive interline agreement that short lines must negotiate with their connecting carriers. Other aspects for negotiation include the following:

- revenue settlements - the procedure for agreeing on how to settle each railway's total revenues for a given period (e.g. on a bi-weekly basis);
- car supply - many short lines depend on the main line carrier to supply railway cars and agreement is needed to ensure that an adequate car supply at agreed-upon rates is available to the short line;
- repairs - many short lines depend on the services of their connecting carrier on an as-needed basis to repair rolling stock or infrastructure;
- procedures for inspecting and handling cars between railways at the point of interchange; and
- financial and operating arrangements (which may include performance measure stipulations) for other contracted or shared services, such as plowing snow or controlling vegetation.

2) Operating Expenses

The major categories of operating expenses are discussed below.

- **Transportation Expenses:**

Transportation expenses include wages for train crews, fuel expenses, and other costs incurred to direct the movement of trains, including the operation of yards where cars are switched and trains made up, communications between train crews and dispatchers, and other signalling costs.

Both in absolute terms and as a percentage of revenues, short lines incur lower labour costs for ***train crews***. Short lines often employ two-man crews, whereas many Class I train runs are operated by three-man crews in accordance with collective agreements. In addition, operating practices employed at short lines are generally more flexible. Short line operating employees are usually paid somewhat lower wage rates than their Class I counterparts.

Fuel expenses in the U. S. are generally lower than for Canadian railways, due mainly to taxes applied by federal and provincial governments. Fuel costs are proportionately slightly lower for short lines than for Canadian Class I carriers. This may be because only the Class I railways and BC Rail operate in mountainous terrain, which impacts heavily on fuel consumption.

Other transportation expenses are significantly lower for short lines. Many short lines and potential short lines are unsignalled, and communications between the train crew and dispatch is infrequent and inexpensive. Main line carriers, on the other hand, have elaborate communications and signalling networks to guide the movements of hundreds of trains daily, and to ensure safe operations where several trains operate over the same track.

- **Equipment Expenses:**

Equipment expenses include the cost of railway cars and locomotives. When expressed as a percentage of operating costs, equipment expenses are similar for Class I and short line railways. However, the nature of the costs is quite different. Class I railways own and maintain the majority of cars in their fleets, and operate much of the remainder of their fleet under medium to long-term leases. Some short lines also own their own cars, usually where the short line has a high degree of intraline traffic. Most short lines, however, do not own or lease any revenue-generating cars. Instead, they pay a "per diem" charge to the connecting carrier for the duration that the connecting carrier's cars are on the short line's track.

- **Maintenance of Ways and Structures:**

Class I carriers carry out their own maintenance of ways and structures. They own large, specialized equipment, which is kept busy over their large route network. Thus, while maintenance is a significant ***operating*** cost, Class I railways also incur large ***capital*** costs for maintenance equipment and capital improvements. The operating costs of ways and structures is relatively higher for short lines because almost all of the short line's costs in this category are incurred as operating, rather than capital costs. Most short lines do not own specialized maintenance equipment, nor a large workforce of maintenance employees. The minimal length of short lines is insufficient to keep specialized maintenance equipment and track forces busy for long periods. Most short lines contract out a large portion of their track maintenance requirements. Depending on the nature of the requirement, short lines may contract with their connecting carrier or with local contractors.

- **Depreciation:**

Class I carriers have a wide range of assets that depreciate, including track and related structures, buildings, signals and communication equipment, rolling stock, and work equipment and roadway machines. Newer, and thus more costly, equipment owned by U.S. railways likely explains the higher depreciation charge for U.S. versus Canadian Class I railways. Short lines typically have a much narrower asset base to depreciate. Depending on the property, the track and related structures may be the only significant capital asset to depreciate.

- **General and Administrative Expenses:**

Short lines normally have a lower level of general and administrative expenses than Class I railways, as their operations are simpler and easier to administer than the large railways. In the case of a branch line formerly operated by a Class I railway, and subsequently turned into a short line, the administrative costs per tonne of freight handled should be lower for the short line. Nevertheless, administrative costs can be relatively high for short lines, when expressed as a percentage of operating expenses. Because of flatter management structures, the costs associated with short line administration can vary significantly, depending on whether they are assigned to "administrative" or "functional" areas. Aside from salaries and benefits for administrative personnel, short lines may incur administrative costs in areas such as insurance coverage, outside services (including audit, legal and other professional assistance), property taxes and utilities, travel and communication costs, and office expenses.

V. The Process of Selling a Short Line

These are the steps that are usually followed in selling a short line:

- **Preliminary evaluation of opportunities.** The Class I carriers continually evaluate their options for rationalizing railway infrastructure. Options include offering alternative service such as intermodal operations, branch line abandonment or the short line alternative. Potential short line operators can conduct their own preliminary evaluations.

- **Information package on potential short line.** Once the Class I carrier decides that a short line is an option, it prepares an information package containing a detailed description of the physical plant, traffic and revenues.

- **Potential short lines submit a proposal.** Based on the information package, interested bidders submit a proposal. This proposal generally includes a business and operating plan and the proposed terms of sale.

- **Selection of short list candidates.** The Class I carrier selects the short list candidates with which to conduct further discussions. These candidates can inspect the line and are provided with further information on the operations and finances of the line.

- **Selection of final candidates.** Several factors are taken into consideration in the selection of the final candidates, e.g. interest in the line, business plan, financial backing, railway experience, and willingness to work with the Class I carrier to protect and generate future traffic. The short line candidates conduct their own pre-feasibility studies.

- **Comprehensive evaluation by final candidate.** The final candidate is allowed to talk to shippers and conducts due diligence investigations. The due diligence work includes labour negotiations, financing, interline agreements, car-hire agreements, and discussions with shippers.

- **Regulatory approval.** The potential short line operator will likely have to deal with the National Transportation Agency, a provincial regulator and several other interested bodies before final approval is attained.

- **Final sale negotiations.** Drawing together all of the above aspects of the sale, the short line candidates and the Class I carriers negotiate the final sale of the line, make all required announcements, and arrange for transfer of operations.

VI. Key Success Factors In The Short Line Industry

The extensive experience with the short line industry in the U.S. over the last fifteen years and the more limited developments in Canada provide insights into the key success factors required for the viable operation of a short line. The following important factors should be considered in the evaluation of every short line opportunity.

- **Adequate Revenue Base**

The first requirement for success is to have an adequate traffic base and the potential for generating a reasonable level of revenues. No short line can succeed without a traffic level and revenue base that can cover the costs of operating, maintaining and financing the line. The potential short line operator should know the history of the line and the trends it has experienced. If traffic has been declining, it is important to determine in advance whether the decline was due to changes in shippers or their financial position, losses to competitive modes or neglect on the part of the main line railway. Traffic losses due to the first two factors are difficult to curtail; trends in the third area can represent opportunities for short lines.

- **Critical Evaluation of the Rail Plant**

Another key success factor is an accurate evaluation of the condition of the physical plant and an estimation of the required rehabilitation and ongoing maintenance costs. Inadequate consideration of the rail and tie condition can lead to derailments and slow orders. Slower speeds result in higher crew wages, inefficient use of equipment and reduced service levels. Future rehabilitation requirements should be considered in the short line's capital plan.

- **Experienced Management**

A solid management team is a third requirement of success. Effective management of a short line railway requires adequate control over costs, track, equipment, employees and record-keeping, and the ability to maintain good relations with shippers and with the connecting railways. Sound background knowledge in the railway field is essential. The management of short lines will vary depending on the size of operation, relative skills of the proposed owner, and the nature of operations. In most cases, the management team should be composed of "lean" and highly productive entrepreneurs.

- **Adequate Capital and a Good Capital Plan**

Another success factor is adequate sources of capital and a good capital plan. The purchase price of physical plant and equipment, start-up costs, working capital and rehabilitation costs should be carefully considered. Lines may be purchased at net salvage value (e.g. lines considered for abandonment) or at fair market value (e.g. lines sold as a going concern). Before a sale transaction occurs, debt and equity funding must be fully in place. Outside investors will carefully review the short line's business plan and management skills before providing capital.

- **Lower Operating Expenses**

Lower operating expenses (primarily labour costs) are an important potential advantage for short lines. Greater flexibility in the use of labour, the ability to pay wages based on local levels, the use of part-time labour and contracting-out can reduce operating expenses. Efficient operation of light traffic lines may require that individuals perform a number of different tasks, such as train operations, equipment maintenance, office work, and track work. In the United States, many short lines include profit sharing in the compensation package to encourage high performance and productivity from their employees.

- **Interline Agreement**

The cooperation of major carriers is an important success factor for short line railways. Interline agreements dealing with matters such as overall rate-making, rate divisions, car supply, revenue settlement, interchange rules and major equipment repair are essential. Experience indicates that interline agreements should be comprehensive and completed in advance of the new short line's start-up. The Class I railways are usually prepared to negotiate an interline agreement in advance, but the terms and conditions of the agreement should be considered carefully. Satisfactory interline agreements will greatly reduce the short line's risk of failure.

- **Sound Business Plan**

The potential short line operator should conduct its due diligence work and prepare a sound business plan. The business plan should include an operating plan, a financial evaluation and a capital plan. The short line operator should carefully consider the downside risks and have a plan to deal with unexpected events (i.e. a contingency plan and reserve capital).

VII. Summary and Conclusions

Since 1986, Canada has witnessed the creation of at least ten new and successful short lines, operating in seven provinces from coast to coast. Network rationalization by the main line carriers will probably accelerate over the next few years, presenting many additional excellent opportunities for potential short line investors and operators. Both major railways are actively cooperating with new short line ventures and they are eager to create additional "win-win" situations. Proposed legislative changes will streamline the regulatory process for the creation of short lines from former Class I rail lines.

New short lines can be created in all regions of the country. Some lines will move a few key commodities like grain, while others will have a more diverse traffic mix. This paper described some of the economic, financial and institutional aspects of buying and operating a short line railway in Canada. By applying the key success factors to prospective purchases, many more successful, vibrant short line railways can emerge in Canada, preserving and providing new jobs, as well as profitable and efficient rail transportation services.

Re-examining Government Policies with Respect to Short Line Railways

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INTRODUCTION

This paper sets out the need and rationale for short line railway development in Canada, contrasts Canadian progress with that in the U.S., and identifies some of the real and perceived impediments relative to provincial and federal government roles. It comments on potential future direction within the context of the Nault Task Force report.

A short line railway , sometimes referred to as a feeder railway, is an independent company which takes over a line, typically less than 500 k.m. in length, that a major carrier no longer wants to operate. [1] Alternatively, a short line can be a flexible subsidiary of the Class 1 railway, where the work rules may be adjusted to allow for better utilization of the workforce, thus not requiring the sale of the track to a private investor. It has been demonstrated that short line railways can be viable alternatives to abandoning lines in many situations. They can preserve low density line service because (unlike the national railways), they operate with small, flexible workforces. As a result, their overall operating costs are low. Short lines allow for the Class 1 railways to do what they do best - move large blocks of cars long distances without being concerned about the needs of small or remote shippers. The short line railways are then able to do what they do best - provide personal, individualized services for smaller shippers.

Since the passage of the *National Transportation Act*, 1987, the law has allowed for third parties to acquire segments of railway land and infrastructure slated for abandonment, or by way of a transfer independent of abandonment, and maintain services through short line operations. Yet, there has not been a proliferation of short line railways in Canada since the *NTA*, 1987 came into effect. So why re-examine government policies with respect to short lines? Why now?

* The views expressed are those of the author and not necessarily those of the Ministry, nor her colleagues, whose constructive criticism is gratefully acknowledged.

Throughout the past couple of years, the CN and CP have repeatedly stated that they must improve their revenue situation by lowering operating costs because the other alternative- to raise freight rates - is not a realistic alternative in today's competitive marketplace. There have been and remain concerns about the potential abandonment of rail lines, yet to be competitive, in both the continental and global marketplaces, CN and CP seem to have no choice but to shed their uneconomic feeder line operations. According to the Railway Association of Canada, the Class 1 rail network is too large for the current workload. This is especially true in Eastern Canada, where about 90% of the traffic is handled on about 40% of the network.[2] At the same time, CN and CP's operations along key corridors can be supplemented by the traffic generated by connecting short line railways where cargo volumes are adequate for the smaller carriers to be profitable.

Are short line operations across Canada to be an important factor in our national railways' competitive survival? Assuming that this is so, it is important to examine if government policy at the national level is actually facilitating the development of short lines in Canada, what obstacles are in the way, and what changes can be made.

Why Short Lines? Why Now?

For the Canadian railway industry to reduce its costs and be competitive in both the continental and global marketplaces, the Class 1 railways, CN and CP, do need to shed uneconomic, low density branch line operations. Both railways have stated their intention to abandon or sell to short line operators 25% of their combined 21, 120 k.m. network in Eastern Canada by the end of 1995.[3] Canada is a country rich in resources and manufacturing, and much of its railway track is in good condition, making conditions very favourable, some say even more favourable than conditions were in the U.S. in the 1980's, for successful short line operations.[4] However, more than quality track is required to make a successful short line operation; there has to be sufficient volume on the line. The major railways have been slow, until recently, to aggressively pursue the short line option. Now, CN's vision of the future is seen as that of a core line from Halifax to the Pacific Coast ports, with short line "feeder" networks that will supply CN with locally generated traffic. CP has also stated its intent to concentrate on its "core" business.

National legislation has been in place since 1987 to allow for the development of short lines. All levels of government must work together with the railways to facilitate short line creation because short lines can address the needs of not only the railways, but of all levels of government, and most importantly, Canada's shippers. Perhaps it is time to re-think the philosophy behind the *Constitution Act* of 1867 allowing the Parliament of Canada to declare only some short line railways as being to the "general advantage of Canada". Under Section 92(10) of the *Act*, most

provincial short lines are subjects of exclusive provincial legislation because they are not **"..railways ...connecting the Province with any other or others of the Provinces, or Extending beyond the limits of the Province"**.

A seamless and integrated rail network which includes short lines across Canada, with standardized operating and safety procedures would be to the general advantage of Canada by improving this trading nation's ability to move exports and imports to market.

Until the passage of the *National Transportation Act*, 1987, legislation did not permit CN and CP to sell a line until they had applied and received permission to abandon it. Often, this requirement prevented any short line entrepreneur from acquiring the line until all of the business along the line disappeared completely.

The *National Transportation Act*, 1987 contains provisions for the establishment of short lines prior to the abandonment of the line. Section 158 of the *Act* permits the railways to convey instead of abandon. Two parties come to an agreement, and then, for thirty days, public input is sought by the National Transportation Agency. The applicant has ten days to respond to that input. Section 174 of the *Act* permits a short line operator to buy a line which the Class 1 railway has applied to abandon. It is a requirement that the buyer be a short line "company" before the line can be purchased. A price for the line can be set by the National Transportation Agency. A short line purchaser can still purchase a former railway line after the Class 1 carrier has abandoned it, however, in such instances, the sale is outside of the National Transportation Agency's jurisdiction.

The proceeds from branch line sales are not in themselves lucrative. Most are sold at "net salvage value", which is the value of the steel rails, ties and ballast once the cost of removing the track is subtracted. An appropriate consideration for the value of railway lands may also influence the selling price. The going rate is between $7, 500 and $9,500 per kilometre ($12,000 and $15,000 per mile)[5]

But the sale of lines to short line operators, willing to work in partnership with the Class 1's can supplement Class 1 operations by maintaining traffic and tapping new potential on branch lines along key corridors where the economies of scale are poor for the Class 1's. Short lines serve as feeder lines to the Class 1's main lines, funnelling freight business to them that otherwise would be lost if the track was closed. Partnership arrangements with short line operators allow Class 1's to concentrate on high volume, main line freight activity because this is where the Class 1's comparative advantage is; it is what Class 1's can do best.

To work successfully in partnership with Class 1 carriers, short line operators require, among other things, adequate traffic density, often achieved through a highly diversified base of different commodities. The traffic base can be one of a few commodities which have a high, stable market. The traffic base can also be composed of a few major commodities whose traffic cycles offset each other, resulting in traffic density stability on an annual basis.. A short line is not likely to be successful relying on seasonal traffic, or a single shipper or industry. It is usually better to have access to more than one connecting Class 1 partner as this can give the short line competitive leverage in accessing rail cars and the ability to offer its customers competitive routings. Multiple connections increase shipper access to additional markets or inbound freight origins, which can increase short line traffic density. All this translates into higher traffic levels and increased profits for the short line.

The relationship between a short line and the Class 1 carrier is truly a partnership where both sides cooperate to receive some benefit from the "feeder road" relationship. Short lines depend on Class 1's to originate their inbound traffic and deliver outbound commodities, so a good working relationship is critical to a short line's success. Uncooperative Class 1's can deny market access through switching charges, or joint rates, or fail to supply equipment.

The short line entrepreneur must also form a working relationship with employees on the line to run an efficient operation. Labour flexibility is a necessity for successful short line operations. Employees benefit from working close to home and seeing the value of their work for their customers with whom they maintain close relations.

To be successful, a short line operation also requires experienced management, ideally with prior railroad operating experience and some knowledge of the marketing of the commodity that is on the short line, in order to be able to understand shippers' distribution and marketing problems. The short line operator also needs access to adequate capital. Access to capital is necessary to allow management to acquire necessary locomotive power, and to immediately address any existing track quality problems as a result of deferred maintenance by the previous owners. With adequate access to capital, the short line can offer a high quality of service that will maintain existing business and attract new traffic.

Government assistance may be essential to a short line operator's survival and expansion. Without government guarantees, lenders may be reluctant to give the short line operator money to rehabilitate the infrastructure. Governments have a public policy interest in preserving rail services. Short lines can preserve services in smaller communities, and keep rail shippers in these smaller communities, to preserve local jobs. They can preserve rail lines for future development whereas if

the tracks are removed, they are unlikely to ever be put back in. Short line railway services can help to keep traffic off Canada's highways, cutting pollution, congestion and highway repair costs. Most importantly, short line operations can offer Canada's shippers the personalized services that they require to efficiently export their goods in the continental and global marketplaces, making Canada a more competitive trading nation.

Short lines are flexible enough to adjust their services to handle the number of loads on the line, and supply custom solutions to customers' logistical problems. Most customers along the branch and secondary lines have endured a period of "service deterioration" from a Class 1, leaving them with the perception of rail service and the railways as slow, undependable, unpredictable, and unresponsive. Short line operators who are closer to the customers, offering tailored services can reverse these imbedded perceptions of rail service. With short line operators, shippers manage to avoid dealing with the large bureaucracies of the Class 1 roads and benefit from more responsive service. Short lines, then, can attract new businesses to the line or to the rail mode. The short line general manager is approachable, and with the flexibility afforded short line railways, can design schedules, rates and other services to each customer's needs. To a short line operator, a small company is thought of as a big customer.

Analysis of the Development of Short Lines in Canada

The regulatory environment for the formation of short lines is more restrictive in Canada than in the U.S. The Canadian process is time consuming, involving both federal and provincial regulatory bodies. There is no harmony between federal and provincial rail legislation in many provinces. In some provinces, the laws governing short lines are non-existent or outdated. This uncertainty surrounding short line sales unnerves shippers on the line, sometimes causing them to shift to an alternative mode, and thereby depriving the short line of key customers before the sale is finally approved. In the U.S., by contrast, a railway may simply notify the regulator a week in advance of transferring ownership of a branch line.

Short line railways have been successful in the U.S., and have helped increase the traffic density of the U.S. Class 1 railways. The *Staggers Act* and the *Motor Carrier Act* of 1980 increased competition within the rail industry and between the railroads and motor carriers. In this new, competitive environment, Class 1 railroads adopted a cost reduction strategy to maintain profitability. The sale of branch lines to short line operators was part of that strategy. Since 1980, 263 new short line and regional railroads have been created. There are now over 450 short line and regional railways operating in 50 states. These railways operate almost 70,000 kilometres of track.[6] The peak year for short line creation in the 1980's was 1987, when 46

short lines were formed and 6,674 miles (10,740 kilometres) of rail line were transferred to short line operation.[7] It is important to note that federal transportation policy also stimulated the formation of short lines. Three pieces of legislation, the *3R Act*, 1973, the *4R Act*, 1976 and the *Local Rail Service Assistance Act*, 1978, all included provisions for operating subsidies and rehabilitation for light density branch lines. By contrast, only nine short lines have been formed in Canada since 1986.

Canadian short lines are usually incorporated under provincial rather than federal law because they normally operate only in one province. In Ontario, they are governed by the *Ontario Railway Act*, 1950. The granting of approval to operate a provincial railway under this act is the responsibility of the Ontario Municipal Board. This activity is a minor responsibility and one inconsistent with the Board's primary role. The *Ontario Railway Act*, 1950 is outdated and the processes contained in it did not envision present circumstances.

Regulatory approval is required once the short line entrepreneur and the federally regulated Class 1 carrier agree on a selling price for either an active or an abandoned line for sale. Under the present legislation, the purchase of a branch line may only be made by another railway company, and the price offered must be at least equal to the net salvage value of the line. The Class 1 must then get approval from the National Transportation Agency to sell the track. This process can take up to six months, or longer, if hearings are required. The National Transportation Agency examines the feasibility of the short line operator's purchase plan, and any impact that the conveyance may have on shippers. The buyer must then have the proposed operation incorporated under provincial charter to become a railway company. In Ontario, this requires passage of a private member's bill in the provincial legislature. The buyer must then apply to the Ontario Municipal Board for authority to operate the trains. This requires presentation to the Ontario Municipal Board of technical information. The Board may require hearings if objections to the proposed railway operation are filed. A certificate from a professional engineer is required certifying safety. If the line offered for sale had previously been abandoned, no notice is required by the National Transportation Agency, and the buyer can apply immediately to the Ontario Municipal Board for approval to operate. The National Transportation Act Review Commission (1992), set up to review the *National Transportation Act*, 1987 recommended changes to this approvals process, suggesting shortening the approval time to approximately two months.

Some parties interested in the purchase of a line are not railway companies and are uncertain as to how to become a railway company, and often have neither the railway operating experience, nor a rigorous business plan. But even experienced short line operators like San Antonio-based Railtex have cited that they incur unnecessary legal and other expenses as a result of the complex approval process in

Canada. The approvals process for Railtex to establish the now successful Goderich and Exeter operation in Ontario, and Cape Breton & Central Nova Scotia took over a year in both instances. This lengthy approval process in Canada is cited as a deterrent to the formation of short lines.

The Goderich-Exeter Railway, headquartered in Goderich, Ontario, began operations in April 1992. This 70 mile (133 kilometres) stretch of track, running from Goderich southeasterly to Stratford, with a branch line running from Clinton to Centralia, was Railtex's first acquisition in Canada. The line was acquired from CN for $4 million and interchanges with CN at Stratford.[8] Major commodities on the line include salt, fertilizer and grain. Some 80% of the business on the line is salt.[9] Since Railtex acquired the line local farmers use it to ship their grain to the Goderich elevators, something they had not done with CN for about 30 years. Other cargo includes canned goods, vegetable oil, and machinery. Carloadings on the Goderich-Exeter for only eight months of 1992 were 5, 098.[10] In 1993, the carloadings rose to 7,588.[11] In September of 1992, the Mayor of Goderich described the Goderich-Exeter's success in the following way:

"The railway has had an impact on the economy of the town,...They are moving a lot more product than their predecessor because they are going out and looking for new business.'"[12]

It took CN and Railtex approximately a year and a half to get approval from the National Transportation Agency and the Ontario Municipal Board to get the Goderich-Exeter operation started. The length of the approval process results in difficulties for both short line entrepreneurs and shippers on the line. During the extended conveyance approval process, track, which the vendor has little interest in maintaining, can deteriorate, and shippers, uncertain of rail's future, may shift to an alternative mode or relocate their operations.

The Cape Breton & Central Nova Scotia Railway is Railtex's 380 kilometre line from Sydney to Truro, which Railtex purchased from CN Rail. CN sold this marginally profitable line to Railtex for $20 million.[13] There is a good mix of commodities on this line, including forest products, automotive tires, and coal. A large single shipper moves 2, 500 carloads of pulp and newspaper along the line annually.[14] Rapid expansion helped the railway company post a profit of $3.6 million (U.S.) in 1993 on record revenues of nearly $60 million.[15] As was the case with the Goderich-Exeter in Ontario, the approval process took a full year. One bidder for the (Sydney to Truro) line was quoted as saying that if they were picked to acquire the line, they would have spent $500, 000 (in legal and other expenses) without any guarantee that they would get approval to operate it.[16]

Merits of Having a Short Line Chartered Provincially

The primary reason for the creation of short lines under provincial jurisdiction has been to avoid successor rights provisions in federal labour legislation. As more provinces close this legal loophole, by making undertakings moving from federal to provincial jurisdiction subject to provincial successor rights legislation, it is logical to consider an alternative approach, that is, that emerging provincial short lines be under federal jurisdiction. This would provide the additional benefits of harmonization of rules, procedures and safety regulations that federal leadership could provide.

A key issue in short line development is whether potential short line operators can negotiate new suitable contracts with their workers. Some perceive that this is affected negatively by successor rights provisions which provide that if an employer who is bound by a collective agreement sells the business, the successor employer becomes bound by the same agreement. The trade union continues to be the bargaining agent for the employees of the successor employer. Ontario's *Bill 40* closed a loophole which enabled avoidance of successor rights when an undertaking was moved from federal to provincial jurisdiction (such as in the case of a short line railway taking over a line belonging to a federally chartered Class 1 railway). British Columbia and Saskatchewan have enacted similar legislation. In April 1993, the president of Railtex said that he will not buy any more lines in Ontario because of the 1993 amendments (as a result of *Bill 40*) to the *Ontario Labour Relations Act* that require the labour agreements of the seller (CN or CP) be transferred to the buyer.[17] Railtex's position is that employees on a short line must be flexible enough to do a variety of jobs. Railtex claims that it can not accept the craft distinctions which restrict flexibility in the collective agreements of the national railways. The president of Railtex was quoted as saying:

"'In a small operation...you just cannot afford to have an electrician whose only job is changing burned out light bulbs.'"[18]

More recent documents indicate that such hard line positions may be changing. There is nothing in the *Ontario Labour Relations Act* which prevents unions and potential short line operators from working together to establish a workable collective agreement and establish successful short line operations. As an example of union flexibility, the negotiations between the Wisconsin Central Limited and 9 unions representing employees of the Algoma Central Railway have resulted in agreements satisfactory to all parties. The nine member Nault Task Force, established in the fall of 1994 by the federal Transport Minister to explore the commercialization of government-owned CN, reported on the Algoma Central arrangement saying:

"The example of the recent negotiations for the sale of the Algoma Central to the Wisconsin Central is a case in point - it has been announced that the unions have agreed to work on the line with approximately 240 instead of 500 staff." [19]

These agreements were reached within federal jurisdiction (in which successor rights apply). Also, in Ontario, the provincial Ministries of Transportation, Economic Development and Trade, Agriculture, Food and Rural Affairs, Northern Development and Mines and Labour are working through an interministerial committee to examine the possibilities and deal with the issues surrounding short line development. The committee reports significant progress in securing labour's commitment to negotiating a single collective agreement for short line railways. The committee cautions that the progress made with respect to labour issues will only benefit lines with economic potential where shippers are willing to work with short line entrepreneurs, and commit to using rail. Further, the Province contends that no situations have arisen in Ontario where a rail line has been abandoned that could have been an economically viable candidate for short line operation.

Recently, two key rail unions, the Brotherhood of Locomotive Engineers and the United Transport Union have agreed that workers at new short lines will be able to select which union they want to represent them, and that union will enter into bargaining for a new contract that fits the conditions of the line. These recent union proposals go a long way toward offering short line entrepreneurs the kind of employee flexibility they say they need.[20] The Nault Task Force addressed labour's commitment to flexibility, reporting this finding:

"Many intervenors and indeed industry analysts have made much of the drawbacks that investors perceive dealing with possible purchases in provinces that have enacted specific successor rights legislation. Organized labour was quite clear in their presentations and in further discussion that this topic should not be a drawback and that they are willing to negotiate with authorities and prospective purchasers, if they are given the chance."[21]

It is clear, therefore, that successor rights are not the barrier to the formation of short lines that some would like them to be.

The Real Advantages of Having Short Lines Under Federal Jurisdiction

As more provinces close the successor rights legal loophole, a sound case can be made that the emerging provincial short lines be under federal jurisdiction given the harmonization of rules, procedures and safety regulations that federal leadership could provide. Having short lines under federal jurisdiction would also serve to standardize economic regulation and minimize the opportunity for a patchwork of

provincial government marketplace intervention. In Nova Scotia, the provincial Cabinet has complete discretion not only in whether or not to incorporate the railway, but also in deciding what rates it charges. The *Ontario Railways Act*, which regulates all aspects of provincially incorporated railways in Ontario, is obsolete (1950). Any re-drafting or updating of individual provincial railway acts will be a cumbersome process that will only lead to fragmented rules, procedures and safety regulations, and, ultimately require lengthy harmonization discussions and efforts. The Nault Task Force made the following recommendation:

"The Task Force is of the opinion that short line railways, at the time of their initial conveyance, should remain under federal jurisdiction to comply with national standards of operation and safety. Provinces should be asked to harmonize with federal legislation. This would be necessary for these operators to operate on main line trackage."[22]

If short line railways remained under federal jurisdiction, the process for establishing short lines would be streamlined by eliminating some of the duplication between National Transportation Agency and provincial regulatory agencies' requirements. The Nault Task Force recommended that as many steps as possible occur concurrently. If a national carrier and a short line carrier freely enter into an agreement to sell and transfer a line, that line should be sold and the sale approved without any consideration other than whether the short line operator is financially secure, adequately insured, and capable of conducting a safe operation. Intervenors told the Nault Task Force examining the commercialization of CN that a national standard for short lines is required.

To quote again from the Task Force report:

"Prior to starting discussion of this subject (short lines), two topics must be addressed...The first is whether or not short lines should fall under federal, provincial or be subject to joint jurisdiction. Intervenors were in agreement that it would be less confusing if one national standard were in effect." [23]

The Transportation Safety Board, an independent federal agency whose mandate is to advance transportation safety, is authorized to conduct investigations for provinces at their request. The railways have expressed a desire for provincial safety legislation that mirrors federal legislation.[24] While the provinces' economic policies may at times differ, when it comes to safety, there is not much room for different patterns of behaviour. Presently, in Ontario, the OMB rules mention federal safety requirements, but provincial governments enforce all safety requirements under provincial jurisdiction. This provincial input runs the risk of missing all the other resources available with respect to safety.

The federal government should recognize the contribution of short lines to Canada's economy and the national railways continental and global competitiveness. Leadership is needed to cut the red tape associated with the approval process to facilitate their growth. Consideration might also be given to providing for financial assistance through loan guarantees. Since short lines operate branch lines at about a third to half of what it costs CN and CP can operate them, instead of paying subsidies for uneconomic branch lines, the federal government could allow for speedier conveyances, and then openly provide financial assistance based on clearly established, fair, standardized criteria.[25] Published figures reveal that a total of $18,680,124 in branch line subsidy payments was paid out to CN and CP between 1988 and 1993 to maintain uneconomic branch operations in the Province of Ontario alone. It would appear that blanket "subsidies" such as this could be replaced with strategic "investments" in short line operations based on established criteria.

The Nault Task Force finding that the subsidization of uneconomic branch lines must change, without the federal government neglecting regional issues, reflects recommendations heard from stakeholders across Canada:

"The Task Force recommends that the government transform any public policy role for the (national) railways to allow the full commercial and independent operation of CN as a private business. Further, that the operation of uneconomic rail lines for regional requirements and development or for other reasons be funded by the government on a fully transparent basis."[26]

" That the National Transportation Agency be directed to fully take into account regional issues as part of a more expedient process of abandonment applications and transfers of lines to new operators. That the railways, in conjunction with the Agency and Transport Canada, establish the core network of rail lines, in order that an orderly shedding of economic assets can be done."[27]

The Nault Task Force suggested a reasonable new short line policy whereby prior to filing for abandonment, the railways would have to submit to Transport Canada a detailed analysis of lines they consider surplus to their needs. This analysis would include operating, marketing and financial plans, and the lines proposed for sale would be classified as either profitable or not. Then, the NTA would conduct a thorough review of the analyses and recommend sale or closure, or if a public policy role is envisioned, like regional economic development, compensation in order that services be continued. Throughout this process, everything could be transparent with all information being publicly available to potential buyers, all levels of government, industry, shippers, interest groups and others. [28] The National Transportation Agency has experience in evaluating the railway industry and is best suited to develop the criteria for a profitable short line project that minimizes the risk of loss of federal funds. The federal government might also consider helping

new short line entrepreneurs establish themselves in the market by providing them with contacts in the supply industry, in short line engineering services, with retired railway executives, and short line railway consulting firms. Providing financial backing in the form of loan guarantees, or approved upgrading projects, etc.,for short line railways, instead of subsidizing uneconomic branch lines would be more cost effective for the federal government, while not detracting from the federal government's responsibility for regional development across the country. The Nault Task Force also reported this finding:

"There would appear to be no reason to assign any particular rail operation to either one or the other of the main Class 1 railways, and, indeed, with the possible expansion of the number of short lines ..., better value for money could result, as the short line would not be burdened with all the overhead and cumbersomeness of the large railways."[29]

Conclusions

It seems that the legislative process for short line approvals is a major obstacle in the further development of short lines in Canada. In addition, leadership is required to facilitate intelligent rationalization of the railway network. The federal government has the resources, knowledge, and the requisite power to simplify the process and provide necessary direction. The time to act is now. The railways must rationalize their networks to remain financially viable, and they would prefer to sell lines (and continue to receive revenues from them) rather than abandon them. CN and CP's operations along key corridors can be supplemented by the traffic generated by connecting short line railways where the cargo is adequate for smaller carriers with lower operating costs and greater flexibility to operate profitably. While the Province of Ontario has taken the initiative to promote short line development by establishing an interministerial committee to work with all stakeholders to promote the establishment of practical, economically viable short line operations, effective federal action could achieve greater, more timely results. Ontario is taking the necessary steps to ensure that lines slated for abandonment are thoroughly analyzed. Ontario cannot act alone to improve our national railways competitiveness. Short line operations in Canada will be key to our Class 1 railways' global competitiveness, making short line development a federal transportation issue related to the general (economic) advantage of Canada. The federal government has the required expertise (and the years of experience) to provide for safe provincial short line operations. The questions are: is the federal government sufficiently committed to resolving railway rationalization, and will it demonstrate that commitment by forthright action?

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MUDDLING THROUGH THE MAZE OF LIABILITY FOR MULTIMODAL MISHAPS

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I. Introduction

Multimodalism has provided huge benefits in cargo handling and delivery, but it has also produced a great tangle of liabilities. The seamless movement of goods in a container from exporter's warehouse to importer's door is a magnificent achievement of efficiency and coordination amongst carriers. However, this advance in cargo handling has not been matched by a simplification in the regimes governing the distribution of risks and liabilities during a multimodal movement.

Today, a door-to-door delivery of a container of merchandise may be subjected to a series of different laws regulating the individual modes and transhipment points through which the shipment passes. Or it might be governed by one of three voluntary sets of multimodal rules. Or it may be contractually covered by the multimodal operator's own standard trading terms, which might additionally incorporate parts of the previous choices of laws. In other words, no two multimodal movements over the same route may be regulated in the same way. Further, in a single movement of goods the cargo owner will be exposed to changing risks and the multimodal operator will be affixed with varying liability all along the way.

Common sense dictates that such confusion of liability rules and limits is dysfunctional. It cannot help the efficient delivery of multimodal services. It must waste time and money to unravel when a casualty occurs. This paper first explores how the multiple liability regimes impact in the event of a casualty. In particular, it details the array of differing limits of liability that may be brought into operation before it examines the resulting profusion of claims. The subsequent discussion about the settlement procedures for all these claims leads to concluding predictions about an unified system of regulating the multimodal transport industry.

2. The Multimodal System of Overlaid Liability Regimes

A convenient mental image of the multiplicity of multimodal rules is to picture them as a system of overlaying regimes on three levels. On top and overarching all the rest are the terms of the particular combined transport contract. Below them are the uniform international rules for each individual mode of transport, and on the bottom level are the multifarious national laws of every country. By explicit incorporation, these levels form an hierarchical network, which figuratively has the shape of a pyramid.

At the apex of the pyramid, the combined transport document issued by the multimodal transport operator (MTO) to the shipper of goods contains the terms and conditions of the delivery. Amongst them will be found clauses fixing the basis and extent of the MTO's liability. These trading terms may be of the MTO's own making - (a house bill), or they may incorporate a standard set of conditions in the industry - (such as those issued by FIATA or the Through Transport Club), or they may refer to an internationally approved set of rules -(of which the most recent are the UNCTAD/ICC Rules of Multimodal Transport Documents, 1992).

Whatever multimodal rules are applied, their objective is the same, namely to allocate the risks of the delivery between the cargo owner and the MTO. It does not matter whether the MTO is one of the carriers part of the way or is a non-vehicle/vessel-owning operator (such as a freight forwarder), the combined transport contract obliges it to take responsibility for the cargo right through the movement to the ultimate destination. In the event of a casualty, the cargo claimant may hold the MTO liable, leaving it to recoup what it can from the actual defaulting carriers.

This simple system of risk allocation in a multimodal movement is limited by its contractual nature. Since the liability rules are applied by agreement, they cannot contradict or overreach mandatory laws. Thus the existing international agreements establishing uniform rules of liability for air, sea, road and rail carriers unimodally[1] will also operate within multimodal movements wherever the conventions have been implemented and the cargo injury can be localized. But these unimodal standards of liability have not been universally adopted, so in their place the local national law concerning a particular segment of the multimodal movement will be relevant. If this law simply recognizes the freedom to contract the terms and conditions of transport services, the MTO will not be constrained other than by its own agreement with the actual service provider.[2] But if, as is more usual in the field of transport law, a specific liability regime is mandated by local legislation, the multimodal movement will be subjected to its effects in like manner to a compulsory

unimodal convention. For instance, the MTO's agreement with the cargo owner may express a fixed limit to the compensation payable in the event of a casualty. But if this amount turns out to be less than the minimum compensation required by the relevant unimodal convention as applied in the place where the casualty occurred, or, failing its implementation there, by the appropriate local law, the MTO will have to contribute to the cargo owner's loss at the higher compulsory rate.

In addition, the MTO is not interested in agreeing to a level of compensation with the cargo owner that exceeds the maximum rates required by the different unimodal conventions or relevant national legal systems because it will be unable to recover a full indemnity for its recompense of the casualty from the actual defaulting carrier. For this reason, the MTO's combined transport document typically incorporates the relevant unimodal regimes by reference whether they have compulsory application by legislative implementation or not.

Thus the desire for simplicity and uniformity in the liability regime between the cargo owner and the MTO is overtaken by the variety in the underlying compulsory unimodal conventions and national laws. The differences affect all aspects of multimodal operations including, importantly in the event of a casualty, notice of claims, time for suit, basis of responsibility, and defences, excuses and limits to liability. For convenience in this paper, the limits of liability have been selected to illustrate the range of differences between the relevant regimes. Thus the following table 1 comparing the limits of liability between a selection of relevant multimodal, unimodal and national regimes amply demonstrates the great divergence in the rates of compensation payable according to the coincidental location of the casualty.[3]

Table 1: Limits of Liability under Selected Multimodal, Unimodal and National Regimes

Regime	Limit per kilo	Limit per package
Multimodal		
- Multimodal Convention 1980,[1] greater of	2.75 SDR[2]	920.00 SDR
- but if no sea leg	8.33 SDR	n/a
- UNCTAD/ICC Rules 1992[3]	2.00 SDR	666.67 SDR
- but if no sea leg	8.33 SDR	n/a
- TT Club B/L[4]	US $2.00	n/a
- but in US trade, lesser of	US $2.00	US $500
Transport Terminals - OTT Convention[5]	2.75 SDR	n/a
- but if no sea connection	8.33 SDR	n/a
Sea Carriage		
- Hague Rules per U.S. version[6]	n/a	US $500
- Hague/Visby Rules,[7] greater	2.00 SDR	666.67 SDR
- Hamburg Rules,[8] greater of	2.50 SDR	835.00 SDR
Road Carriage - CMR[9]	8.33 SDR	n/a
Rail Carriage - CIM Uniform Rules[10]	17.00 SDR	n/a
Air Carriage - Warsaw Convention[11]	17.00 SDR	n/a

Notes:

1. U.N. Convention on International Multimodal Transport of Goods, art. 18 (not in force).
2. SDR = Special Drawing Right of IMF. 1 SDR = US $1.46 (Feb. 1995).
3. UNCTAD/ICC Rules for Multimodal Transport Documents, rule 6.
4. Through Transport Club's Bill of Lading Series 100 & 101, clause 6(3)(A) and (4)(B).
5. U.N. Convention on the Liability of Operators of Transport Terminals in International Trade, 1991, art. 6 (not in force).
6. U.S. Carriage of Goods by Sea Act, 1936, 46 U.S.C. App. 1315, s. 4(5).
7. International Convention for the Unification of Certain Rules of Law Relating to Bills of Lading, 1924, as amended by Visby Protocol, 1968 and SDR Protocol 1979, arts. IV(5), (applied by Canada and U.K.).
8. U.N. Convention on the Carriage of Goods by Sea, 1978, art. 6 (in force, but not widely applied).
9. Convention on the Contract for the International Carriage of Goods by Road, 1956, as amended by SDR Protocol, 1978, art. 23 (applied in Europe).
10. Convention concerning International Carriage by Rail, 1980, Appendix B, Uniform Rules concerning the Contract for International Carriage of Goods by Rail, arts. 7, 40 & 42 (applied in Europe).
11. Convention for the Unification of Certain Rules Relating to International Carriage by Air, 1929, art. 22 as amended (applied generally).

3. Claims Profusion and Procedures

In the ordinary course of commerce, the shipper will insure the goods for the duration of their transport. Hence, when a casualty occurs, the cargo owner is paid for its loss out of the insurance. Thus it is really the insurer who, in place of the cargo owner, brings the claim.[4] As a participant in the industry, the insurance company is well aware of the complexities of multimodal liabilities and therefore it does not stop at presenting a claim merely against the MTO as the combined transport contract intended. Typically it names multiple defendants, including as many participants to the multimodal movement as it can identify. It is probably wise to do so in light of the pyramid of possibly applicable regimes. The insurer cannot afford to risk losing a claim because one operator or carrier in the movement has an excuse which shifts responsibility to another one that has not been cited. It wants to maximize its recovery by pressing the claim to the highest of the various limits of liability applicable in the circumstances.

In addition, the MTO will also pursue all the carriers and terminal operators to whom it may be possible to attribute the loss. While the MTO cannot deny its responsibility in principle, it will want to make sure it can pass that liability along to the truly defaulting parties, so far as the pyramid of regimes permits. Normally every one of the defendants named by the cargo insurance claimant and by the MTO will have their own insurer who will deny liability and resist paying compensation. In consequence a host of adjustors will be called upon to handle this profusion of claims.

To some degree the complicatedness of multimodal claims has been reduced by the operations of the Through Transport Club (TT Club).[5] This organization provides insurance services through a mutual association of multimodal operators, carriers, freight forwarders, terminal operators, stevedores, port authorities and other participants in the intermodal industry. Its basic principle is mutual protection, like the P and I Clubs of shipowners. However, its membership is made up of so many different kinds of service providers and its cover extends to so varied types of risks, that it has to rate participants by classes not so unlike regular insurance business.

The advantage of the TT Club is that it is able to provide cover for all the segmented services that go into the performance of a multimodal movement. It offers single source insurance for combined transportation. Not only the multimodal operator who is principally responsible for the cargo, but all the other sub-contracted carriers and handlers may be insured through the TT Club. Thus the profusion of claims that may arise from a multimodal casualty can be handled within the defined structures of the Club. Initially there has to be

agreement amongst all the named defendants to permit the Club to handle all the claims and decide where fault lies. This is an important step since one or more defendants may have rights of set off or claims over against other codefendants according as the investigation of the casualty turns out. Even with this agreement, protection of the interests of each party is necessary, and is afforded by the Club appointing a separate claims' handler for each defendant. It is then the task of these handlers to adjust the loss.

The degree of difficulty in adjusting a multimodal loss depends on the particular circumstances of the casualty. If, for instance, the cargo has been spoiled by getting wet, analysis of the water may solve the problem. If it turns out that the goods were wetted by seawater, the carrier on the sea leg is conspicuously implicated. But if the wetting was by freshwater, any carrier along the way may have been careless. A further investigation of the reported condition of the cargo at each place of transhipment will have to be made in the hope of localizing the source of the problem.

The success of multimodal transport was made possible by the innovation of containerization of cargoes. It is containers that have so facilitated the provision of door-to-door delivery service which commerce now assumes and depends on. Yet at the same time as containers have reduced the kinds and occasions of risk of injury to goods in transit, they have increased the problems of ascribing fault when loss and damage do occur. A sealed container of goods which is not opened for inspection between origin and destination readily conceals any damage suffered. Consequently, the probability of attributing fault between the MTO, the carriers and the cargo handlers, as the pyramidal network of multimodal regimes demands, is much less certain than under the old fashioned, break bulk methods of transportation. An example may usefully illustrate the difficulties.

Suppose a container of high tech, high value product originating in Mississauga is moved by truck to Montreal and thence by sea to Rotterdam from where it is carried by rail to Cologne. The container arrives in apparently good condition with its seal intact, but when it is unstuffed the consignee discovers that much of the merchandise is damaged or broken. The consignee claims on its insurance, and now the insurer is looking to recover from the MTO and the carriers. What is each party hoping for?

Obviously the cargo insurer seeks the maximum compensation it can achieve in order that its recovery approaches as nearly as possible the full loss on the goods, which would have been the amount from insurance it had to pay to the consignee. The insurer would therefore hope the casualty proved attributable to the final stage of the movement, so that it could hold the MTO

liable at the highest rate of compensation of 17 SDR per kilo in accordance with the rail transport regime (see Table 1). The MTO, who has to answer to the cargo insurer, will want to minimize its liability. Hence, it will also want to attribute the casualty to a particular stage of the movement so it can pass its liability for the loss along to the carrier who was actually responsible for it. Each carrier, in an effort to avoid liability, will declare that the casualty was not its fault. Faced with this resistance and the resulting prospect that the unattributable loss will fall wholly on it, the MTO will either deny liability or seek to share the loss with all the carriers.

Which way this web of claims and disclaimers will turn out will depend on the available evidence surrounding the damage. It might have been incurred during the humping and shunting of the rail car, as the result of a road accident involving the tractor trailer, through the rolling and swaying of the ship during a storm, or the container being put down too heavily in one of the terminals. Sometimes the significant incident is obvious. If the container was subject to a road accident, there is unlikely to be a need to look further. But if the damage can only be accounted for as incidental to the general handling and moving of the container, it may never be localized. Indeed the absence of obvious error and responsibility will encourage the MTO to deny liability and demand that the cargo insurer proves the cause of the loss. In some circumstances the MTO may even assert that the loss was the fault of the cargo owner for failing to pack the goods and stuff them in the container adequately for their own protection throughout the journey.

The ability of the TT Club to facilitate the settlement of multimodal claims in such situations is a benefit but not a solution. For several reasons, the Club has limited effect. First, not all participants in the multimodal movement may be Club members. In particular, the TT Club does not provide cover for those carriers who are insured elsewhere, such as shipowning members of P and I Clubs. Secondly, the profusion of claims still demands multiparty adjustment. Although the Club may compensate the cargo insurer, it has also to allocate the loss amongst the relevant members. Thirdly, the TT Club will only reimburse the cargo insurer up to the limit of liability expressed in the combined transport document. Since this document establishes the limits by reference to the pyramid of liability regimes, the TT Club still has to try and localize the cause of loss in order to determine the maximum rate of compensation it must pay.

4. Solution and Conclusion

There is a solution to this multimodal muddle but it may not be immediately popular. The obvious choice is an intermodal convention, i.e., an intergovernmental agreement that establishes an uniform regime for all modes of transportation and has mandatory effect. Indeed there already is one on the books. The United Nations sponsored a Convention on International Multimodal Transport of Goods in 1980 but it has not yet come into force and does not seem likely to do so in the near future. Part of the reason may be that the Convention continues to rely on the pyramidal system of network liability and to incorporate the existing regimes for unimodal transport. Fatally, the 1980 Multimodal Convention does not escape the weakness of segmental liability.

The way forward would be an international convention constituting an uniform system of liability in all modes of transportation. It should fix the standards of cargo care as well as the excuses and defences to responsibility of the MTO and the carriers in all modes. It should establish the liabilities and their limits for all service providers in the international[6] transport industry. Much as the TT Club and other trade organizations like FIATA ease the present difficulties in governing multimodal transport by trying to create an uniform regime, ultimately they cannot achieve that end because they do not have the power to do so. So long as their efforts depend, as they must, upon contractual agreement for the implementation of their standard trading terms and conditions of liability, they are unable to avoid the impacts of the mandatory unimodal regimes and national laws. At bottom, the TT Club can usefully facilitate the administration of multimodal claims, but it cannot overreach the complexities of the pyramidal system of network liability.

To establish an uniform mandatory intermodal regime is obviously going to be a very difficult task to accomplish. Equally, it seems to be a necessary goal for the transport industry. Major resistance to the development of such a regime may be expected from carriers and carriers' associations in the different modes.[7] An intermodal convention may have to await the fortuitous conjunction of insistent demand from exporters and other trading clients of the multimodal industry, and a readiness on the part of MTOs and, more particularly, carriers, born of the need to protect their business in the new global economy, to entertain change to the existing governing regimes. That could occur sooner than some may expect.

The trend in the industry is towards ever more integrated transport systems to serve increasingly global trading needs. The development of multimodalism is, in part, a response to that demand. Long term strategic

partnerships within the transport industry have been established to support multimodalism. The general deregulation of business by governments in the previous decade has encouraged the deepening of these service alliances across transport modes and the broadening of them to include the customers of the transport industry. In this decade the onset of electronic information technology is transforming the way both trade and transport are administered. Logistics systems now unite the previously distinct activities of production, sales, delivery and payment.

The seamless transportation of goods, which the multimodal industry created as the ultimate product of service for its manufacturing and exporting customers, is fast becoming just one part, though an essential one, in the continuing interrelationships of particular suppliers, manufacturers, transporters and purchasers in the global marketplace. The new, world-wide, electronic commerce is progressively submerging the differences between traders and transporters, and with them the old commercial frontier between cargo owners and carriers. Instead, it increasingly demands the provision of global services that are deliberately integrated and competitively structured for the mutual benefit of the participants who are joined in partnerships that transcend traditional industry lines.

With this new impetus to integrate trade and transportation, can the need for, and appreciation of the benefits of, an integrated and uniform international regime for transport services be far behind? Remembering that it was just such a coming together of cargo and carrier interests that brought about agreement on a compulsory regime in each of the transport modes when they operated largely in isolation, there is every reason to expect a similar concertedness of business interests in the new commercial conditions will lead to the development of an uniform liability regime to govern the now interrelated multi-modal transport industry.

ENDNOTES

* These remarks arise from a larger study of multimodalism being undertaken by the author with the generous support of the SSHRCC.

1. And also for terminal operators at the points of transhipment between modes.

2. For instance, road and rail carriers in the United States bear full responsibility as common carriers but are generally free to set their own conditions and limits of liability by agreement with shippers, subject only to filing tariffs with the Interstate Commerce Commission.

3. Of course, the MTO is not expected to compensate the cargo claimant beyond its actual loss, hence these limits of liability only operate where the extent of the injury to the cargo exceeds them.

4. In law, the insurer is said to be subrogated to the claims of the insured.

5. Much of this discussion of the TT Club is based on the expert views expressed in a telephone interview on February 9, 1995 by Mr. Paul Crompton, Underwriter, Marine Insurance Co. Ltd. and TT Club contact in Toronto ON. His assistance is gratefully acknowledged by the author, who, however, retains responsibility for the remarks that follow.

6. Whether purely domestic transportation is to be subjected to the same regime is a matter of choice for national authorities. It may be convenient to apply an uniform regime to intra- and inter- national commerce but it is not essential. Generally the existing international trade and transport conventions compulsorily extend only to interstate movements of goods while providing the opportunity of adoption for local traffic as well.

7. The strength and effectiveness of the sea carriers in preventing the implementation of the more modern Hamburg Rules in place of the old Hague Rules within their own mode of transport amply demonstrates the likely force of objection to an intermodal convention.

TRANSPORTATION AND LOGISTICS IN CANADA: AN ECONOMIC AND STATISTICAL OVERVIEW

Ken White, Industry Canada

I. PREFACE

Much of the material in this paper has been drawn from three research papers prepared by Alan Jones, Industry Canada which are listed below.

The Economic Costs of Logistics: The Cost of Distributing and Storing Goods and Services - Canada and the USA Compared.

The Distribution and Storage Sector: The Supply and Demand of Transportation Services

Manufacturers Inventory Management and Implications For Logistics in Canada - Evidence of Structural Change

The discussion on Supply Chain Reengineering is based on material provided by KPMG Management Consultants: Canadian Logistics Benchmarks.

II. PURPOSE

1. To investigate the demand for transportation services in Canada from 1971 to 1990.

2. To assess the relationship between transportation services demand and the overall efficiency of moving goods throughout the supply chain.

3. To examine the changing demand structure for air, rail, water and truck.

4. In addition to transport and storage costs, to estimate other logistics costs including private warehousing, private trucking and hauling and materials handling such as wrapping, crating and other preparations for distributing goods and services.

5. To assess changes in inventory management techniques to determine if there has been a structural shift in inventory holding behaviour amongst the players.

6. To assess the extent companies are reengineering their supply chains to meet the challenges of increased competition, global trade and demands for better customer service.

III. CONTEXT

The business environment of the 1990s is changing fast and is becoming more customer driven based on knowledge, technological applications, rapid access to information and strategic alliances. The production, distribution and marketing of goods and services is now a key part of the global economy with lower tariffs and the creation of large trading blocks such as NAFTA and the European Community.

Transportation and distribution, with the emergence of electronic commerce and integrated logistics management concepts, is similarly becoming part of this fast paced and changing "new economy". At the same time, transportation and communications is becoming more and more deregulated, thus opening opportunities for greater efficiencies through productivity improvements and lower prices as well as improved services to customers. Transportation and its larger umbrella - logistics - is becoming a knowledged based industry encompassing both new technologies and a greater emphasis on research and development.

Both multinational enterprises and small and medium sized companies are taking a more global approach to their business strategies - which could result in a massive restructuring of the transportation and related sectors in Canada. This change is already happening with the lowering or elimination of freight subsidies, rationalizing rail branch lines, emergence of private "short-lines", and so forth.

Inventory management techniques of those firms surviving the recent recession are changing profoundly with higher inventory turns, lower inventory to sales ratios, etc. The challenge is to get the goods and services to customers fast and to minimize capital being tied up in inventory not being sold.

With the emergence of the global economy, the mix of commodities shipped abroad could change with an increased level of highly processed products. Changes in shipping and inventory strategies will also result in an increased demand for faster and more reliable transportation. As R. Delaney of Cass

Informations Systems recently stated to the US Department of Transportation, "Transportation merely adds motion to inventory". Lower transportation prices allow producers and sellers to trade-off the use of more transportation to lower inventory carrying costs and to provide improved services to customers. Service time and reliability determines how carrier selection decisions are being made. Order cycle and transit time used to be measured in days - it is now done in "hours".

IV. TRANSPORTATION SERVICES DEMAND

This section of the paper undertakes to investigate demand for transportation services in Canada from 1971 to 1990.

The data set was obtained from the Input-Output Division at Statistics Canada and covers the 1971 to 1990 period. It encompasses a pre-and-ongoing deregulation environment for the transportation sector. It also covers two major recessions and a cautionary flag should be raised concerning the performance of firms in the terminal year (1990) of the analysis.

Two explanatory points should be addressed. First, since unadjusted-for-inflation data is required to include labour costs in the cost structure, the question of price effects arise. Since most of the analysis is expressed in terms of a ratio or share, price effects generally "wash out". A second potential concern is the use of the end point analysis - which addresses and compares how certain variables are today (1990) compared to how they were yesterday (1971). A twenty year period is needed in order to assess structural changes in the industry. In addition, it was considered necessary to examine data when the industry was highly regulated (1971) and when deregulation was starting to be in effect (1990).

The transportation modes assessed included rail, air, water, and pipeline as well as storage and warehousing.

Transportation services are reported in two ways in the input-output matrices. The first is the direct value of transportation services provided by the producing industry. The second measure is the transportation margin. This is the difference between the price paid by the purchaser and the cost or price incurred by the producer of the service.

The total transportation demand for both 1971 and 1990 has been expressed as a ratio of total domestic transportation costs (indirect and margin) to aggregate industry output. This ratio is referred to as transportation intensity.

Transportation services used in the export function are reported as a transportation margin - which is not available by industry. The transportation intensity ratios, therefore, underestimate the true relative value of transportation costs as the outbound costs for goods being exported are excluded. These ratios, however, are useful as rankings to compare transportation intensity on an industry basis and to compare transport costs over the two periods being examined.

Industrial Demand for Transportation Services in Canada - 1971-1990

	Transportation Services Demand ($B, current)	Total Industrial Output ($B, current)	Transport Intensity
1990	41.7	1,022.5	0.041
1971	7.7	148.8	0.052
Average Annual Growth %, 1971-1990	9.4	10.1	

Source: Statistics Canada Input-Output Division; aggregate data is not available in inflation adjusted dollars in the same base year for the period.

There has been a decrease in the intensity of transportation use in Canada over the 1971 to 1990 period as the ratio of transportation production to total business sector production declined from 5.2% to 4.1%.

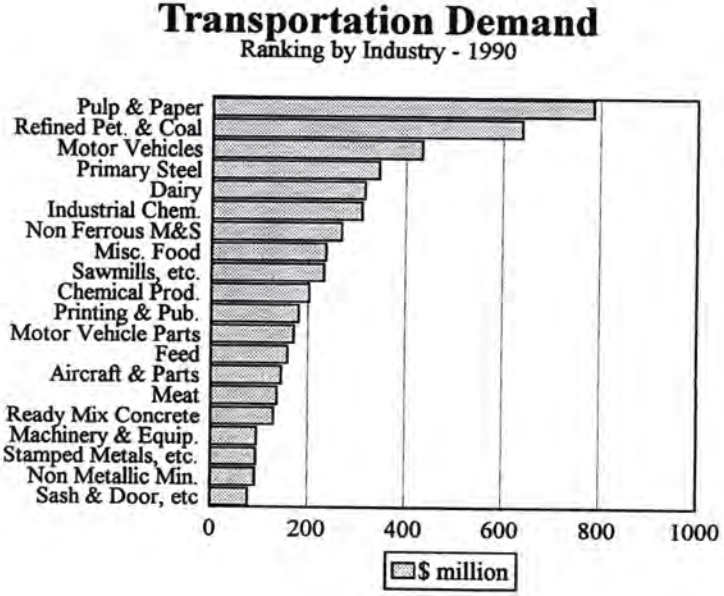
For manufacturing the two largest consuming industries of transportation services have been the pulp and paper industry and the refined petroleum and coal products industry. Other volume users of transportation services include the primary steel industry, the dairy industry and motor vehicles.

Of the top twenty manufacturing users of transportation services in 1971, all but three were in the top twenty in 1990 (the aircraft and aircraft parts industry, the sash, door and other millwork industry and the non-metallic mineral products industry) were in the top twenty in 1990 displacing other electrical and electronic products, the paper box and bag industry and the man-made fibre yarn and woven cloth industry.

In the manufacturing sector as a whole, twenty-three of 94 industries (25%) were found to have increased their transportation demand intensity between 1971 and 1990. These industries are listed below:

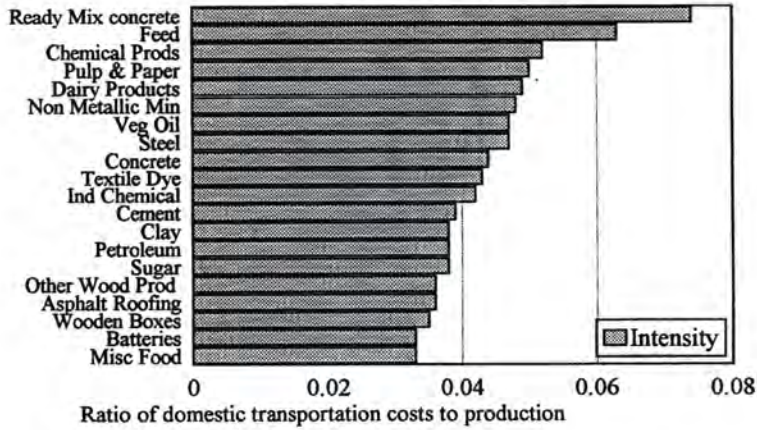
Increasing Transportation Intensity - Manufacturing - 1971-1990

Primary Steel	Power Boiler & Structural Metals
Leather Tanneries	Aircraft & Aircraft Parts
Dairy Products	Footwear
Concrete Products	Brewery Products
Chemical & Chemical Products	Pulp and Paper
Cane & Beet Sugar	Non-Metallic Mineral Products
Contract Textile Dye & Finishing	Bread & Other Bakery Products
Clay Products	Soap & Cleaning Compounds
Wooden Box and Coffin Copper Roll.	Distillery Products
Cast. & Extrud.	Floor Tile, Linoleum & Coated
Cement industry	Fabrics
Soft drinks	
Ready Mix Concrete	



Transportation Intensive Industries

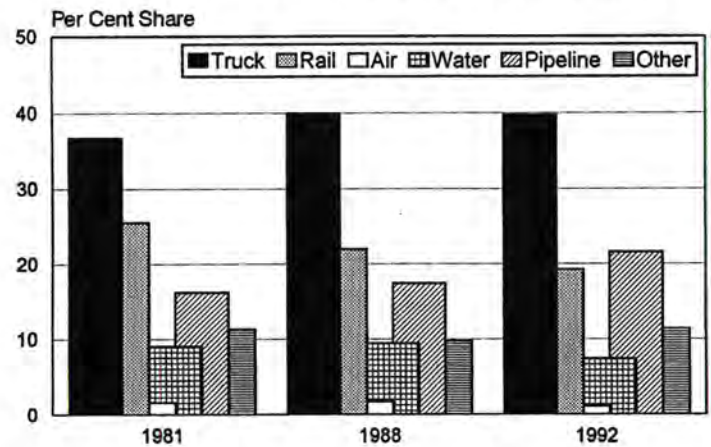
Manufacturing - 1990



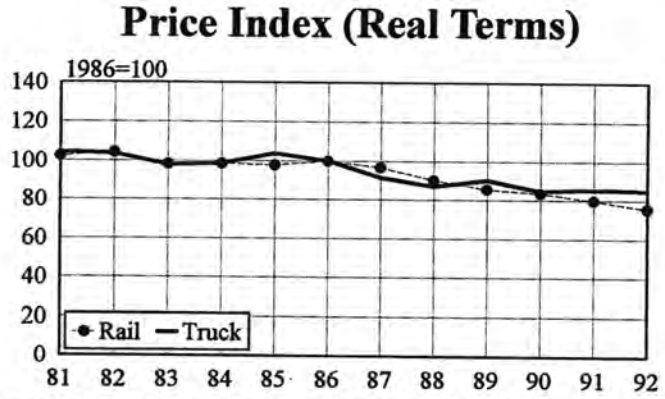
Why have some industries, especially in manufacturing, showed an increase in transportation intensity when overall this trend was declining?

Freight GDP by Mode

Rail demand has fallen - truck & pipeline increased

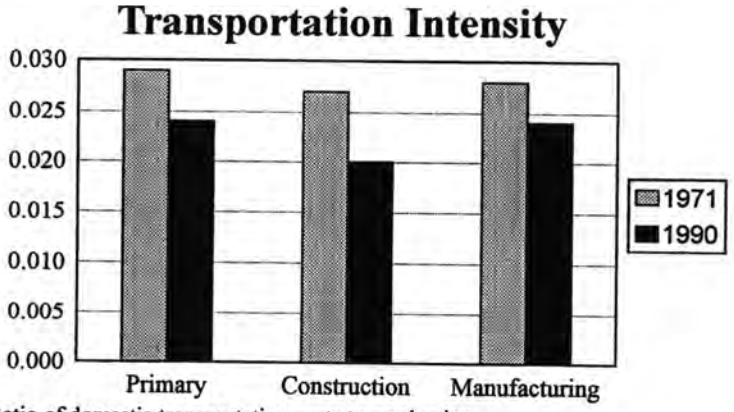


Shippers may be trading off lower surface transportation prices for greater overall logistical efficiencies. To capture these logistical efficiencies shippers, to some extent, have shifted from rail to trucking - which provides more frequent on demand service.



Source: Economic Research Branch, TC, November 1994

Lower transportation prices are allowing firms to trade-off the use of more transportation to lower logistics i.e. inventory, etc, costs and to provide better customer service.



Ratio of domestic transportation costs to production

V. AN INTRODUCTION TO LOGISTICS:ECONOMIC COSTS OF TRANSPORTATION AND STORAGE

Logistics, broadly defined, involves business activities and services used to move materials and information through supply chains from their source to points of consumption to meet customer service requirements. Logistics narrowly defined excludes the internal logistics activities of the firm such as private hauling, crating, etc.

This section of the paper estimates the "economic" costs of transportation and storage in the Canadian economy. It reports estimates of the proportion of total economic activity that logistics functions represent.

The measure of cost used to assess each transportation mode is the value-added or gross domestic product of transporting freight in each industry.

The economic cost of holding inventories is valued as the alternative use of using a dollar's worth of capital. A user cost is first calculated to arrive at the cost of holding inventories.

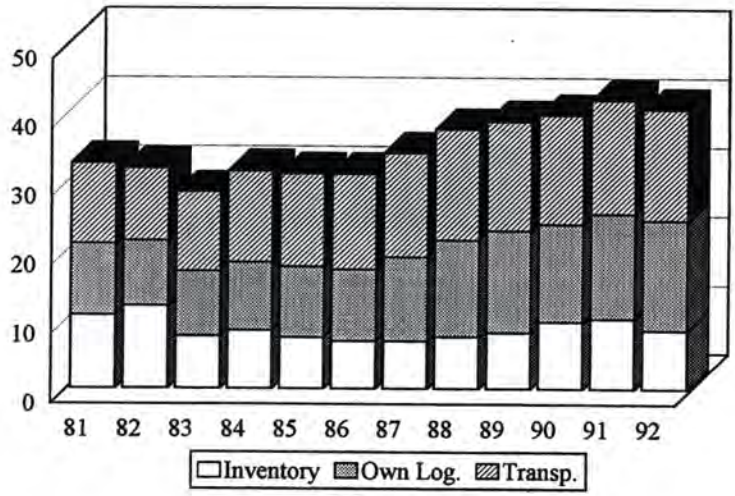
The final magnitude to be valuated are the costs associated with "own logistics activities". These include private trucking services and materials handling - wrapping, crating and other preparations for distribution. Unlike the two previous measures, the own costs of logistics are measured in gross terms at the producer's price of the goods used. This data has been obtained from the input-output matrices.

The sum of these three costs are then used as an estimate of the total cost of logistics.

Economic costs should not be taken in a negative sense. Even though there is a resource use cost of providing logistics services, there is at the same time a benefit occurring, i.e., the value of the service to both producers and consumers.

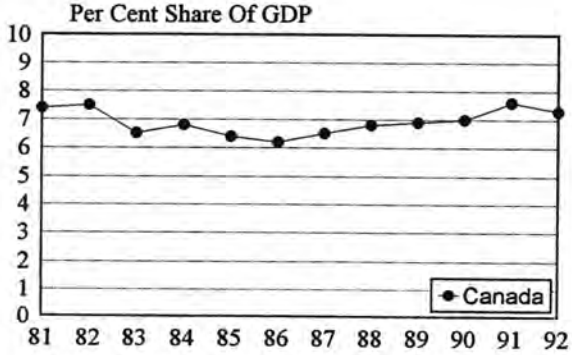
Economic Costs of Logistics

Canada - $B, Constant



Logistics Costs -Broadly Defined

Logistics costs dipped in early 80s and rose from 86 to 91; then fell in 92



Including own logistics

VI. MANUFACTURERS INVENTORY MANAGEMENT AND IMPLICATIONS FOR LOGISTICS IN CANADA

Logistics activities include both the movement of goods through the supply chain and their storage, either in finished form or in some intermediate assembled form - including raw materials.

Business in Canada is trying to increase the efficiency and productivity of manufacturing and distribution and to decrease the size and costs of holding inventories.

Just-in-time manufacturing techniques and quick response strategies reduce inventory costs. In addition, bar coding and EDI point-of-sale computer systems have increased the effectiveness of managing inventories while reducing order cycle time and improving customer service.

To what extent has these new management techniques resulted in a changed inventory management structure?

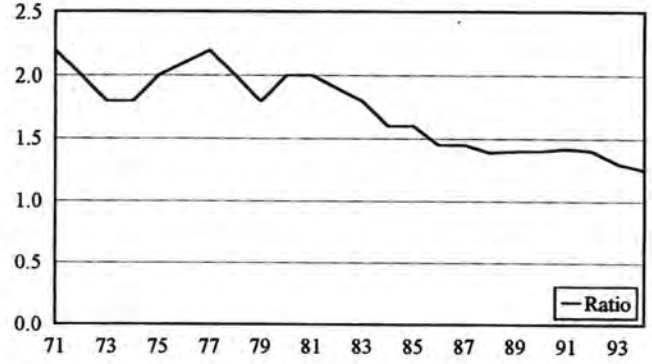
More efficient inventory management has positive implications on logistics. Lower inventory holding costs and lower transport costs translate into real gains for producers and consumers. Declining inventory - sales ratios - is associated with increased productivity. Leaner inventory holding translates into lower costs for both labour and capital. Lower transportation prices and better transportation services are allowing firms to trade-off the use of more transportation relative to other logistics costs such as inventory costs - and provide better customer service.

A greater value of inventories are being held by wholesalers and retailers than manufacturers - suggesting a major change in inventory management practices.

Inventories to Sales Ratio

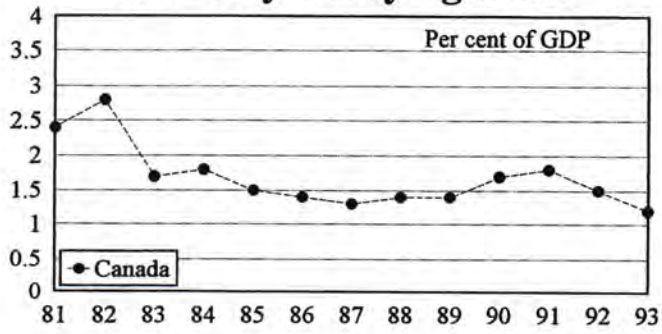
Manufacturing

Changed inventory practices ,e.g., Just-In-Time and increased electronic commerce use have lowered inventory costs.



Inventory carrying costs as a per cent of GDP have been declining in Canada over the past 10 years or so.

Inventory Carrying Costs



Non farm inventories in the manufacturing industries has been declining slightly in relative terms since 1981 due to an increase in inventories in retail and wholesale trade.



VII. SUPPLY CHAIN REENGINEERING

Companies are reengineering their supply chains to meet the challenges of increased competition, trade globalization and demands for better customer service. Supply chain reengineering is defined as integration of operations with suppliers and customers.

While the current popularity of reengineering supply chains stems from competitive pressures of the global economy, the explosive growth in information technology is the strongest driving force.

Historically, information technology was used merely to automate the archaic or primitive manual business processes. Computer systems were massive, very expensive and quite difficult to change. The availability of cost-effective and very powerful information systems today provides firms of all sizes - large and small - with opportunities to re-think their business processes, especially in their logistics systems distributing goods and services to customers.
There has been, therefore, a considerable growth in logistics information systems in areas such as bar coding, EDI with vendors, EDI with carriers, radio frequency applications, inventory control and warehouse management systems.

The following three charts prepared by KPMG Management Consulting identify:

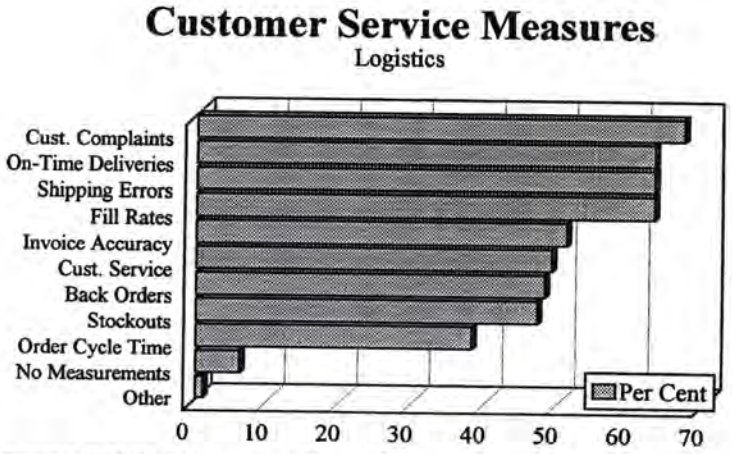
1) most frequently tracked customer service measures;

2) logistics applications partially on completely implemented; and,

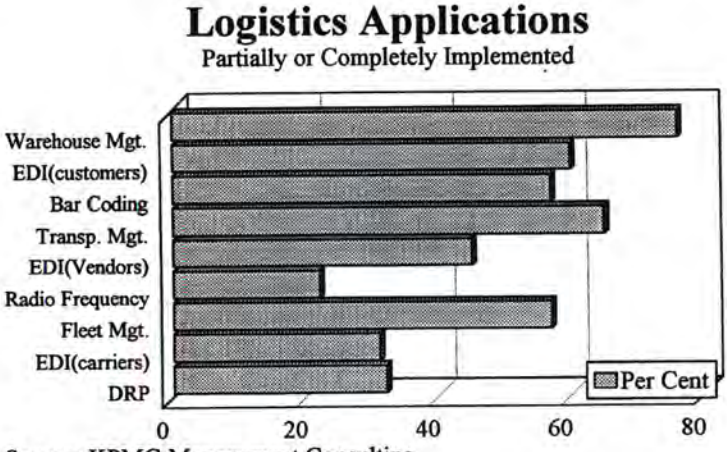
3) logistics applications on schedule.

This information was based on a survey prepared by KPMG Management Consulting for both Canadian and USA firms. This survey showed that more than 70% of companies are involved in the supply chain reengineering and food companies are leading the change.

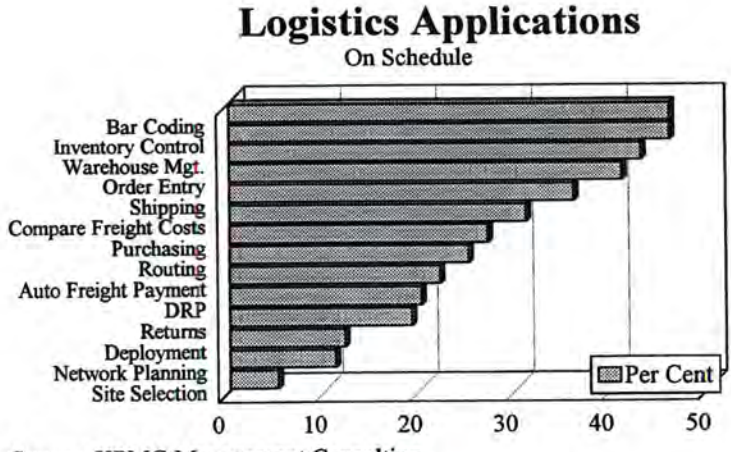
Medium projected savings from supply chain reengineering range from 10 % to 75 % of the total logistics budget. Almost all firms are tracking one or more customer service measures. Logistics software applications are rapidly growing, although some implementation problems are evident.



Source: KPMG Management Consulting



Source: KPMG Management Consulting



Source: KPMG Management Consulting

VIII. CONCLUSIONS

1. The transportation intensity of the Canadian economy has generally declined over the past 20 years, although certain industries are experiencing a rising transportation intensity, i.e., transportation costs as a per cent of production costs.

2. Those industries experiencing rising transportation costs in relative terms are likely purchasing more transportation services in order to lower their overall logistics costs by relying to a greater extent on more frequent and perhaps better trucking services.

3. Canadian companies have made major structural shifts in their inventory holding patterns and in the manner in which they carry out their logistics practices, i.e., getting their goods and services to customers. These changes are being driven, in the main, by new global trading patterns associated with more demanding customers and especially by the emergence of information technology.

L'IMPACT DE LA DÉLÉGATION DE RESPONSABILITÉ DANS LES ENTREPRISES ET LES DÉCISIONS EN MATIÈRE DE TRANSPORT

Jacques Picard, Université du Québec à Montréal

I. Introduction

La société canadienne ainsi que la plupart des pays du monde occidental font l'expérience depuis un certain nombre d'années d'une crise de rentabilité. De nombreuses entreprises et industries qui étaient relativement prospères se sont retrouvées assez rapidement confrontées à une situation de crise financière. Cette crise s'est manifestée particulièrement par une baisse de revenus qui a conduit par voie de conséquence à une baisse de rentabilité. Un certain nombre de raisons ont pu être avancées pour expliquer ce phénomène: La fin de la guerre froide, la crise immobilière, la concurrence de pays nouvellement industrialisés facilitée entre autres par les baisses de coût transport, l'amélioration des communications, des techniques de production en petites séries, etc. Il n'en reste pas moins que la plupart des entreprises canadiennes ont dû pour ne pas sombrer trouver des moyens de se refaire une santé. Comme dans bien des cas il semblait impossible en raison de la concurrence toujours plus féroce d'augmenter les prix (ou plutôt de ne pas les réduire); il a fallu sabrer dans les dépenses. A cet effet un grand nombre de firmes canadiennes ont implanté une politique de réduction de leurs coûts d'opération.

II. Les politiques de rationalisation des dépenses

En principe les dépenses dans une entreprise n'existent pas sans motif. Pour une raison ou pour une autre, quelqu'un dans la firme a dû à un moment donné de l'histoire de l'entreprise considérer qu'une telle dépense était nécessaire pour générer de manière directe ou indirecte des revenus. Il n'en demeure pas moins que très souvent lorsqu'on examine attentivement l'ensemble des opérations de l'entreprise, on réalise que certaines dépenses ne se justifient plus, et ceci pour diverses raisons possibles. D'abord parce que les revenus générés ne sont pas suffisants pour de telles dépenses. Il est aussi possible que des moyens nouveaux (technologiques ou autres) permettent d'atteindre les mêmes objectifs, en termes de revenus nets, à moindre coût. Une véritable rationalisation des coûts débute

donc d'abord par un processus d'analyse permettant de percevoir quelles sont les dépenses de l'entreprise qui ne se justifient pas économiquement soit en raison de la faiblesse des revenus qu'elles génèrent soit en raison de l'existence de moyens moins dispendieux pour les réaliser. Cette première étape d'analyse ne doit cependant pas conduire nécessairement à l'élimination de ces dépenses. Il faut entre autres, veiller à ce que dans l'hypothèse d'une telle élimination, les revenus de l'entreprise ne soient pas plus affectés que prévu initialement. On retrouve en effet, dans l'histoire des coupures de coûts dans les entreprises, de nombreux cas où ont été éliminés des "loss leaders", et de ce fait la réduction de certaines activités, s'est avérée nocive pour la rentabilité des firmes dans la mesure où les revenus auxquels elles ont dû finalement renoncer ont excédé les économies générées par l'élimination de ces activités. Il est donc absolument crucial dans toute tentative de réingénierie d'être conscient des relations systémiques existant dans l'entreprise et de reconnaître l'impact d'un changement particulier sur l'ensemble des activités de l'entreprise. Pour cela il est bien évident qu'une vue d'ensemble et une compréhension globale de l'entreprise est absolument cruciale. C'est d'ailleurs effectivement de cette manière que certaines organisations ont réussi, dans le cadre d'une stratégie globale et cohérente déterminée par leurs plus hauts cadres dirigeants, à effectuer des retournements spectaculaires en termes d'efficience et de rentabilité des opérations.

Malheureusement, cette aproche n'a pas été suivie universellement, et dans de nombreux cas les directives de la direction générale se sont réduites à exiger des compressions de coûts auprès de chaque secteur de l'entreprise. Si ce type d'exigences peut se justifier dans des circonstances bien précises (réduction de coûts d'un très faible pourcentage, et de façon non récurrente), elles sont à long terme contre productives. En effet une telle approche ne tient aucunement compte de l'existence de systèmes dans la firme, où coûts et revenus interagissent. Une illustration particulièrement saisissante de ce type de phénomène s'est produite l'année dernière.

Au Québec, le gouvernement provincial ayant exigé de tous ses ministères de réduire leurs dépenses d'une certain pourcentage, le ministère du revenu a dû renoncer à utiliser les services d'employés temporaires qui chaque été aidaient à la vérification de centaines de déclarations d'impôts. Cette mesure permit une économie de trois millions de dollars, en dépenses. D'un autre côté ces mêmes employés arrivaient traditionnellement à récupérer 150 millions de dollars d'impôts non payés. Par conséquent, pour économiser trois millions on a renoncé à 150 millions de dollars de revenus. Cette histoire a été révélée par la presse québécoise, combien d'autres existent dont on ne parle pas ?

C'est dans le domaine du transport et de la logistique que l'on retrouve souvent au niveau des entreprises commerciales les résultats des politiques de

compression de coûts indiscriminés les plus désastreux. En effet, comme d'autres l'ont dit avant nous, les coûts associés à la distribution sont interreliés. Si l'on tente de diminuer les coûts de transport, on peut sans doute dans certaines circonstances y arriver en trouvant des moyens plus économiques pour véhiculer la marchandise à son client sans que ce dernier n'en souffre en aucune façon. Le plus souvent, cependant, la réduction des dépenses en transport se fera aux dépens du client ou alors, en augmentant d'autres dépenses associées à d'autres éléments de ce qu'on appelait autrefois le coût total de distribution[1] et que l'on dénomme maintenant coût logistique total[2]. Ainsi, afin de ne pas allonger le délai de livraison à ses clients une entreprise ayant réduit ses coûts de transport en utilisant le train plutôt que le camion se voit obligée d'installer des entrepôts dans les diverses régions géographiques qu'elle dessert. Ceci n'est pas un mauvais choix dans la mesure où l'on a effectivement calculé l'impact du passage à un mode différent de transport sur les dépenses d'entreposage. Malheureusement dans le cas où les réductions de coût de transport ne se sont pas faites dans le cadre d'une politique de minimisation du coût total logistique, mais plutôt suite à une pression de la part de la direction de réduire les dépenses, il est fort probable que l'effet d'une telle diminution aura comme effet soit une augmentation du délai de livraison (donc une réduction du service à la clientèle et fort probablement une baisse des ventes) soit un accroissement des coûts d'autres éléments du coût logistique total (frais de manutentions, entreposage, stocks, assurances, empaquetage, etc.).

Il est donc évident que l'on ne devrait pas dans une entreprise essayer de réduire les coûts de transports ou les coûts d'inventaire ou les coûts de manutention. Le faire serait s'exposer à la sous-optimisation. Il est donc avisé de tenter de réduire l'ensemble du coût logistique total. Or, ceci ne peut être fait que si, d'une part, un individu au moins, comprend le système de distribution dans son ensemble et que d'autre part la responsabilité du coût logistique total lui incombe. Le rôle de ce responsable sera non pas de fixer des normes de diminution des dépenses à chacun des départements qu'il chapeaute mais plutôt d'obtenir d'eux différents scénarios de coûts. C'est à lui que reviendra la charge d'effectuer les simulations nécessaires pour trouver la combinaison gagnante c'est-

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[1] Johnson, J.C. and Wood, D.F., Contemporary Physical Distribution, P.P.C. Books 1977, p. 6.
Sont inclus dans le coût total de distribution le coût de transport, d'expédition, de traitement des commandes, manutention, empaquetage, assurances du fret, coût d'entreposage, etc.

[2] En réalité le coût logistique total inclut aussi les dépenses associées à la fourniture des matières premières à l'entreprise. Néanmoins, nous avons pour des fins de simplification adhéré à une définition plus restreinte du terme est équivalente au coût total de distribution physique.

à-dire la politique détaillée de distribution à même de minimiser le coût logistique total.

Cette étape cependant ne peut prendre place de façon isolée. Minimiser un coût total de distribution sans avoir au préalable déterminé les normes minimales de service à la clientèle que l'entreprise veut respecter, n'a aucune utilité. Une telle directive si elle était prise à la lettre, pourrait entraîner un arrêt total de la livraison de commandes. En effet, de cette façon on arriverait à un coût logistique total équivalent à zéro. Évidement on ne vendrait plus rien du tout non plus.

III. Détermination des normes de service à la clientèle

S'il est manifeste que c'est le coût total de distribution qu'il faut minimiser et ce sous la contrainte d'une norme minimale de service à la clientèle (délai maximal de livraison, etc.), le processus de détermination de cette norme est moins clair. On a souvent prétendu que c'était au responsable du marketing dans l'entreprise qu'incombait cette tâche. Le problème associé à cette solution est que le directeur marketing est le plus souvent si préoccupé par les ventes des produits de la firme qu'il risque d'exiger des normes de service à la clientèle trop élevée. Que veut-on dire par "trop élevée" ? Une norme de service à la clientèle sera trop élevée s'il est possible pour l'entreprise de faire des bénéfices plus importants, en abaissant ces normes. En effet il peut arriver qu'en diminuant ses exigences en matière de service à la clientèle, le coût de distribution économisé de la sorte, excède la perte de ventes correspondante à la réduction du service.

Il est donc nécessaire de déterminer la norme de service qui compte tenu des coûts logistiques qu'elle entraînera fournira le bénéfice maximal à l'entreprise. Pour cela il faut d'abord simuler plusieurs niveaux de normes de service au client, évaluer les ventes et les coûts logistiques correspondant à chacun de ces scénarios, et choisir finalement le niveau optimal.

A qui doit incomber cette tâche ? A notre avis aux cadres supérieurs de l'entreprise, c'est-à-dire à ceux qui sont directement responsable à la rentabilité de celle-ci.

Cette tâche n'est certainement pas aisée, mais le résultat final d'un tel processus sera de loin le plus effectif. En effet, dans un tel contexte les responsables d'activités doivent remettre à l'échelon supérieur les différents scénarios de coût par rapport aux résultats possibles relatifs à leurs activités. Ainsi par exemple le responsable du transport devra décrire les différentes alternatives de moyens de transport et de groupage de commandes pour

destinations en terme de coût et de délai de livraison. De la même façon le responsable de l'entreposage devra illustrer les différentes possibilités en terme d'addition d'entrepôts dans différentes régions et le coût total d'opération de ces entrepôts. Une fois les scénarios effectués à ce niveau là, c'est au coordinateur de ces activités (dans notre exemple le responsable de la distribution ou de la logistique) de déterminer pour chaque niveau possible de normes de service au client (pouvant être définies par exemple comme délais de livraison exprimés en heure), quelle sera la façon d'organiser l'ensemble de la distribution physique de la manière la plus économique. Le responsable marketing de son côté déterminera pour différents niveaux de service possible au client quelles seront les ventes que l'entreprise peut espérer faire. Ce sera finalement aux membres de la direction générale de déterminer la norme de service à la clientèle minimale sur la base de ces informations et aussi sur la base des nombreux autres facteurs qui peuvent rentrer dans l'équation (système de production, existence de syndicat, capacités financières, etc.).

C'est parce que l'entreprise est une interconnexion de systèmes et que la direction supérieure est la seule qui en connaît vraiment les rouages que c'est à elle qu'incombent ces décisions. On peut donc parler d'une délégation en sens inverse (reverse delegation) des décisions dans l'entreprise.

Cependant pour que l'entreprise soit réellement efficace, les choses ne doivent évidemment pas en arrêter là. Il faut encore que les unités opérationnelles, une fois fixées les contraintes auxquelles elles sont confrontées, tentent de réaliser les meilleures économies possibles (ou dans le cas des marketeurs les plus hauts revenus). Ainsi une fois la norme de service à la clientèle établie, le responsable logistique devra toujours essayer de minimiser encore plus le coût total. Le directeur du transport devra donc dans le cadre de la politique de distribution déterminée par le responsable logistique tenter toujours plus de réduire les coûts de transports.

L'idée générale de notre argument n'est pas de bureaucratiser ou centraliser l'entreprise mais plutôt de faire en sorte que les unités d'opérations ne soient pas entraîner à faire de la sous-optimisation. La haute direction de l'entreprise ne peut plus se contenter d'arbitrer les conflits entre les différentes unités, elle doit au maximum tenter de les éviter en faisant en sorte que chacune d'entre elles connaisse le cadre de contraintes dans laquelle elle opère.

C'est aussi à la haute direction qu'incombe dans le cas de turbulence dans le système (par exemple, une difficulté d'approvisionnement, un contrat inespéré), la tâche de réassigner et redéfinir les contraintes dans lesquelles opèrent les unités fonctionnelles. La raison en est toujours la même: ne pas imposer à différentes

unités des objectifs contradictoires, à même de mener à la sous-optimisation globale.

Il est bien évident que ce que nous avons dit à propos du transport et de la logistique est tout aussi vrai pour d'autres secteurs de l'entreprise. Ainsi c'est toujours à la haute direction de déterminer les normes minimales de qualité de produit imposées aux unités de production, les normes minimales de liquidité imposées au département de finance, etc. C'est encore l'interconnexion entre les différentes décisions dans l'entreprise qui fait de l'approche systémique, donc celle où seuls ceux qui ont accès à l'ensemble des informations peuvent déterminer les politiques à suivre, la seule envisageable.

Il est évident que pour atteindre un tel objectif les cadres supérieurs de l'entreprise doivent posséder une connaissance quasi-intime de tous les éléments qui ensemble affectent le succès de l'entreprise. C'est la raison pour laquelle, il sera de plus en plus nécessaire d'avoir à la tête des entreprises des individus communément décrits comme super-généralistes, capables de bien comprendre toutes les facettes de l'organisation dans laquelle ils opèrent.

Conclusion

Dans cet article nous avons tenté de démontrer qu'il ne peut y avoir de véritable rationalisation des coûts en matière de transport et distribution que dans le cadre d'une réflexion faite au niveau de l'ensemble de l'entreprise et selon une approche systémique. Pour cela il est nécessaire que les cadres supérieurs de l'entreprise, plutôt qu'exiger des unités de base de couper leurs coûts selon un certain pourcentage, acceptent de "se compromettre" en établissant des politiques claires et si possibles quantifiées sur un certain nombre de normes à respecter (entre autres au niveau de la qualité des prestations, des délais de livraisons et d'approvisionnement). C'est seulement une fois ces normes établies que pourront s'effectuer les efforts de réduction des coûts en général et ceux de transport et logistique en particulier.

Canadian Transportation Research Forum

Submission

Assessment of the Competitiveness of Canadian Supply Chains

Canadian Transportation Research Forum

Assessment of the Competitiveness of Canadian Supply Chains

INTRODUCTION

This paper sets-out the case that to be competitive, it is no longer sufficient for our supply chains to simply transport goods from door to door. Even the Just-In-time delivery of goods is too narrow an approach to compete. There is a need to focus private and public policies on the better management of inventories through all marketing, production and distribution activities among all parties in the supply chain. This new paradigm focuses on shipper rather than carrier requirements.

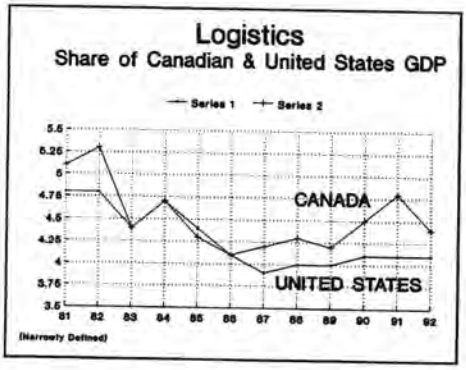
Logistics is a fundamental business process carried out by all companies. It is driven by time based competition and enabled by advanced communications. Leading edge logistics practices are geared to serve the needs of the total business process rather than just the logistics process itself. Supply chain performance is measured by the ability of logistics systems to improve customer service, lower costs and increase market share for not only the firm; but, all participants in the supply chain.

Production cost advantages have diminished to the point that competition is now based on who can provide the best service to consumers, as well as remain price competitive. Consequently, the reliability and flexibility of logistics services to deliver the right products, at the right price and at the right time has become a critical part of the business strategies of companies to increase their market shares.

Canadian supply chains may not be as competitive as those of our foreign competitors. At issue is whether Canadian users and suppliers of logistics services have been able to restructure their business practices in response to an increasingly customer driven business environment, and to more open competition in a global marketplace.

Logistics, broadly defined, involves business activities and services used to move materials and information through supply chains from their source to points of consumption at the least cost and in the optimum time to meet customer service requirements. It is an activity which consumes more GDP than our health care or educations systems.

This chart shows the trend of logistics GDP over time in Canada and the United States. In Canada, logistics narrowly defined to exclude the internal logistics activities of the firm is estimated to have constituted 4.8% of Gross Domestic Product (GDP) in 1991. It is clear that logistics requires a very significant quantity of economic resources.



More broadly defined to include the internal or private logistics activities of producers and distributors of goods, the total economic cost of logistics in Canada is estimated to have constituted 7.6% of Canadian economic activity in 1991. Private logistics activities of shippers include purchasing, order processing, private fleets, packaging, insurance, storage, trade documentation activities. This figure is considered to be low due to the lack of some of the private sector logistics data. Some experts estimate total logistics cost to be closer to 8.5% of GDP.

THE NEW ECONOMY

The business environment in the 1990s is significantly different from that which existed in the previous decade. Competition in the New Economy is customer driven. It is based on knowledge of the business environment, rapid access to information, capitalization on new ideas, creation of strong business relationships and the application of technologies.

There have been major changes in markets, technologies and government policies. The production, distribution and marketing of goods have become more global. The worldwide lowering of tariffs and the creation of large trading blocks has forced firms to adjust their business practices to remain competitive. This new market environment depends on customer service and time-based competition. It is

supported through strategic alliances, particularly those with third party logistics services. The most important technological development has been electronic commerce. In respect to policies, governments have reduced or eliminated barriers to competition and changed trade patterns. Examples are transportation deregulation and the North American Free Trade Agreement.

Companies are taking a continental approach to their business strategies and restructuring their business practices. Action includes the rationalization of sources of supply for products and services, and the restructuring of production and distribution facilities to serve the North American market. In response, shippers, carriers and logistics providers are forming strategic alliances to create systems which have reduced costs and improved customer service.

TRENDS

Supply Chain Requirements

Domestically, the manufacturing sector is the still the major user of logistics, as measured by the demand for transportation services. However, its use of logistics services has declined in recent years. Historically the largest consuming industries of transportation services have been the Pulp and Paper industry, Chemical and Chemical Products, Automotive, Food and Steel industries. Other volume users include the Primary Steel industry, the Food industry and the Motor Vehicles industry. Of the top 20 users of transportation services in the manufacturing sector in 1971, all but three were in the top twenty in 1990.

Internationally, according to an internal study by Transport Canada[1], there have been changes in the mix of commodities being exported from Canada to the other countries. An increasing share of exports tend to be more highly processed products. Changes in the shipping strategies to provide quicker customer response services also increased the need for faster transportation.With better transportation services at reduced rates, shippers now can afford to use faster transportation modes. These changes in the mix of Canadian commodities transported in our international trade and other factors are affecting modal choices.

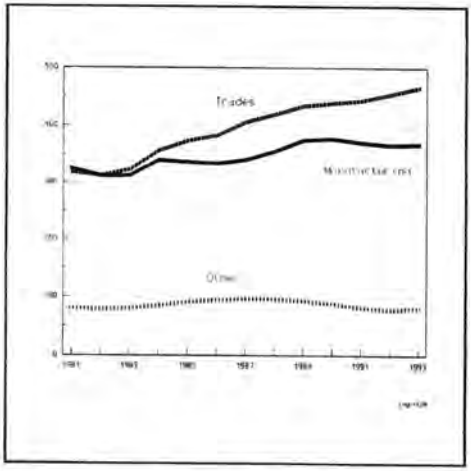
Traditional rail and water carriers are losing ground to the truck and air modes. Motor carriers have added 20% to their market share since 1976 and accounted for 54% of the transportation market in 1992. More higher valued, service sensitive products, such as motor vehicles, communication equipment, and industrial machinery are moving into the United States by truck. Air more than doubled its market share to 8.5%. Rail lost 4% of its share to hold 13% of the market. Water's drop of 6% its market share brought it to an 18% share.

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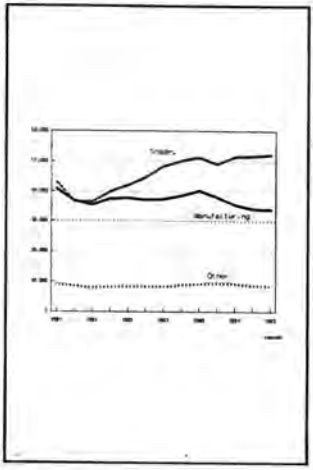
[1]**A Profile of Canadian Trade and Modal Shares**
Economic Research Branch, Transport Canada

Inventory Management

The charts below show that the value of inventories held in both Canada and the United States have been increasing. However, when compared to economic growth, firms on average are holding less inventories today than they did, a decade ago. The cost of holding inventories as a percent of GDP has declined.



U.S.: Non-Farm Business Inventories (Constant $, Billions)



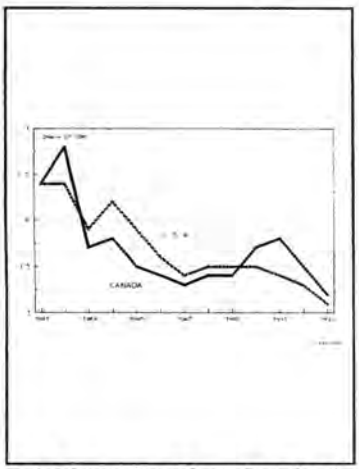
Canada: Manufacturing & Trades Inventories (Constant $, Millions)

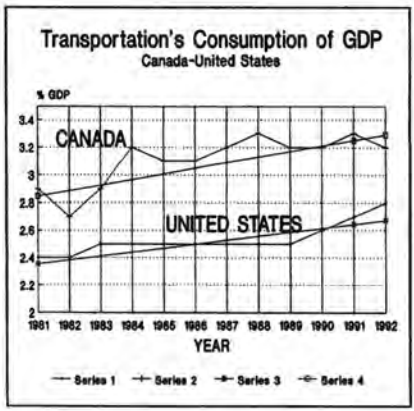
A greater value of inventories are being held by wholesalers and retailers (trades) than manufacturers. This shift may suggest a major change in North American inventory management practices. This trend is more pronounced in Canada than in the United States. In Canada, the trades share rose from 46% in 1981 to 55% in 1993 while in the United States the Trades share rose from 44% in 1981 to 51% in 1993.

This may reflect structural differences in the integrated logistics management of the flow of inventories through supply chains from points of production to consumers. This may be due to a lag in Canada's adoption of applications of electronic commerce. Other reasons may be the more regional procurement and distribution of products in the United States versus the centralized production of goods in Canada for national distribution, as well as more advanced development of intermodal and shipper/carrier strategic alliances in that country.

Transportation

It would appear that lower transportation prices are allowing firms to trade-off the use of more transportation to lower inventory carrying costs and provide better customer service. More transportation services are being used due to the overall growth in the economy. Inventory holding costs as a share of GDP have been on the decline. The influence of interest rates appear to have been less of a factor in inventory holding costs in the United States than in Canada.





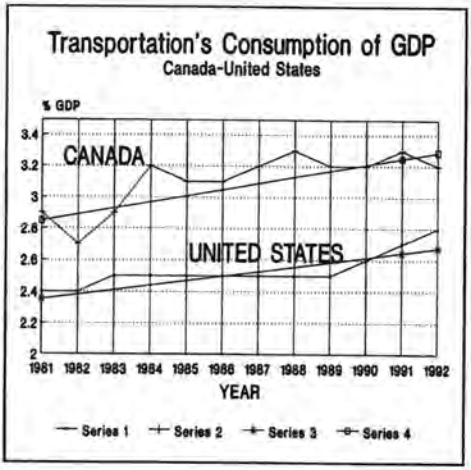
Total Inventory Carrying Cost as a Share of GDP (Canada and the U.S. Compared

Transport Canada[2] research on trucking prices notes "*Trucking prices were basically flat, with nominal increases of 4% between 1986 and 1991. In real terms, the cost of trucking for users has dropped by 15% over this period*". There have been sharp gains in labour productivity reported by the National Transportation Agency, as measured in revenues per tonne-mile per employee. As the sector restructures, the relative importance of labour in the overall cost structure of transportation services providers is decreasing. In all transportation industries, telecommunications expenditures have grown faster than production; as well, business services have risen in relative importance in all industries. The Truck, Air and Rail industries experienced a significant growth in the cost of insurance, as well as financial services provided by the banking and trust industries between 1970 and 1990.

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[2]**Trucking Price Indices 1981-1992**
Economic Analysis Directorate, Transport Canada

In general, transportation has become a smaller percentage of the operating costs for the majority of producers and distributors of goods in Canada. A few large industries are experiencing greater transportation intensities, where transportation is becoming a larger percentage of the value of goods sold. However, The transportation component of GDP experienced low and stable growth over the last decade in Canada and the United States. In 1992, freight transportation represented 3.2% of GDP. The supply of transportation services grew 3.0% annually from $11.7 billion in 1981 to $16.2 billion in 1992.



This chart presents the GDP consumed to supply transportation services in Canada and the United States. Canada consistently consumes on average approximately 15% more labour and capital in producing transportation services. Over the period from 1981 to 1992, there is a higher rate of growth in transportation GDP in Canada than in the United States.

No conclusions on competitiveness can be drawn from this comparison due to structural differences in the Canadian and United States economies. Some structural differences are geographical, goods produced, transportation services, distances required to ship products to domestic and international markets, shipment lot sizes, traffic densities, levels of capital investments in transportation infrastructures and equipment, or overcapacity in the supply of logistics services.

This fact raises more questions than providing answers. It does present a challenge for further research to determine underlying factors and their impact on the competitiveness of Canadian supply chains. For example, has Canada overbuilt its transportation infrastructure?

ISSUES

The importance of supply chains to the competitiveness of industry is reflected by the logistics practices used to respond to the demands of the New Economy. The competitiveness of Canadian supply chains can be qualitatively measured by comparing the effectiveness of Canadian and United States responses.

Some new initiatives include the restructuring of distribution channels and the application of electronic commerce. Other changes in the management of supply chains are re-engineering, rationalization of production and distribution systems, rationalization of sources of supply for products and services, and the use of strategic alliances. Current research[3] in Canada shows:

Issue 1.	**A significant gap exists in the logistics performance of Canadian companies and United States companies**

Canadian companies have failed to match United States logistics performance. It was found that they have not introduced effective logistics strategies and tactics through logistics improvement programs in the areas of customer and supplier interfaces, warehousing, transportation, and materials management. There have been some improvements in service and distribution productivity. It is expected that future progression will be generated in the areas of information and materials management other than in the traditional areas of transportation and warehousing.

Issue 2.	**Canadian distribution channels are operating at a disadvantage with their United States counterparts**

Canadian channels are composed of relatively more retail and wholesale establishments. Canadian establishments tend to be about one-half the size of United States wholesalers and retailers. Products made in the United States and brought into Canada actually pass through an additional level of distribution channels in our supply chains. These structural differences affect distribution and inventory management efficiency.

In international trade, the creation of effective channels and distribution efficiencies is hindered by the small size of our domestic market. We often lack sufficient volumes of traffic to enter into distribution agreements with foreign nationals. In these cases, Canadians have found it more effective to distribute their goods through United States or large distributors in other countries. The downside of this arrangement is that often Canadian goods become secondary sources of supply. Part of the cause of this situation is a general trend for Canadian manufacturers to sell on a F.O.B factory door to export markets due in part to low volumes of trade or the lack of knowledge to establish international supply chains. This might be overcome through greater shipper /carrier cooperation in establishing shipment consolidation services and foreign distribution hubs for these markets.

[3] **See Bibliography**

Issue 3.	**Canadian industry is lagging behind the United States in the use of electronic commerce, particularly by small business.**

A 1993[4] survey revealed that the percentage of Canadian respondents with action plans in place to convert from manual to computerized order processing was 67%, while in the United States the figure was 75%. A higher percent of United States companies had plans for productivity improvement programs, such as on-line confirmation of stock availability and centralized order entry systems.

Issue 4.	**There are no comprehensive logistics performance indicators to help Canadian industry develop supply chain strategies**

Little information exists on the comparison of the competitiveness of Canadian supply chains with their foreign competitors. Collecting logistics information is difficult due to its application across many sectors, particularly in respect to service factors.

Another research challenge is the establishment of logistics performance measures. Comparisons at firm or sector levels for specific groups of products could provide valuable insights into the competitiveness of the supply chains of companies. It is an area that is just being studied and provides an opportunity to evaluate vendor performance. Starting from market requirements, a more rigorous comparison would need to look at the impact of a multitude of interrelated factors.

Issue 5:	**Canadian traffic and trade densities are considered by carriers and shippers to be a major transportation and channel efficiency competitiveness problem.**

Despite the downward pressures on transportation rates, Canadian carrier prices and service levels are still considered by some shippers to be higher than those available to them in the United States.

Differences in the scale of the Canadian economy and geographics are considered by many to be the cause of competitive differences in Canada-U.S. transportation costs. Similarly, the lack of world scale sources of supply of Canadian products raises problems in finding sufficient volumes of traffic. Combined with traffic lane imbalances carriers face difficulties in serving their clients.

[4]Doing Business on the Information Highway
Canadian Electronic Commerce Committee

Some solutions to this situation include rationalization of Canadian supply chains and the greater use of strategic alliances to develop volumes and traffic densities. In international trade, the use of free trade zones is considered by some interest groups, as a way to develop consolidation and breakbulk hubs for this purpose.

Leading motor carriers are interested in addressing the issue through the development of North American traffic lanes. They would like to see a deregulation and harmonization of North American carrier licensing.

Issue 6:	**There is a consensus among logistics services, particularly among carriers and forwarders, on the need to raise the awareness of Canadian shippers of the importance of transportation and logistics to their competitiveness.**

Canadian forwarders have noted the trend for Canadian exporters to exclude logistics in their marketing plans. They consider this practice to be a major disadvantage against U.S. and Japanese competitors, who include logistics in their marketing and distribution business processes.

ASSESSMENT

Although there are opportunities to improve Canadian supply chain performance, our assessment of Canadian logistics performance is positive. Canadian business appears to be managing inventories, as well as United States competitors. Productivity gains have occurred in the transportation sector. Canadian shippers are enjoying lower transportation prices. However, Canadian carriers are facing more foreign competition from new entrants into the market, in particular, the U.S. motor carriers. Similar pressures exist for Canadian shippers, as foreign distributors enter Canadian markets with more efficient supply chains.

There are opportunities to enhance the competitiveness of Canadian supply chains. Canada needs to improve its application of electronic commerce, its domestic and particularly its international distribution channels, and the integrated management of inventories. Of particular importance is the need to obtain more detailed information on the relative competitiveness of Canadian and United States supply chains for products.

Canadian firms are adopting new supply chain management techniques to remain competitive. They are forming shipper-carrier strategic alliances, out-sourcing logistics services, rationalizing service suppliers and distribution facilities, and opening new distribution channels. While these are positive measures, it is not known how well some of them are being applied in comparison with foreign competitors.

STRATEGIES AND PUBLIC POLICIES

Recognition of what factors have the greatest impact on the competitiveness of firms is the first step in establishing strategies and public policies. It is contended in this paper that total supply chain cost and service requirements must be considered rather than a silo approach to looking at pieces of the supply chain or the needs of individual firms in each link of the chain. Action must be based on practical initiatives that can be carried out by industry or in partnership with governments.

Japan is an example of a country using supply chain strategies to enhance its industrial development and trade. It has a service based trade strategy which allows firms to quickly identify market opportunities and use shorter order cycle times to respond to these market opportunities ahead of competitors.

Canada's product mix may require different strategies. Should we focus on reducing supply chain costs, improving service levels and/or simply using existing distribution channels more effectively. For low value-high logistics cost products, reduction of supply chain costs may generate increased market shares, profits and jobs. For others with lower logistics costs, advantages may lie in the improvement of customer service using just-in time and efficient customer response techniques. In cases, where no cost or service advantages are achievable, we may need to focus on establishing better distribution channels to sell Canadian products. There are different options for different products. Each one must be carefully weighed before initiatives are taken.

Government and industry strategies exist for improving productivity and marketing products. However, none exist for improving the distribution of goods beyond the development of transportation systems. The challenge is to determine what government and/or industry logistics initiatives have the greatest pay-off for the Canadian economy to warrant action. The ultimate challenge is to find logistics solutions which optimize all requirements for the production, distribution and marketing of products when these activities are controlled by many diverse interests.

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A FEASIBILITY STUDY OF DEVELOPING THE EDMONTON SOUTHWEST RING ROAD AS A PUBLIC-PRIVATE PARTNERSHIP PROJECT

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1. Introduction

Due to fiscal restraint and other competing priorities, governments can no longer rely solely on traditional sources of funding for new infrastructure construction. Emphasis is often placed on maintaining existing infrastructure, and funding for new construction is dwindling. Despite the fiscal realities, demands for additional roadway capacity to meet traffic growth and to serve new development continue. Governments must explore other non-traditional, innovative ways to finance infrastructure projects.

The concept of public sector forming partnerships with private sector in joint ventures is not new. However, the traditional role of private sector in public works projects is usually limited to provision of design and construction services. The public-private partnerships are now expanding into areas of project financing, risk sharing, facility ownership, maintenance and operation.

Using public-private partnerships to build toll roads is gaining momentum in Canada. The Highway 407 project in Toronto and the Fixed Link to Prince Edward Island are two prime examples. British Columbia is considering tapping into private sector resources to assist in adding capacity to the Lion's Gate Bridge crossing in Vancouver. Collaborating with the City of Edmonton and with the assistance of Price Waterhouse, Alberta Transportation and Utilities undertook a case study to assess the feasibility of public-private partnerships in transportation infrastructure in Alberta. This paper briefly summarizes the process and results of the study.

2. Study Background - An Alberta Context

The Alberta government is committed to balancing its budget and eliminating the deficit by the end of fiscal year 1996/97. Alberta Transportation and Utilities has reduced its budget from over $1 billion in the early 1980's to less than $600 million in 1994, a decrease of almost 50 percent. The austerity measures are expected to continue beyond the balancing of the provincial budget. The limited funds are understandably spent mostly on rehabilitation and maintenance of existing infrastructure.

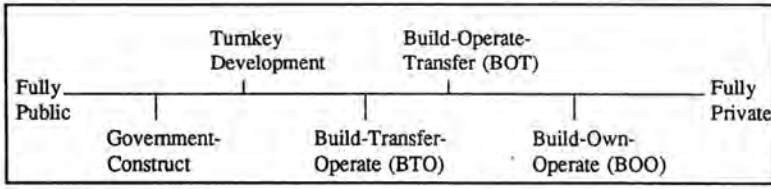
Determined to reduce the size of government, the Alberta government advocates the involvement of private sector in the delivery of government programs and services. The private sector is perceived to be inherently more efficient and innovative, and may be better suited to operate some of the traditional government functions. The recent privatization of liquor sales, motor vehicle and land title registrations marks the beginning of an era of reduced government and increased private sector involvement in Alberta.

In support of the government's overall direction, Alberta Transportation and Utilities strives to operate in a more business-like, user-pay environment. It recognizes the potential benefits of public-private partnerships in financing, building and maintaining infrastructure, and is exploring the feasibility of the partnership model for transportation projects in Alberta.

3. Public-Private Partnership Models

In order to attract private sector to invest in a project, there must be revenue streams or opportunities that allow private developers or investors to recover their investment and possibly make a profit commensurate with the risk involved. In a new road construction project, potential revenues include user charges (tolls), government subsidies, and/or other revenues captured from the development of the road.

A public-private partnership is defined by how the public and private sectors share risks, responsibilities and rewards. A successful partnership structure will combine the strengths of the public and private sectors to create a complementary relationship. Depending upon the extent and role of private sector involvement, public-private partnership models can be illustrated on a continuum of possibilities ranging from fully public to fully private. The five classical models described here are the most common for new road construction projects. They are briefly described as follows:



- **Government-Construct.** On one end of the continuum is the traditional government-construct (fully public) model where the public sector is responsible for initiating, planning, designing, funding, owning, operating, and collecting tolls (if it is a toll facility).

- **Turnkey Development.** Next to the government-construct model on the continuum is the turnkey development model. A private partner designs and constructs a facility to meet the performance objectives specified by the public partner. In most cases, the public partner would directly finance the project. However, the private partner may also be required to carry some financial risk and upfront part of the project costs, and is reimbursed by the public partner upon completing the project to the satisfaction of the public partner. The public partner owns the facility, and the same private partner may likely maintain and operate the facility under a maintenance contract.

  The government still finances the project, but makes use of private sector expertise, innovation and cost-effectiveness in the design, construction and possibly operation of the facility. The Highway 407 project in Toronto has become a turnkey model project with the Government of Ontario assuming the project financing.

- **Build-Transfer-Operate (BTO).** The model is similar to the turnkey model, but the private partner is required to finance the project and bear the financial risk. The private developer builds the facility and transfers the ownership to the public sector. The government then leases the facility back to the private developer under a long term lease. The private partner recovers its investment by charging user fees and capturing other revenues, such as the right to develop adjacent properties.

- **Build-Operate-Transfer (BOT).** This is the most common model for public-private toll roads. The private partner finances, designs, constructs, and operates the facility for a defined period of time as specified in the agreement with the public partner. When the term of the agreement expires (usually 20 to 30 years), presumably the private partner has recovered its investment, the ownership of the facility reverts to the government.

This partnership structure is common in most European toll roads and is serving as the model for the Pearson Airport development and Fixed Link to Prince Edward Island projects.

- **Build-Own-Operate (BOO).** In this scenario, the private partner is given the franchise to build, own, operate, and collect tolls in perpetuity. The project is like a private facility but the user charges are regulated by the government, who may also specify safety and service standards.

There are a variety of interrelated considerations, from both the public and private sector perspectives, that determine the appropriate partnership model and the unique deal structure arising from negotiations among the partners. One driving factor that determines the position of the partnership model on the continuum is the projected revenue coverage. This is the estimated profitability of the project on a stand-alone basis, determined by the extent of discounted project costs covered by discounted revenue from all sources.

A project with a low projected revenue coverage or high market risk is a likely candidate for a government-construct or turnkey model, funded mostly by the public sector. On the other hand, a project with a high projected revenue coverage tends to be attractive to private investors, and drive the partnership model toward the fully private end on the continuum.

4. Case Study Project Selection

The road construction industry in Alberta has expressed interest in public-private partnerships in constructing toll roads, and taken the initiative to press the Alberta government to consider them. In response, Alberta Transportation and Utilities decided to undertake a case study to assess such feasibility. First and foremost, a ranking process was devised to select potential case study projects that would be ideal for toll road development.

At the outset, two fundamental criteria were established in selecting potential case study projects. Firstly, tolls would be applied to new roads only. The case study would have to be a new road construction project. This criterion excluded the "wraparound addition" model where tolls would be charged on an existing road and used to finance an addition or improvement to the facility. Secondly, alternate "free" routes would be available for motorists who choose not to use the toll facility. These two basic underlying criteria would be required to gain public acceptance, which is critical to the success of toll roads and public-private partnerships.

Other selection criteria that are also crucial to the success of any toll road project are summarized below:

- Project Financing
    - Ability to generate high toll (traffic) and other revenues.
    - Extent of public (provincial and municipal) and private sector financial participation.
    - Total costs of project.
    - Potential economic stimulation and job creation.
- Network Compatibility / Accessibility
    - Provide overall transportation system improvement.
    - User benefits (travel time savings).
    - High development potential for adjacent lands.
    - Reduce congestion or delay needed improvements on adjacent roadways.
- Ease of Implementation
    - Availability of right-of-way and design plans.
    - Attractiveness to municipalities.
    - Minimum impact on adjacent land uses (environment, residents, and other stakeholders).

It was apparent that any potential toll road project would have to be in a major urban centre where the traffic demand is high enough to support it. A number of projects in the cities of Edmonton and Calgary were assessed and ranked based on these criteria. The Edmonton Southwest Ring Road emerged as one of the projects having the highest potential for toll road development.

5. Edmonton Southwest Ring Road Case Study

Since the early 1970's, plans have existed for a complete transportation and utility corridor around Edmonton, including a freeway-standard ring road. The ring road, when completed, will provide a continuous link for all the primary highways through the city. The Alberta government has acquired most of the necessary land for this corridor. In 1991, a 3.2 kilometre first section of this ring road was completed as 4-lane at-grade facility between the major east-west routes of Whitemud Drive and Stony Plain Road in the west sector of the city. The proposed Southwest Ring Road extension would connect Highway 2 (Calgary Trail) in the south end of the city with the existing ring road at Whitemud Drive,

as shown in Figure 1. Highway 2 is the main north-south highway connecting the two major cities in the province, Edmonton and Calgary.

From a provincial perspective, this section of the ring road provides an important link between Highway 2 in the south and the Yellowhead Highway (Highway 16) in the west of the city. The present connection via Whitemud Drive has multiple at-grade signalized intersections on the connecting roads, and already carries a significant volume of traffic. Future costly improvements on the existing route will be required to increase the capacity if alternative routes, such as the Southwest Ring Road, are not provided.

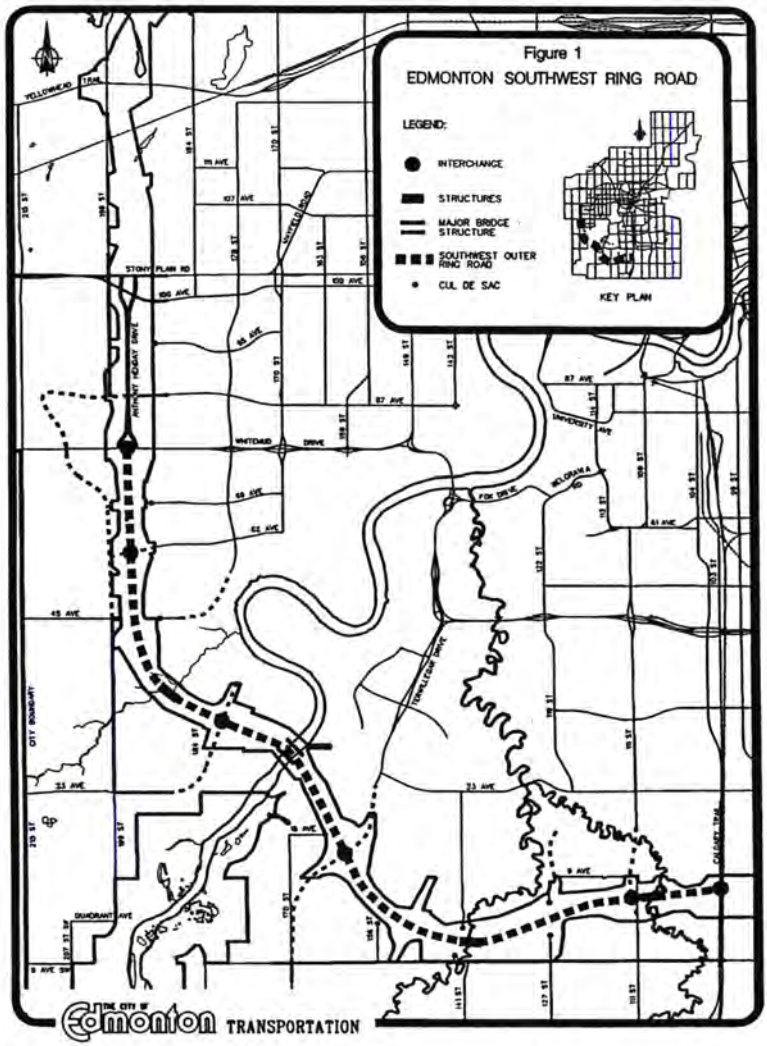
The proposed Southwest Ring Road is 17.4 kilometres long, and includes a crossing of the North Saskatchewan River, 4 miles south of the nearest existing bridge crossing. The adjacent land inside the roadway is zoned for residential use, and is expected to be fully built out in a 20-year time frame. Presently, the adjacent land outside the proposed road is predominately agricultural/acreage development, and no alternative land uses are currently approved.

The Southwest Ring Road will serve both "through" traffic, passing through the southwest sector of the city, and "local" traffic generated by the adjacent land. Four intermediate access points to the proposed Ring Road are planned, as shown in Figure 1. The Ring Road would be constructed as a 4-lane high standard roadway with a 100-km/h operating speed. In the initial stage, the traffic volumes at three of the access points can be handled by at-grade intersections with free flow movement on the Ring Road, with interchanges required in around a 10-year time frame.

A 20-year financial analysis was conducted of the total costs of construction and operation of the Southwest Ring Road facility as a toll road, compared to potential toll revenue estimated from traffic forecasts of roadway usage. Construction was assumed to take place over a 3-year period. This analysis work made use of available data and techniques to produce a broad estimate of financial feasibility of the toll project. The estimates of annual usage and revenue for the project were preliminary in nature. It was intended that more detailed analysis, including a rigorous market study, might be undertaken if the toll project was to be pursued further.

5.1 Toll Collection Method

Options for manual, electronic, or mixed toll collection systems were briefly studied. Developments in fully-automated toll collection have been rapid in recent years. They offer the most convenience for road users, with no


Figure 1
EDMONTON SOUTHWEST RING ROAD
LEGEND:
INTERCHANGE
STRUCTURES
MAJOR BRIDGE STRUCTURE
SOUTHWEST OUTER RING ROAD
CUL DE SAC
KEY PLAN
THE CITY OF Edmonton TRANSPORTATION

requirement to incur time delays to pay toll charges, and the lowest operating costs. Other studies have identified concerns with electronic tolling, based on the need to install special identification tags/transponders in vehicles, loss of privacy, and potential revenue losses for out-of-province users. These concerns can be overcome to an extent by measures such as licence video tracking, pass selling, and the use of restricted information accounts. In addition, the proportion of out-of-province users of the toll road is expected to be relatively small, as the majority of users would be Edmonton area residents and businesses.

For the purposes of this study, it was therefore assumed that a fully-automatic toll collection system based on automatic vehicle identification (A.V.I.) technology would be installed for this project. Transponder scanners would be placed at various points along the route, with vehicles paying a toll per kilometre. A toll collection method has not been selected but may include traditional user invoicing or prepayment by cash, cheque or credit card. For simplicity, it was also assumed that the toll rate would be uniform throughout the day, and apply evenly to all vehicles, although the technology exists for more sophisticated toll rate application to market demands.

5.2 Capital and Operating Costs

Capital costs of roadway construction, including six interchanges and a major river crossing bridge structure, were estimated to be $142 million (all financial figures are in 1994 dollars) to be staged over three years. Construction of three interchanges, totalling $33 million, could be deferred for ten years. Most of the land for ring road development is already owned by the Alberta government. Capital costs of the toll collection equipment were estimated to be $3.5 million. These were preliminary cost estimates and subject to further refinements.

Three types of operating costs were considered: ongoing maintenance items, periodic maintenance items, and toll collection. Annual maintenance costs such as street cleaning and snow removal were estimated to be $112,000 per year, based on the length of the roadway.

A major final overlay would be required in the fifth year of operation, costing about $4 million. In the tenth and fifteenth years, a $350,000 rehabilitation cost would be needed for each of the two years. Major road rehabilitation would also be required around the twentieth year of operation, but this cost is beyond the 20-year financial analysis period because of the 3-year construction time at the start of the project. Annual toll system operating costs were estimated at $500,000 in the first year of operation, rising by around $50,000 annually as traffic volumes increase.

5.3 Traffic Usage and Toll Revenue

One of fundamental assumptions behind this case study was that alternative routes would be available for those not wishing to pay a toll. From computer road network simulations, it was estimated that using the toll facility would result in around a 10-minute travel time saving at peak traffic times for vehicles travelling the full length of the toll road, over the alternative city routes. This peak period travel time saving would increase in the future as traffic volumes and congestion increase on other city roadways. At off-peak times, delays from traffic congestion would be less, and travel time savings associated with the toll facility would decrease to around 5 minutes, for a full trip. Travel distances for the alternative routes were similar.

Road users using the toll road facility would only use this facility if the benefits, shorter travel time and distance and less stops, outweighed the monetary costs of buying these travel features. This principle was used to make estimates of traffic that might use the toll road.

Using the EMME/2 transportation modelling package, the City of Edmonton had constructed a Regional Travel Model that predicted future auto and transit travel demand, and road and transit network usage, for the AM peak hour, for the entire Edmonton region. Future estimates of AM peak hour auto travel demand were available for 5, 10 and 20-year time frames, based on projected land use growth.

The model forecasts were adjusted to allow for additional land use development that might occur in the southwest sector of the city because of the presence of the major new toll road facility. The model road networks were also adjusted to include the toll road.

The travel model also contained a disaggregate nested logit mode choice model, estimated separately for work and post-secondary education travel purposes based on 1989 travel survey data. The work purpose utility functions for the auto driver contained both travel time and operating cost variables, from which a behavioural value of travel time could be calculated. The auto driver value of time for commuting work trips in the Edmonton area was known to be $11.77 per hour, or $0.196 per minute.

This value of time can be used to convert a proposed toll charge to an equivalent travel time penalty associated with using the toll facility. One dollar of toll charge is thus equivalent to 60/11.77=5.1 minutes of auto travel time for commuter trips, and one cent of toll is equivalent to 3.06 seconds of auto travel time. The proposed toll charge method was based on a per kilometre rate. For any link L kilometres in the road network, the effective travel time penalty

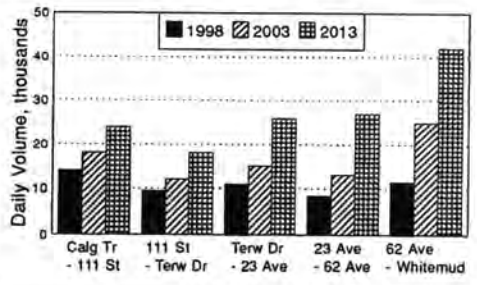
associated with a toll charge of $0.0C per kilometre is L*C*3.06 seconds.

This toll penalty time was coded into the link description for each link where the toll was levied. A normal equilibrium capacity restraint traffic assignment was then performed. The assignment process assigned vehicles to the toll facility if the travel time for the vehicle, including the toll penalty time, was shorter than any other route. Estimates of AM peak hour auto vehicles using the toll facility were therefore determined for 5, 10 and 20-year time frames.

In Edmonton, peak traffic volumes occur for around two hours in both the AM and PM periods, with PM volumes approximately the reverse of AM volumes. Peak period traffic volumes using the toll facility were calculated as four times the AM peak hour volumes. Peak period traffic also makes up around 30% of daily volumes, with 70% of traffic occurring outside the peak. For purposes of this study, off-peak traffic demand was estimated from AM peak hour estimates using these ratios. These off-peak trips were assigned to the road network on an all-or-nothing basis, as there was little congestion in the off-peak. Daily estimates of future usage of the toll facility were obtained by summing the peak period and off-peak numbers.

Different toll rates were tested, varying from 3 cents to 8 cents per kilometre. It was found that overall toll revenue was maximized with a toll rate of 6 cents per kilometre, equivalent to a toll charge of $1.04 for a vehicle using the full length of the toll road. Figure 2 gives estimates of daily traffic volumes using each section of the toll facility, over time, varying between 10,000 to 40,000 vehicles per day. Toll revenue was estimated by multiplying daily vehicle for each ring road section by the toll for that section. Annual revenue was estimated by assuming typical weekday travel volumes occur for 340 days per year, taking into account weekend traffic, and based on permanent counter data.

Figure 2. Average Daily Traffic Volumes
(Toll = $0.06/km)



This method of estimation of toll road usage and revenue made use of available techniques and information. Daily trip usage was derived from AM peak hour estimates. Commute to work values of time were used to represent all purposes. Studies for other areas have shown that while leisure trips have similar values of time to the commute for work purpose, other purpose trips, or persons such as retired people, generally have lower values. The value of time used was derived for the auto driver only, and did not take time values for other occupants into account.

Other studies have shown that auto passengers have a lower value of time than car drivers (in British Columbia, for example, adult car passengers value their time at 70% of the car driver, and children under 16 at 50% of the car driver). For this study, it was assumed that the offsetting factors of lower values of time for other purposes/persons were offset by higher values per vehicle when all occupants are taken into account.

The methodology also implicitly assumed that all drivers have perfect knowledge of travel times for all routes, that the use of an average value of time to represent all drivers is reasonable, that the value of time does not increase in real terms over time, and that there is no "toll resistance" because of the dislike of paying tolls. All drivers whose route including the toll facility and associated penalty was shorter than any alternative route would use the toll road. Other studies have shown that this toll resistance factor can be significant. Loss of potential toll revenue from toll resistance, combined with difficulties associated with toll collection for out-of-province users and payment evasion, might amount to as high as 20% of total revenue.

This potential usage/revenue loss is offset by the fact that for this study all users were assumed to pay the same toll. Certain users, particularly commercial vehicles, have a higher value of time because driver wages are taken into account, and vehicle operating costs are higher. Studies in Edmonton and British Columbia estimate commercial vehicle value of time in the $30 to $40 range. These vehicles would therefore be prepared to pay a higher toll to obtain the toll road travel benefits. Limited information available on existing truck movements indicates that these vehicles might make up 3 to 5% of the estimated toll road usage. A truck toll of three times the auto rate might produce additional revenue of 10% over original estimates.

Taking into account the potential for loss of revenue due to toll resistance, out-of-province users, and payment evasion, offset by potential extra revenue from certain user categories, the original toll revenue estimates were reduced by 10%, for use in the financial analysis. Potential annual toll revenue was estimated at $3.5 million in the year of opening, and would increase to $5.3 million in the

tenth year and to $8.9 million in the twentieth year.

5.4 Sources of Other Potential Revenue

There would be other potential revenues, in addition to tolls, that might be raised with the construction of the toll road. These included sale of surplus corridor lands, development-related off-site levies or impact fees, and creation of special assessment districts along the toll facility. Although revenue potential from these sources might be significant, in all cases restrictive operational or legislative barriers would have to be overcome. Issues of equity and double taxation can arise. The study concluded that it was reasonable to assume that some of the difficulties associated with the raising of other potential revenues would be resolved. Over a 20-year period, other revenues associated with the toll road construction might be in the order of 10% of total toll revenues.

5.5 Financial Analysis

A net-present-value economic analysis was performed on the Edmonton Southwest Ring Road toll road project, based on the above capital and operating costs, and toll and other revenues. A 20-year analysis period was used, with costs and benefits in future years discounted at an annual rate of 9%. This 9% rate is applicable for public sector capital projects, and is consistent with Government of Canada long term bond yield. Private sector projects might require a higher yield and discount rate.

The results of the financial analysis indicated that project revenues would only cover about 33% of overall costs, with the project having a negative net present value of -$77 million. Alternative land use growth scenarios were tested to see the impact on revenues and overall financial performance, but projet revenue coverage remained in the 24% to 34% range. Extending the analysis period to a 30-year period would not significant alter the analysis results, as a higher discount rate of 11% would be required to compensate for the increased risk of predicting revenues further into the future.

A projected 33% toll revenue coverage indicated that significant financial support from the public sector would be required to make the Edmonton Southwest Ring Road project of interest to the private sector. This would place major constraints on the form of any public-private partnerships that might be considered, with government having to play a major role.

6. Implementation Issues - A Government Perspective

There is a strong public perception that roads are to be "free" public services, supplied by public sector and financed by general tax revenues. Public resistance to toll roads and the involvement of private sector in controlling and operating roads cannot be underestimated. The proposed privatization of many traditional government functions in Alberta has already created considerable debate in the public arena. The idea of charging tolls for using roads is still a relatively foreign concept to most, and would face significant political barriers in Alberta, where Albertans enjoy a relatively low tax regime and no sales tax. To build the Edmonton Southwest Ring Road as the first toll facility would set a far reaching precedent for future road construction in Alberta.

Public acceptance is therefore very critical to the success of toll roads and public-private partnerships. Lack of public support may discourage politicians to proceed and ultimately affect usage of the facility and toll revenues. The concept of forming public-private partnerships to build toll roads must be well conceived, planned and communicated to the public in order to win acceptance. The challenge is convincing the public that change is necessary.

The government should develop a communication and marketing strategy to articulate the government's proposal and objectives. The public should be assured that the government has thoroughly assessed all options, including but not limited to public-private partnerships, and the partner selection process would be fair and open. It is also important to emphasize that without private involvement and charging user fees, the government would not be able to fund the facility with public money for a long time.

In Alberta, there are indications that public perceptions are changing, and the public is reluctantly accepting the user-pay philosophy. As the Alberta government moves toward reduced government size and role, the opportunity to pursue public-private partnerships still exists despite the political hurdles and potential public resistance. However, the initiative would have to be financially viable and driven by private developers and needs.

7. Implementation Issues - Financial Considerations

Forming partnerships with private sector provides access to new sources of capital and a wide range of flexible financing instruments including both debt and equity financing. Debt financing generally includes bank loans, investment from institutional investors, such as pension funds, and issuance of bonds for individual investors. Bonds are a common vehicle for government to raise funds when a

revenue stream, such as toll revenue, exists to match debt service payments. Private rates of return under debt financing are higher because infrastructure financing is still considered to be a high risk in North America, unless it is supported by government guarantees. Bonds for the Prince Edward Island Fixed Link project were issued on the strength of guaranteed subsidies from the Government of Canada.

A private developer may assume the role of a shareholder of the project, and be responsible for parts of the project costs and management. Being an equity shareholder, the private partner would be involved in sharing ownership, responsibilities, risks, and profits associated with the project. As equity investors are not guaranteed a fixed schedule of interest and principle payments, they expect a even higher rate of return than debt investors do.

Most of the infrastructure projects in Canada are still financed by government funds. Predicting toll revenues is still too large a risk for the financial sector to bear. Invariably, the private sector would seek government guarantees to lessen the revenue risk and also demand higher rates of return. Governments are finding that it would be cheaper to finance with government funds. The Highway 407 project in Toronto was originally planned to be privately financed. Given the high cost of private financing, the Government of Ontario has now decided to raise the financing through a separate crown corporation.

Many jurisdictions are considering setting up quasi-government entities to finance infrastructure projects. Such entities have the flexibility, similar to the private sector, to raise funds, develop adjacent land, and negotiate deals without the restrictions inherent in government bureaucracies. Many of these separate entities, although controlled by government ministers, are established to undertake "off-balance sheet" financing. The financing is ultimately public debt, but it is not shown on government ledgers. The Highway 407 project is being financed by the Ontario Transportation Capital Corporation. The British Columbia Transportation Financing Authority is a crown corporation that had been established to seek out innovative ways of financing highway projects.

With a projected toll coverage of about 33% of the total costs, the Edmonton Southwest Ring Road would not lend itself to public-private partnerships without significant government financial participation. Given the high market risk and uncertainty of the financial sector with toll roads in Canada, a government-construct or turnkey project or private investment in distinct portions of the project, such as interchanges or tolling system, would appear to be feasible.

8. Conclusions

Given the relatively low traffic levels in Alberta, the high cost of the project ($142 million), and the fundamental principle to apply any toll roads to new routes with alternative routes available, the results of the financial analysis are not surprising. Even though the Edmonton Southwest Ring Road is one of the projects identified to have the greatest potential for toll road development in Alberta, only about 33% of the total costs may be covered through toll and other revenues. A significant government contribution would be required to attract private interest. This condition would apply to almost any potential public-private partnership in road construction in Alberta.

However, a contribution of 33% of project costs that might be obtained from toll and other revenues, as found for the Edmonton Southwest Ring Road, is still significant. This may enable construction to take place that otherwise cannot be afforded. Governments and the private sector may be able to enter into partnerships to take advantage of this, to their mutual benefit.

A major factor in the consideration of the introduction of toll roads in Alberta is public acceptance. The public would have to be convinced that this approach is a genuine method of providing a facility that otherwise could not be afforded for a long time, and that the benefits of using the facility are significant.

Ontario is proceeding with the Highway 407 project, and the Fixed Link to Prince Edward Island project is underway. Many other provinces, including British Columbia, Quebec and New Brunswick, are also actively developing strategies of public-private partnerships for highway construction. The momentum of public-private partnerships cannot be ignored by any responsible government.

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Road Costs and Marginal Cost Pricing

Michel Boucher* and Fred P. Nix**

1. Introduction

Questions have been raised about a shortage of infrastructure investment as a possible cause of the decline in the productivity of the Canadian economy. In the specific context of highway infrastructure, two different theses promoting this idea were often mentioned, the first being the "under built" thesis (were pavements designed with less than optimal strenght?) and the second one, the "under maintened" thesis (we are not spending enough on our roads to maintain them). As data on the stock of infrastructure are not easily available, especially for the road component, we are unable to address directly the validity of these questions. However, there is another avenue which, in the long term, can shed some light on the issue. If charges for the use of the road (road prices) are set efficiently (marginal social cost of road use), road users will reveal their preferences and -- assuming the appropriate institutional arrangements linking prices to investments -- over the long term the optimal amount of money will be spent on roads.

This paper summarizes work for the Royal Commission on National Passenger Transportation in which the authors partially addressed this issue.

2. The physical characteristics of roads

As the work for the Royal Commission focussed on existing roads, only one aspect of the physical characteristics of road was examined: pavements[1]. In other words, the analysis only considered other subjects (bridges, capacity, vertical and horizontal geometry, traffic control, enforcement, original land costs, externalities) briefly if at all. These other subjects would have to be considered if the full marginal social costs of road use were to be estimated.

2.1 Pavements

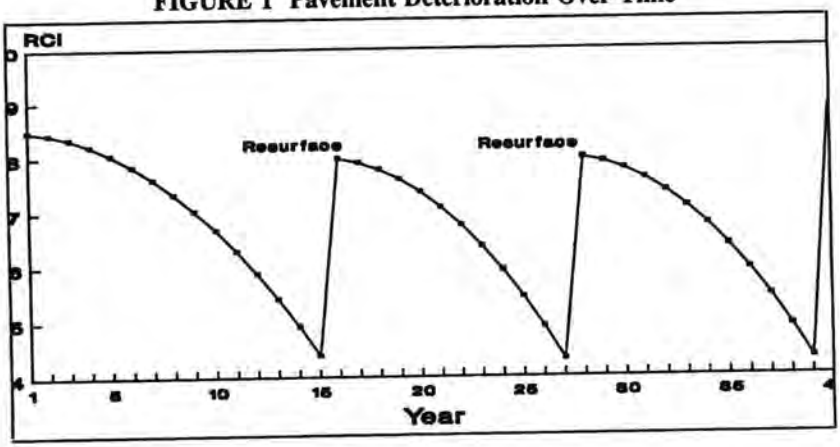
The principal pavement used in Canada is a flexible pavement consisting of granular base and sub-base courses and a surface course of asphaltic concrete. This section focuses exclusively on these flexible pavements-an important point

since much of the controversy surrounding road costing emanates from recent work in the United States where rigid pavements are more common.

Flexible pavements wear out or deteriorate over time. The FHWA in the United States identified three major types of deterioration[2]: a) surface distress: fatigue cracking, low-temperature cracking, rutting, ravelling, bleeding or flushing, roughness due to differential subgrade volume change; b) reduction in surface friction: skid resistance; and c) reduction in serviceability: increased roughness. Reduction in serviceability is also caused by surface distress since the distress normally creates roughness.

For this discussion, it is the third type of deterioration which is of interest as this is the primary operating function of a pavement. In many allocation procedures, this is the measure which can be related to vehicle operating costs (that is, increased roughness means increased vehicle operating costs). In Canada, roughness, or the riding quality of a pavement, is usually measured with the Riding Comfort Index (RCI), a subjective estimate rated on a scale of 0 to 10. The change in RCI over time is usually monitored through objective measures of pavement distortion which have been correlated with the subjective ratings.

FIGURE 1 Pavement Deterioration Over Time



New pavements typically have an initial RCI of 8.5. This decreases as the surface distorts under the action of traffic load and climate. On first-class highways,

pavements are normally considered to have deteriorated to an unacceptable condition when the RCI has declined to a level of 4.5 (see Figure 1). At year 15 and again at year 27, the pavement is resurfaced with an overlay which would vary from about 50 mm on lightly travelled highways to about 90 mm on heavily travelled highways. Generally, flexible pavements in Canada will be resurfaced twice in 40 to 50 years before a decision is made to reconstruct the pavement.

2.2 Pavement Deterioration

The principal mechanisms contributing to the surface distortion of flexible pavements are permanent deformations of the surface created by traffic loads and deformations of the sub-grade which are transmitted through the pavement structure to the surface. Deformation of the sub-grade occurs under the stresses imposed by heavy axle loads, and by freeze-thaw cycles and sub-grade moisture changes. The distortion of pavement surfaces induced by climatic factors is a significant component of pavement deterioration, and flexible pavements deteriorate to an unacceptable RCI magnitude in 25 to 35 years even under very light traffic loads.

A concept central to deterioration models is the relative pavement damage of different axle loads. In the AASHO Road Test, a standard load was defined as 18,000 lbs (8,163 kg) on a single axle supported by dual tires (that is, four tires per axle). This was the common limit for single axles in much of the United States and Canada in the early 1960s. The equivalent single-axle load rating of any other axle load or configuration, ESAL or LEF, is defined as the number of passes of the standard axle load required to create the same amount of damage as one pass of a candidate axle load. For example, a single axle load of 10,000 kilograms (22,050 lbs) has an ESAL rating or LEF of 2.25. This is calculated from what is commonly referred to as the "fourth-power law" of pavement damage:

$$LEF = \left(\frac{L(x)}{L(s)}\right)^4$$

where L(x) is the candidate axle load and L(s) is the standard axle load.

To put the issue in dramatic terms, this 10,000-kilogram truck axle (the maximum load limit in three Canadian jurisdictions) does 160,000 times as much damage to a flexible pavement as does a car axle load of 500 kilograms. That is, the truck's ESAL of 2.25 is 160,000 times as large as the car's 0.000014 ESALs. This concept of load equivalency, and the manner in which these equivalencies increase sharply with load, is of crucial importance in all modern costing studies.

Whatever other controversies exist, most people agree on this point: heavy axle loads (hence, trucks) are a major factor in deterioration (hence, costs).

2.3 Models of Pavement Deterioration

One of the reasons for the controversy surrounding the subject of road costing is the wide choice of pavement-deterioration models. In the work for the Royal Commission, several different models were examined but primary reliance was placed on an Ontario-based model ("OPAC"). This is one of the few models which separates load (ie, axle weight) and environmental (ie, climate) deterioration.

Using typical results of the OPAC model for southern Ontario, it can be shown that pavements deteriorate (ie, reach and RCI of less than 4.5) over 40 years or so in the absence of any axle loads. Conversely, with 2 million ESALs a year (this is about the heaviest loading any highway in Canada experiences), flexible pavements deteriorate in about 14 years. The relative importance of environmental factors decreases with higher volume (ie, higher annual ESAL loadings) roads. So, for example, for low volume roads, environmental factors may account for 80% of the deterioration. For high volume roads, environmental factors may only account for 50% of the deterioration.

The implications of this for road costing are that it is not a simple matter to develop that portion of the marginal cost of road use that relates to pavements. It depends, in the first instance, on the choice of pavement deterioration model; and --at least for the OPAC model -- it depends on the volume of traffic (axle loads).

3. Road Costing

There are four commonly recognized costing methods in use.

The Incremental Method: Used in the 1956 federal study in the United States, this is based on the concept of avoidable costs: if a cost can be avoided because a particular vehicle class is excluded, then this cost is properly attributable to that class. In effect, the methodology recognizes a base road and associated cost which is assigned to all vehicles. Pavement costs are assigned to all vehicles in proportion to axle-miles and other costs (bridges, grading) in proportion to vehicle-miles. Costs for features of the road not included in the base system are assigned to larger and heavier vehicles.

The Federal Method: Also developed in the United States in the 1982 FHWA study[3], this method has been further generalized in Australia and the United

Kingdom. Although similar in its basic philosophy to the incremental approach, the two methods differ in the way they allocate pavement costs and bridge replacement and repair costs. The first major difference lies in the definition of a minimum pavement and the use of ESALs for allocating pavement costs over and above this minimum. The incremental method benefits users with heavy axles as, in effect, they capture all of the benefits of the economies of scale inherent to pavement strength production. The use of ESALs in the federal method assigns these costs equally to all vehicles in proportion to their responsibility for ESALs. Secondly, under the federal method, expenditures for rehabilitation and replacement which were not taken into consideration under the incremental method, are based on distress models which simulate the consumption of pavements. Finally, rather than allocating bridge replacement and repair costs in proportion to the allocation for new bridges as the incremental method does, the federal method uses a bridge replacement function.

The Benefits-Based Method: This assigns cost responsibility across road user classes in proportion to some measure of differential benefits derived from highway expenditures. It is a variant of the benefit theory of taxation holding that people should be taxed according to benefits received from government expenditures. The underlying principle is to reproduce, in the public sector, the one-to-one relationship which exists in a market economy between benefits received and opportunity costs incurred. To allocate benefits, however, consistent information on operating costs, travel time costs and accident costs of road users is required. This is difficult to find. In any case, most have rejected the benefits method as it is at odds with the efficiency goals of public policy.

The Marginal Cost Method: Often advocated by economists but rarely used in practice, this method holds that users should pay the marginal social cost of using the road network. Until recently the required procedures for allocating costs in this manner were not well developed. The 1982 FHWA study made an attempt at such an approach in one of its appendices[4]. More recently, Newbery[5] and Small, Winston and Evans[6] have presented theoretical frameworks and applied the results, respectively, to the United Kingdom and the United States. In general, the marginal cost method considers two categories of cost: the private cost of road use and the social road-use costs. The first category includes the vehicle operating costs and the cost of the operator's time. The second category includes costs borne by third parties: highway agency costs, pollution costs, road damage costs (that is, the passage of a candidate vehicle raises the costs of subsequent vehicles by, for example, making the pavement rougher) and congestion costs. There is disagreement as to whether the correct cost is a short- or a long- run one.

The underlying philosophy of these four approaches is different. The first three are based on equity principles, whereas the last one is essentially efficiency-

oriented. More specifically, among the equity methods, the first two put the emphasis on the use of costs as an allocation devise and the third puts the emphasis on benefits received. The incremental and federal methods attempt to determine equitable cost allocations among various user classes according to a cost-occasioned standard. Although the benefits-based method shares the same equitable principle, it proceeds by allocating benefits to highway user classes rather than costs. Finally, the marginal cost method, which searches to promote economic efficiency is not constrained by having to consider road expenditures as total costs. The basic principle is that each trip should be priced at its marginal social cost. This marginal cost pricing rule, then, does not involve allocations of costs among users. For this reason, it is similar to the situation encountered by a multi-product firm where the only concern is that marginal revenues equals or exceeds marginal costs.

3.1 Marginal Road Costs

Economists argue that roads should be viewed as a valuable and scarce resource and, therefore, their use should be rationed by the price mechanism. In the particular context of a road which is characterized not only by the private costs of road use, but also by externalities such as congestion, pollution, road damage and accidents, an efficient price implies that road users should pay the marginal social cost of using the road network, regardless of the particular trip undertaken.

The 1982 FHWA Study: An early application of the concept of a short-run marginal cost (SRMC) to roads is found in the 1982 FHWA study. Costs are calculated in a two-step procedure. First, private costs of road use paid by owners are computed: fuel, wear and tear, driver's time, and so forth. Second, the social costs arising from vehicles using roads and borne by third parties are calculated.

The first of these social costs is pavement wear which is subdivided into two distinctive parts: pavement repair costs borne by the road agency and road damage costs borne by road users. Both are a function of axle loads. Environment and soil conditions are recognized for their potential effect on pavement deterioration, but are not taken into account for technical considerations. The portion of pavement wear borne by users arises because rougher pavements increase vehicle operating costs.

The second social cost is the cost of congestion which is subdivided into three parts: the decrease in speed below free-flow levels, implying additional travel time; the increase in operating costs resulting from these delays; and the increase in the frequency of accidents. The first two parts are computed by using linear volume-delay functions whereas accident costs, though known to be important, are not incorporated because of an absence of good estimates.

The third social cost is air, water and noise pollution arising from vehicle use. Air and noise pollution costs are computed; however, water pollution costs are not because of insufficient evidence on how to estimate efficient prices.

The final result of these computations, as presented in Table 1, gives an idea of what an efficient user charge system may be. They depend on the vehicle used, as measured by vehicule miles of travel (VMT), the location, the congestion (measured as a "volume-to-capacity" or "V/C" ratio) and the road class.

TABLE 1
FHWA Efficient User ChargesU.S. 1981 cents per VMT

Vehicle Type	Location	Key Parameter	Road-Use Costs	Congestion Costs	Pollution Costs	Total
Auto - 3,000 lb 1.4 tne	Rural	V/C = .05	0.3	0.3	0	0.6
Auto - 3,000 lb 1.4 tne	Urban	V/C = .85	0.7	11.2	1.6	13.5
Truck 3-axle - 40,000 lb 18 tne	Small Urban	V/C = .35 PCE = 1.2 ESAL = 0.8	33.6	2.2	0.4	36.2
Truck 5-axle - 72,000 lb 33 tne	Urban Interstate	V/C = .15 PCE = 1.2 ESAL = 1.6	40.6	1.4	7.0	49.0
Truck 3-axle - 60,000 lb 27 tne	Urban Collector or Rural	V/C = .25 PCE = 2.0 ESAL = 4.0	244.5	3.1	12.0	259.6
Truck 4-axle - 100,000 lb 45 tne	Rural Arterial	V/C = .05 PCE = 3.0 ESAL= 27.2	503.5	0.3	0.2	504.0
Truck 9-axle - 105,000 lb 48 tne	Rural Interstate	V/C = .15 PCE = 3.0 ESAL = 1.0	9.0	1.2	0.1	10.3

Source: U.S., FHWA, 1982, pp. E-53 and E-54

Small, Winston & Evans: A second application of a marginal pricing technique was undertaken by Small, Winston and Evans. Their proposal is general in that they integrate two economic principles, the first an efficient pricing system to regulate demand for highway services and the second an efficient investment policy to minimize the total public and private cost of providing them. They compute a congestion cost for an urban expressway and a principal urban arterial respectively as a cost-per-peak-period passenger-car-equivalent-mile or PCE-mile. It varies from 14.5 to 15.1 cents (U.S.). They also compute the marginal cost of road wear on the basis of their model of pavement deterioration described in Section 2. This varies from 0.2 to 4.0 cents per ESAL-mile. These costs, both congestion and road wear, are only calculated for urban expressways and urban arterial roads.

Newbery: Newbery promotes the idea that road users should pay the true social cost of transport. His main contribution to the debate lies in his road damage externality theorem which states that "if the age distribution of roads of a given type is constant, and the traffic flow is constant, and all road damage is attributable to traffic, then the average road damage cost of a vehicle is identically equal to the average maintenance cost allocated in proportion to its number of equivalent standard axles. The road damage externality is zero."[7] Subsequent users' costs are raised by the transit of a heavy vehicle (the cost raising effect) whereas the resulting road damage also brings forward the date of road repair (the cost reducing effect). Newbery's theorem shows these two effects approximately balance each other. Therefore, when considering road damage costs, only the pavement cost which reflects the increased cost of repairing the roads, and which is borne by the highway authority has to be considered.

Newbery also considers congestion costs. By using statistical results from different British researchers, he computes a short-run marginal congestion cost (MCC) which varies by road classes (motorway, truck, principal and other), by period of time (peak and off-peak) and by vehicle types. This measure is expressed in pence per PCE-km. The following table taken from Newbery presents some results for the United Kingdom for 1990. Newbery also looks at accident costs in an aggregate manner, without relating them to road classes and vehicle categories. Pollution costs are dealt with directly.

TABLE 2
Marginal Congestion Costs in Great Britain, 1990

	MCC pence/PCE-km	Index of MCC
Motorway	0.26	8
Urban central peak	36.37	1 070
Urban central off-peak	29.23	860
Non-central peak	15.86	466
Non-central off-peak	8.74	257
Small town peak	6.89	203
Small town off-peak	4.20	124
Other urban	0.19	6
Other rural	0.05	1
Weighted average	3.40	100

Source: Newbery, M.D., Oxford Review of Economic Policy, p. 29

Vitaliano & Held: Another recent contribution examines only one of the costs included in an efficient pricing mechanism: road damage. Using a sample of 457 road segments in the State of New York, the authors estimate the road damage marginal cost generated by the cumulative numbers of ESALs passing over a given road surface. The management of this road network is characterized by a damage-sensitive maintenance strategy. That is, as is also the case in Canada, roads are resurfaced when a measure of serviceability (roughness) reaches a certain point. Moreover, they attribute 50 percent of pavement deterioration to the environment. Their estimate of a user charge per ESAL-mile varies from 1.15 cents (U.S.) for rural and urban interstates to 28 cents for rural collectors. For a five-axle tractor-trailer weighing 80,000 lbs, pavement wear costs per mile vary from 3 cents when driving on rural and urban interstates to 74.2 cents when running on rural collectors.

4. A Canadian application

These marginal costs represent *only* the marginal pavement costs of paved roads using the results of the OPAC model and typical Southern Ontario construction costs. Extending these results to all Canadian roads may not be appropriate.

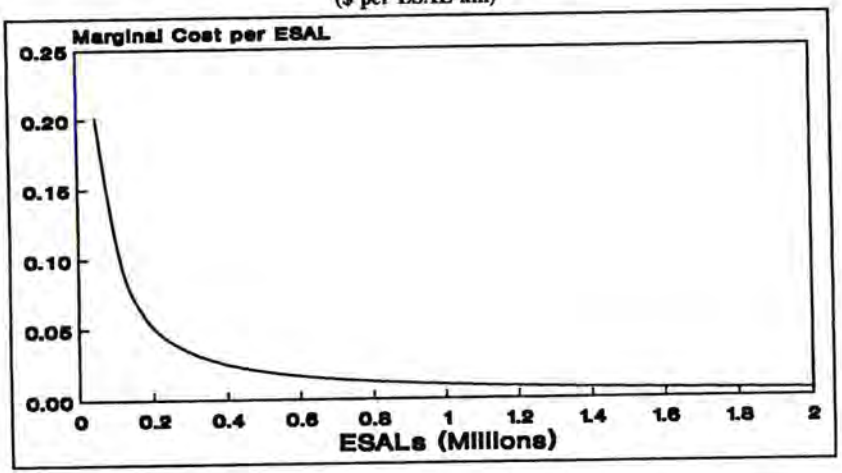
This caveat aside, the process for estimating marginal pavement costs is relatively simple. From the OPAC model described in Section 2 and the construction costs mentioned in Section 3, a series of costs are developed for roads built to withstand a given number of annual ESALs. Initial pavement and overlay lives

are assumed to be 15 and 12 years respectively. Further, overlay costs are assumed to increase for roads built for more traffic (axle loads) as described for typical Ontario conditions. Using this information, the following cost curve (total life-cycle costs of pavements) is estimated. The number of observations is 41, the adjusted R^2 is 0.965 and standard errors are in parentheses:

$$C = 89{,}969 + 23{,}214 \times \log(ESALs)$$

$$(4.42) \quad (7.03)$$

FIGURE 2
Marginal Pavement Costs
($ per ESAL-km)



Source: F.P. Nix, M. Boucher and B. Hutchinson, Road Costs, p. 1008

Marginal costs are estimated from the cost function as shown in Figure 2. For roads built for 250,000, one million and two million ESALs annually, marginal pavement costs are 4.0 cents, 1.0 cent and 0.5 cents respectively. To put these amounts in perspective, total marginal costs per kilometre for three trucks are shown in Table 3. The first truck is a heavily loaded three-axle truck typical of those used in the construction industry in Eastern Canada. The second, the five-axle tractor-semitrailer, is the most common large truck configuration in Canada. For the sake of this illustration, it is shown at the practical maximum weight for cross-Canada operations (some provinces allow higher weights). The last configuration shown is an eight-axle B-train, the heaviest truck in Canada except

for those operating under special permit. It is used to haul heavy, bulk commodities. For this illustration, it is shown at the highest practical weight for cross-Canada operations.

The calculation of costs in Table 3 is based on three different load equivalency factors: (a) ESALs developed from AASHTO; (b) Canadian measurements developed from data collected in the Canroads study; and (c) the reinterpretation of the Canroads data at the University of Waterloo. These different load equivalency factors are used to demonstrate the point that the attempt to develop road costs is highly dependent on a number of engineering measures. They are only illustrations of this point, however, as it is not clear that it is appropriate to use marginal costs developed from a pavement deterioration model calibrated in AASHTO's ESALs to determine the pavement costs of a particular truck where load equivalencies are calculated in a different manner.

TABLE 3
Marginal Pavement Costs
(cents per km)

	LEFs	Low-Volume Road	Mid-Volume Road	High-Volume Road
3-axle truck	a	10.3	2.6	1.3
25 tonne	b	15.0	3.8	1.9
	c	19.5	4.9	2.4
5-axle tractor-	a	13.5	3.4	1.7
semi	b	18.4	4.6	2.3
39 tonne	c	23.4	5.8	2.9
8-axle B-train	a	18.6	4.6	2.3
62 tonne	b	25.5	6.4	3.2
	c	33.1	8.3	4.1
Cost/ESAL-km		4.0	1.0	0.5

Note: These costs are extracted from simulations on the OPAC model.

A final way of putting these marginal costs into perspective is to consider the traffic data developed by Nix, Boucher and Hutchinson[8]. It must be clearly understood that these results are coming from actual traffic.This suggests the following annual average ESALs for different segments of Canada's rural highway network:

TABLE 4
Cost Data on Actual Traffic

Rural Highways	Annual ESALs	Annual ESALs per lane	Marginal Pavement Costs per
ESAL-km			
busiest 10%	427,475	213,737	4.7 cents
medium-volume 30%	115,189	57,594	17.5 cents
low-volume 60%	26,877	13,439	75.0 cents

Although better data are clearly desirable the broad observation can be made that marginal pavement costs rise very rapidly for lower-volume roads. Further, for a large numbers of Canadian roads, these marginal costs *may be* quite high. *May be*, as there is uncertainty at the low end of the range--that is, annual ESALs as low as 13,439--whether the pavement performance underlying the OPAC model is appropriate.

5. Concluding Remarks

As shown in the work for the Royal Commission, the development of even one portion of the marginal cost of road use, the part relating to pavements, is extremely difficult. It is likely even more difficult to measure the cost of externalities such as emissions.[9] Further, even if the cost of other externalities such as congestion can be developed, there are problems implementing charging mechanisms which have to be sophisticated enough to capture the time-of -day and the use of particular roads. Nowithstand these difficulties of measurement and/or implimentation, an effort should be made to both set the price of road use at its marginal social cost and to then link the pricing mechanism with the decision to spend money on roads. Even if a "perfect" solution is not yet available, there are many initial steps which could be made.

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* Michel Boucher is professor of Economics at the Ecole nationale d'administration publique, Université du Québec.
** Fred. P. Nix is an transportation consultant at Orangeville, Ontario.

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A FRAMEWORK FOR DEVELOPING A STRATEGIC HIGHWAY NETWORK - A SOCIO-ECONOMIC APPROACH

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1.0 INTRODUCTION

Current levels of highway deterioration together with demand for improved mobility and better access have put tremendous pressure on governments to provide efficient transportation networks. Based on our need to bring existing highways up to a defined standard and the need for new infrastructure, governments are flooded with a number of projects which cannot possibly all be dealt with in today's tight economic environment.

Often, highway needs are assessed based on operational, safety, technical and cost-benefit analysis but not much attention is given to economic and social factors which the facility is *causing, supporting or contributing* to. As such, we need a methodology which will take into account these social and economic factors and hence determine the overall importance of the highway.

In order to better understand and evaluate highway transportation needs, we would benefit from a strategic[2] assessment of (existing and future) highways to focus our efforts. This paper outlines a framework for arriving at a measure of strategic importance of a link or a highway corridor in developing a *'Strategic Highway Network (SHN)'*. Various social and economic criteria along with associated measures and units are considered. When fully developed, it is expected that the framework will provide a tool that will enable highways to be classified by their strategic importance.

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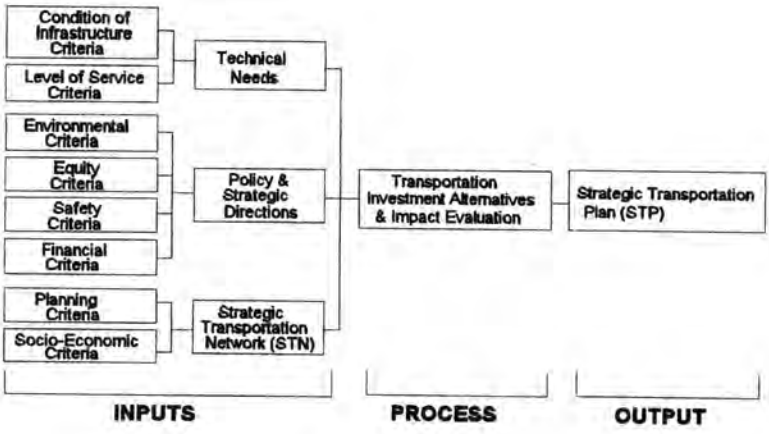
1. The contents of this paper reflect the views of the authors and do not necessarily reflect the official views of the Ministry of Transportation, Ontario.

2. The term **strategic** here is defined as a function of social and economic importance of a facility, transportation service and/or infrastructure.

2.0 A FRAMEWORK FOR A STRATEGIC TRANSPORTATION PLAN

Although this paper focuses on the development of a Strategic Highway Network (SHN), it is a worthwhile exercise to put the concept of a SHN into the context of developing a Strategic Transportation Plan (STP). The significant components of a Strategic Transportation Plan as shown in Figure 1 include: Technical Needs, Policy and Strategic Directions and a Strategic Transportation Network (STN). If all three factors are assessed when developing investment alternatives and impacts, the transportation plan that is ultimately proposed should have a much firmer foundation.[3]

Figure 1
A Strategic Transportation Plan (STP) Framework



The following brief examination of the factors involved in developing a STP will be useful in understanding how the development of a SHN plays a role in the full investment decision making process.

2.1 Technical Needs

Technical needs are based on an assessment of the physical condition of the

3. It should be noted that a STP could include policy initiatives as well as investment initiatives.

infrastructure and on the level of service it provides. For example, Pavement Condition Rating (PCR) is one of the parameters that can be used in assessing the condition of pavement. Age profiles can then be used to establish the level and type of rehabilitation that will be required. Highways can also be ranked by the level of service they provide by comparing actual volumes of traffic to the design capacity, thereby obtaining a measure of congestion. Strategic Transportation Plans can range from fairly high level perspectives to detailed plans of specific projects. Technical assessment of specific projects should include cost-benefit analysis involving a comparison of all relevant costs such as travel time benefits, operating cost benefits and accident cost savings. (This 'technical needs' factor is not addressed in any further detail in this paper.)

2.2 Policy and Strategic Directions

Any framework for a Strategic Transportation Plan (STP) should explicitly recognize that policy directions play an important role in transportation investment decisions. For example, limited accessibility, reduced mobility and/or higher travel time might be acceptable if the investment alternative minimizes the impact on the environment. On the other hand a non-strategic investment might still be considered if it promotes equity. Safety improvements might be made to transportation infrastructure that is already providing acceptable levels of service. Further, in today's environment of fiscal constraint, infrastructure projects might be chosen because they have the ability to support partnerships and innovative financing. (Development of this factor is beyond the scope of this paper.)

2.3 Strategic Transportation Network (STN)

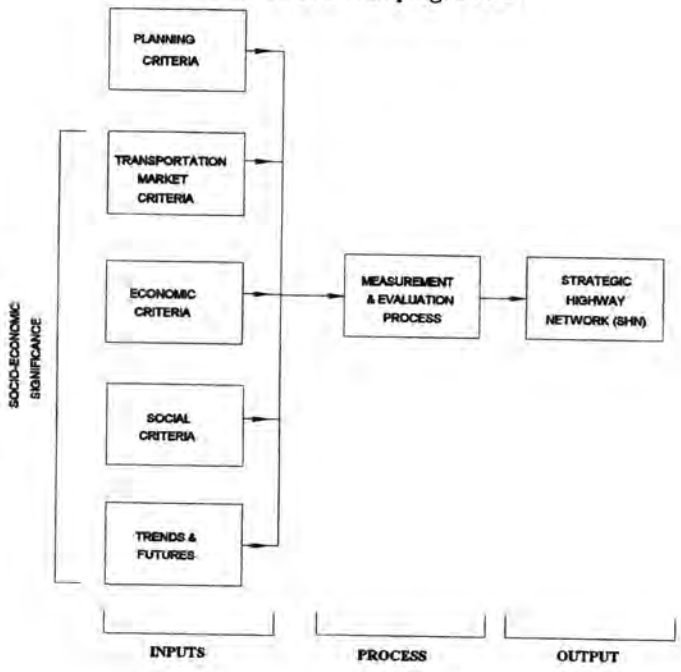
When developing a Strategic Transportation Plan (STP) it is also important to assess the relative strategic importance of a facility or service within the transportation network. The development of a STN provides a method by which transportation facilities or services can be ranked in respect to their importance for moving goods and people. Several approaches could be used to determine the significance of a link. One approach is to determine the importance of a link by its ability to connect population and economic centres (focussing on the nodes). Another approach is to determine the significance of goods and people movement activity taking place on the link (focussing on the link). Both planning criteria and socio-economic criteria (as identified in Figure 1) use these approaches.

The development of a STN should include all applicable modes. As such, a STN should include a 'Strategic Highway Network (SHN)', a 'Strategic Transit Network', a 'Strategic Rail Network', a 'Strategic Airport Network' etc. The remainder of this paper focusses on the highway portion of a Strategic Transportation Network, i.e. the development of a 'Strategic Highway Network'.

3.0 A FRAMEWORK FOR DEVELOPING A STRATEGIC HIGHWAY NETWORK

When complete, a "Strategic Highway Network", could be a complete information source having details on links, highways, or corridors with respect to their contribution to society (predominantly with respect to people movement) and the economy (predominantly with respect to freight movement). The magnitude and the nature of the contribution of a particular link, highway, or corridor could then lead to its ranking in strategic terms thereby signifying the level and need for its maintenance, renewal and even expansion. When fully accomplished this exercise could yield a comprehensive map showing all the links/highways/corridors on a regional or provincial basis by different strategic levels. As an initial attempt the corridor level should be considered and then depending upon the need and resources, it could be aggregated up to a regional or provincial level or even dis-aggregated down to a link level. Development of a SHN will give us a good understanding for developing networks for other modes as well. For the sake of ease and simplicity from now on in this paper, a link, a highway, or a corridor will all be referred to as a "**link**".

Figure 2
A Framework For Developing A SHN



Various strategic criteria which could be analyzed fall into two distinct categories: planning and socio-economic (as shown earlier in Figure 1). The socio-economic category includes four types of criteria: transportation market, economic, social and 'trends and futures'. Figure 2 expands on Figure 1 and proposes a framework for developing a SHN.

The various categories shown in Figure 2 for developing a SHN are described in more detail in the following sections.

3.1 Planning Category

The criteria in this category basically reflect the functional and usage attributes of links. These criteria are included in the current 'functional' and 'highway designation' classifications for Ontario highways.

1. Functional Classification (focus on link)

   The Functional Classification is primarily used for planning and design purposes. Highways are classified as: freeway, arterial, collector and local. The factors considered in this classification are: service function, traffic volumes, running or operating speed, vehicle type, traffic flow characteristics, mobility, accessibility, trip length and highway connectivity. The relevant functional criteria for development of a SHN include:

   - mobility of traffic
   - access to the facility
   - trip length
   - traffic volumes
   - percent commercial traffic
   - jurisdiction - level of government

2. Designation Classification (focus on node)

   Ontario's Highway Designation classifies highways as: King's, Secondary and Tertiary. These are based on this ministry's 'Quantity Standards', which emphasize aspects regarding the use of and relative importance associated with a roadway. This classification is also used for legal and administrative purposes. The relevant 'designation' criteria for development of a SHN include:

   - land use and provincial interest
   - geographic differences
   - size of activity centres
   - connection with urban centres

- connectivity with interprovincial and international boundaries
- connections with rest of the highway or transportation network

Although these criteria recognize important inputs which relate to social and economic areas, they fail to provide any value-added information on the level or amount of their contribution to the province's economy and to its people. As a consequence, planners are being challenged to expand upon these existing planning criteria, and provide more information in terms of the social and economic purpose they are serving.

Socio-Economic Significance

Compared to the criteria mentioned above in the planning category, socio-economic criteria either provide value-added information for the planning category criteria or provide additional value-added information on their own. In practice care should be exercised in properly identifying cause and effect relationships along with the relevant domain of each of these criteria. Effort should be made to segregate specific impacts to avoid double counting.

The transportation market criteria listed below primarily provide value-added information to the planning criteria discussed above. The economic and social criteria listed and 'trends and futures' category provide additional value-added information on their own. Contributions and impacts of social and economic factors are much broader in nature and affect the society at large as well as the specific user. At present, although the majority of these contributions tend to be 'non-quantified' or 'soft' in nature, they have a significant impact on our economy and society. Little research is available to convert these contributions into dollars or to any other suitable quantification, particularly at the link or corridor level. It should be noted that socio-economic criteria provide a better understanding of market forces than do planning criteria and as such socio-economic criteria are better suited for projecting future transportation needs.

3.2 Transportation Market Category

This category deals mainly with measuring the transportation market activity which a link is causing or supporting. It involves people mobility and goods movement.

People Mobility

- accessibility to services
- personal travel
- commuting
- recreation
- tourism

Measures which could be used to provide value-added information to people mobility include:

- % of people having access[4]
- number of personal[5], work, recreational and tourist trips
- number of peak-time users
- number of person-km travelled
- million vehicle kilometres travelled (by trip purpose)

Goods Movement

Goods movement involves a logistics analysis of the inflow and outflow of goods into and/or out of industries that produce, ship or receive goods. A large number of industries could potentially be examined ranging from primary industries such as agriculture and forestry, to secondary industries such as automotive and high tech manufacturing, to trade industries such as retail and wholesale.

Measures which could be used to provide value-added information to goods movement include:

- number of movements or trips
- number of tonnes moved
- number of tonne-kilometres moved
- $ value of goods moved
- number of vehicle-kilometres travelled

3.3 Economic Category

This category mainly deals with measuring the economic activity which the link is currently causing or supporting. The following are the criteria which are related to the current provision of (or support to):

- overall employment in the area
- business and industrial investment
- economic output and competitiveness
- the gross provincial product (GPP)

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4. access being defined by three major criteria: proximity, affordability and ability to serve the physically challenged

5. personal trips are defined as trips made for the daily necessities of life such as shopping, education, health care, accessing services, etc.

By identifying proper measurement systems for these criteria, we can judge the amount of contribution a link is making to the provincial economy. This information thus obtained will certainly be more deterministic and concrete in nature compared to the current levels. Some suitable measures could be:

- number of jobs supported by the link (business employment and commuters)
- tourist revenue generated
- number of businesses located on the link (accessibility)
- $ value or output of the businesses located on the link
- $ value or output of the agriculture industry dependent on the link
- dollar and tonnage volume of Just In Time (JIT) type of freight movement
- $ or % contribution to the GPP

One way of determining the overall contribution of a link to the economy and society is by assuming the worst case of non-existence of the link. Considering the case of total non-existence and quantifying or estimating the contribution of all activities on that link or due to that link will give a measure of its absolute or strategic importance. Based on socio-economic criteria, one end of the scale will identify links that are absolutely essential while the other end of the scale will identify possible links for disinvestment or a reduced standard of maintenance.

3.4 Social Category

This category deals with measuring the social significance of the link's existence. The following criteria relate to the current provision of (or support to):

- quality of life
- integration of major activity and population centres
- community cohesion
- network and service integration
- movements of goods and people in time of crisis
- equity

Once again, by identifying appropriate performance measures for these criteria, we can determine what contribution a link is making to society. Obtaining this information will be a significant step towards adding some rigour and quantifying this 'soft' area. An attempt to identify suitable measures could yield the following list:

- % of network (within and across modes) integrated due to link
- number and size of communities connected
- number of intra-community trips taken
- average trip length on the link (by trip purpose, excluding freight)

- number of emergency operations supported (both passenger and freight)
- number and size of equity groups which the link is serving

3.5 Trends and Futures Category

An additional area which should be considered is a category that can be termed 'Trends and Futures'. This category deals with the enormous changes that are happening to our social and economic fabric. Rapid changes are occurring in the area of technology, globalization of trade, telecommunications, increasing fiscal restraints, social values, lifestyle and a changing workplace. These changes will certainly affect the requirements for provision and maintenance of transportation services and infrastructure. As the need for transportation is a derived demand, these factors have a significant role to play. These factors could very well change the way we do business and what may be required from government as a service provider. Over time, as these changes become more pronounced, their effect on the highway system might be more definite and tangible. Although the exact nature and impacts of this category are not well known, we should make a conscious effort to consider these factors in the development of a SHN.

3.6 Development Strategy

As identified earlier, socio-economic criteria provide value enhancements to planning criteria. One way to develop and implement a SHN will be to start with planning criteria as a base and enhance this base with value-added information from a socio-economic perspective. Over time as socio-economic criteria and techniques become refined and fine-tuned, it is likely that socio-economic criteria will play a more significant role than planning criteria when developing a SHN.

3.7 Measurement and Evaluation

It may be necessary to analyze and score these criteria differently depending on how they interact with other criteria and impact the overall transportation system.

An appropriate *scoring scale* and *weighting scheme* could be developed for each of the above criteria. As applied to a specific link, each criterion would then be assigned an individual score on its respective scale. The total *link score* would then be given by the summation of the product of individual criterion scores and their respective weight. This overall score could then be used to determine a *Strategic Index or Score* for each link. This could be a cumbersome exercise given a sizable number of links. We foresee that a sophisticated and user-interactive computer model would be required to complete this exercise. An illustration of what the evaluation matrix could look like is shown in Figure 3. The 'Trends and Futures' category is not very well defined yet, so we have omitted it from the matrix.

Figure 3
Illustration of Evaluation Matrix

CATEGORY	Criteria Description	CRITERIA SCORES					CRITERIA WEIGHTS
		Link 1	Link 2	Link 3	....	Link n	
Planning	a b c	a_1 b_1 c_1	a_2 b_2 c_2	a_3 b_3 c_3	... ...	a_n b_n c_n	a_w b_w c_w ....
Transportation Market	A B C	A_1 B_1 C_1	A_2 B_2 C_2	A_3 B_3 C_3	... ...	A_n B_n C_n	A_w B_w C_w ....
Economic	i ii iii	i_1 ii_1 iii_1	i_2 ii_2 iii_2	i_3 ii_3 iii_3	... ...	i_n ii_n iii_n	i_w ii_w iii_w ....
Social	I II III	I_1 II_1 III_1	I_2 II_2 III_2	I_3 II_3 III_3	... ...	I_n II_n III_n	I_w II_w III_w ....
Total Link Score = $\sum$ (criteria scores x criteria weights)	$a_1a_w + b_1b_w$ +....+A_1A_w +B_1B_w+....+ i_1i_w+ ii_1ii_w +....+ I_1I_w + II_1II_w + ...	$a_2a_w + b_2b_w$ +.... +A_2A_w +B_2B_w+....+ i_2i_w+ ii_2ii_w +....+ I_2I_w + II_2II_w + ...	$a_3a_w + b_3b_w$ +.... +A_3A_w +B_3B_w+....+ i_3i_w+ ii_3ii_w +....+ I_3I_w + II_3II_w+	... ...	$a_na_w + b_nb_w$ + ... +A_nA_w +B_nB_w+....+ i_ni_w + ii_nii_w +....+ I_nI_w + II_nII_w + ...	$\sum$ (criteria weights) = 1.0

Once again, because of the substantial research and the need for various types of expertise, developing scores and weights could be a controversial, cumbersome and challenging task. Alternatively, a simplified qualitative or a combined qualitative and quantitative method could be adopted for the first round to examine the overall feasibility of the framework. In some cases, some of these criteria may be either insignificant or irrelevant. Therefore, a threshold or minimum acceptable value could be established for certain key criteria without which the link may not qualify for any further analysis and be deemed inappropriate or even insignificant. This will avoid unnecessary efforts and make the task a little bit more manageable. The framework, when fully developed and operational, should be updated periodically to reflect any changes to the factors and criteria affecting the strategic importance.

4.0 APPLICATION OF THE STRATEGIC HIGHWAY NETWORK

As suggested in the first part of this paper, the development of a SHN is an important factor in developing a Strategic Transportation Network. A STN along with technical needs and policy direction should be the mainstays of a Strategic Transportation Plan. The development of a SHN has other applications as well. It could be used:

1. To modify/replace the current highway classification system(s) or devise a parallel 'Strategic Highway Classification System' to be used concurrently with other existing classification systems.

2. As a screening tool in determining relevant projects for application of detailed technical, economic or cost-benefit analysis.

3. To assist in investment planning, project prioritization and trade-offs within the highway program areas such as renewal, expansion and safety/operational improvements. It could be used at three distinct levels of analysis:

   a) Do-nothing Analysis: to determine the socio-economic impacts of letting the network *run down* over time.
   b) Prevention Analysis: to justify *maintaining the network* at the existing level, based on the current usage, to avoid any further adverse impacts.
   c) Future Potential Analysis: to *upgrade* the network in order to accumulate additional benefits/impacts based on current trends and potential future usage.

4. For input into developing : *Facility Standards* with respect to engineering and corridor & access control; *Operational Standards* with respect to road closure, maintenance, signing, right-of-way, vehicle weight and dimensions, goods movement, signalization, rest stops, illumination, speed limits, interchange spacing and at grade crossings; *Administrative Policies* with respect to land use, zoning, official plans, jurisdiction, capital investment, funding and cost-sharing arrangement, surveys and data collection.

5. As a financial model in determining the provincial highway funds allocation. This method could initiate significant changes to the highway funding and budgeting process.

It should be noted that a change in technical or policy factors could have an impact on strategic values. For example, if level of service deteriorates on a particular link, it may become less strategic if users start to divert to alternate routes to improve their service levels. On the other hand, if measures are taken to improve the

condition then the same link could become even more strategic. Proper relationships will have to be developed for each applicable factor.

5.0 TOWARDS THE DEVELOPMENT OF A STN: A CASE STUDY

It should be noted that both traditional planning criteria and socio-economic criteria are necessary for developing a STN. As mentioned earlier, in some cases socio-economic criteria are just refinements or value-added versions of planning criteria. For example, planning criteria are used to determine the importance of a link by examining what is happening on the link (traffic volumes, % commercial, etc.) and what is happening at the nodes (size of population, economic activity, etc.). Transportation market criteria can be used to expand upon this approach. In respect to goods movement, this involves an analysis of the inflows and outflows of the various industries that move freight on a link.

In a recent Southwestern Ontario Transportation Perspective Study, an attempt was made to develop freight transportation market data as input into determining the strategic transportation links in the area. Two different approaches were taken. One approach was from the carrier or supply perspective while the other approach was from the shipping and receiving industries or demand perspective.

Statistical sources of information on the carrier or supply analysis that were used include:

Statistics Canada
- truck origin-destination (O-D) data
- marine commodity flows
- air cargo traffic and aircraft movements

Ontario Ministry of Transportation (MTO)
- commercial vehicle surveys
- % commercial of Annual Average Daily Traffic (AADT) counts converted to volumes

National Transportation Agency (NTA)
- rail commodity flows (CN & CP)

U.S. Department of Transportation
- truck and rail import and export data

Transport Canada
- air cargo traffic and aircraft movements

Carrier analysis yielded useful insights into identifying major corridors. However, the data had too many limitations in respect to detail, reliability and comprehensiveness to allow a detailed ranking of all the specific links within the transportation network. Moreover, it was decided that this approach has no direct

application for predicting which corridors will be important in the future, because it does not provide an understanding of underlying factors affecting commodity flows.

Data sources for the industry or demand analysis included:

Statistics Canada
- Manufacturing industries of Canada - value-added data for Ontario industries
- census employment by industry division, for counties and cities

Dun & Bradstreet
- establishment data

Ontario Ministry of Economic Development and Trade
- provincial industry profiles

Industry Science and Technology (now called Industry Canada)
- national industry profiles

Municipal Economic Development Commissions, etc.
- municipal economic profiles

Ontario Ministry of Agriculture, Food and Rural Affairs
- agricultural statistics

McLean Hunter
- shopping centre data

The objective of the analysis was to deduce specific commodity inflows and outflows based on an analysis of the statistics available on suppliers and markets for various shipping industries. Unfortunately, statistics to develop such an analysis were only available in a few specific cases. As a result, market information was primarily compiled on the locations and sometimes on the relative sizes of the major shipping industries within Southwestern Ontario. It was concluded that some form of shipper survey would be required to develop an adequate understanding of the dynamics of commodity flows.

Preliminary results, from the Southwestern Ontario Study indicate that existing supply and demand sources of information are not adequate for developing a fully developed SHN. Good value-added information was collected that was useful in supplementing traditional planning sources, but new data sources such as revised roadside surveys and/or shipper surveys must be explored if the full potential of developing a SHN is to be realized.

6.0 CONCLUSIONS AND RECOMMENDATIONS

The development of a strategic highway network from a socio-economic perspective appears to have the potential to be a valuable tool in transportation infrastructure investment decisions. Although the approach suggested in this paper builds upon

the existing planning criteria, it is expected that the complete development of a SHN, incorporating socio-economic criteria could take a few years as well as considerable resources. Although techniques for developing transportation market criteria already exist, it will be a challenge to find cost effective ways to collect the necessary data. In respect to economic and social criteria, the challenge will be to determine appropriate measures and develop meaningful relationships and models which explain how and how much the highway network is supporting the economy and society as a whole. Despite these concerns, the development of a SHN should be pursued so that decision makers can take all factors into consideration in their investment decisions. Further research will be required to develop strategic networks for all modes to arrive at a STN for the whole system. In addition, it will be necessary to integrate technical needs, policy directions and an identified strategic transportation network to arrive at a Strategic Transportation Plan.

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PORT ECONOMIC IMPACT STUDIES: AN EXAMINATION

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Abstract

This paper assesses the relevance of port economic impact studies with regards to port planning, infrastructure planning, economic analysis and public policy in general. The rationale for undertaking these studies is reviewed, in light of the current obsession with transportation infrastructure, the role of port authorities and requirements for regional development. The paper explores components of port economic impact studies in Canada and the Caribbean. The usefulness of the these studies is assessed and the problems which arise are discussed. Conclusions are then drawn as to the validity of port economic impact studies in general and their usefulness both for the private sector and as a tool for public policy.

EIA: Elements and Considerations

Economic impact analysis (EIA) belongs to a larger family of tools, including cost:benefit analysis and policy analysis, developed to assess any infrastructure investment decision from a public policy point of view. In the broadest sense, this includes studies of the socioeconomic or environmental factors involved in any investment decision, although traditional economic impact studies ignore these.

> "The economic impacts identify the set of economic events which occur in order to satisfy a given amount of economic demand, that is purchases, incomes, employment and taxes generated in producing the required units of output." (MARAD, p.2)

All port economic studies are driven by different sets of demands, generally dictated by those who commissioned the study or are paying for its completion. Depending on the requirements of the sponsors and the objectives of the particular study in question, impacts on the following types of economic activity may be analyzed:

- **Port industry**—services associated with moving cargo and/or passenger flows through the system;

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- **Local port user industries**—activities of shippers and receivers making heavy use of the port; and

- **Port capital spending**—new construction, expansion or rehabilitation projects, including projects associated with environmental cleanup and mitigation, and waste removal.

For each of these types of port activity, the economic effects or impacts can be separated into the direct, indirect and induced economic impact categories. **Direct** impacts include the initial round of spending and employment generated by the three types of port activities as above. **Indirect** effects are those impacting on other industrial and service sectors caused by the direct activities, and include the inter-industry economic activity supported by the purchases of supplies, services, labour and other inputs. **Induced** effects include the economic activities arising from household purchases of goods and services made possible because of the wages generated by the direct and indirect activities. In both indirect and induced multipliers are usually employed. We agree with J.L. Eyre (1987), who wisely argued against the following overstated port benefits:

> "If a longshoreman has a mother-in-law living with him, and she buys a television set, the television store is deemed port-related."

It is difficult to separate indirect from induced impacts and even more so to quantify the result. While indirect benefits are important in certain areas, they should not dominate an EIA. They are best assessed and measured when analyzing the social and environmental impact of a port project.

For the port industry (see Exhibit 1), direct impacts are generally defined as those activities and expenditures directly involved in handling and transporting waterborne commerce (including passengers) through the port system. The port system includes the land and water transport systems as they link up with port, stevedoring and cargo-passenger handling expenses, vessel port-call expenses, crew expenditures and services relating to freight forwarding, banking, insurance, and so on. The common thread is that all these activities obtain their revenues by directly supporting the movement of passengers and freight through the port.

The direct impact associated with local port users can be difficult to identify. Local users are defined as those dependent on the port in the sense that the port's existence is a major factor in the company's rationale for operating in that location. In many cases, the whole value of the activity can be linked to the port. Problems occur with industries like ship yards which merely take advantage of the port being in that particular location. While the payroll and local expenses of these companies are significant, their aggregate impact must be closely examined. To simplify matters, only the portion of business tied to the inputs or outputs moving via the port should be considered a direct impact. Thus the concept of port utilization is important, as opposed to the purchase of port industry services arising from the movement of goods. To

avoid any double-counting, port user activities should not include the transportation expenditures which have already been captured in the direct impact category.

Exhibit 1

Typical Port Industry Direct Expenditure Categories

Navigational services	Warehousing
Expenses to meet Government requirements	Reefer storage
Supplies	Drayage
Bunkers	Inland transport
•oil	•Trucking
•water	•Rail
Minor repairs	•Barge
Stevedoring	Export packing
Equipment rental	Agency commission
Container stuffing	Freight forwarders
Terminal charges	Customs house brokerage
Storage and facilities charges	Banking and insurance
Wharfage	Other professional services
	Crew expenditures

Source: MARAD, Port Economic Development Kit.

Export-oriented users are easiest to identify, and should include only those located within the region which use the port facilities. Their ability to use other transport routes or nodes should be reflected in the direct impact analysis. Importers using the port present a more difficult case. Generally, only firms located in the immediate region should be used and only those which actually use the port facilities. Hence the decision as to whether to include local port users in an impact analysis depends on the purpose of the port, and how important such industries may be in contributing to the fulfillment of that purpose. Care should be taken; as the study area becomes larger, it becomes difficult to identify and link major port users' activities to the port.

The direct impacts are usually measured on a per tonne of cargo or per passenger basis. However, the scale of the overall potential spending is hidden by such measurement, as a larger cargo or passenger throughput will generate a greater critical mass for spending. This type of measurement must be treated carefully when comparing ports of different sizes/throughputs or when considering very small or very large facilities. Also, the impact of inland transport can only be measured in terms of its direct impact on the port facility.

The direct impact of port capital spending is separate from the above as it is a one time expenditure, and usually very significant. The impact incorporates the substantial amounts of employment, payroll, sales and taxes arising from construction. It is important to capture only the initial impact or double-counting will otherwise occur as the continuing contribution of the cargo-

passenger handling facilities will be measured elsewhere in the analysis. A conceptual issue arises as to whether or not capital spending can properly be separated from the other two types of activity. The need for a port authority to recover its capital expenditures over time via a tariff or user fee indicates that the direct port industry impact implicitly includes a capital recovery element. However, the length of time associated with port expenditures, especially expansion or dredging, necessitates the recovery take place over a long period of time: 15-40 years. Hence, the significant local impact of construction activities is unfairly ignored. Thus while the capital recovery may result in double-counting, it is minor compared to the positive benefits of a rational capital investment program.

The most important aspect of identifying the economic impact of port capital spending involves the consideration of the portion of that spending which stays within the particular economy. Most of the equipment used at a modern port is purchased from outside the port area and cannot be considered as having an impact. This may also true for engineering or advisory services. While labour represents a significant cost of investment, only labour originating in the area should be included as a direct impact. All of the above tends to diminish the impact of investment at the local level but can be significant when considering the impact on a region or country as a whole.

Literature Review

According to Lakshumanan and Johansson (1985), there are a number of elements which must occur in economic impact studies. These are reported under *Economy* in Exhibit 2. The basic economic model identifies four sources of variability in welfare outcomes: (a) price structure for goods and services; (b) production activities and resource use; (c) consumer control over and preferences for goods and services; and (d) consumer technology used to press resources or goods and services into welfare outcomes. They believe a major drawback of the basic economic model is its incompleteness and crucial neglect of the major determinants of welfare outcomes. Individuals and groups rarely control the chain of events linking investment to welfare outcomes. Consequently, the impact analysis must be broadened to include institutional frameworks and networks, as well as environmental factors thereby resulting in the total list of factors, also found in Exhibit 2.

A classic example of the port cost:benefit study is that by Graves, Horwitch and Bowman (1984). The study began with the premise that US society should invest in large-scale coal port development and that the key tradeoff was the cost of dredging versus the lower ocean transportation costs associated with larger vessels taking, to quote the authors, a "society-wide" perspective. The study did not contemplate that taking such a perspective would involve inputs of other countries or that some of the "benefits" accrued to non-US parties. The econometric data (the cost of capital, port capacity, forced throughput at each port, dredging options, investment and maintenance costs and the like) were manipulated and resulting Greek equations interpreted to draw conclusions about **where** such investment should take place. The study did not answer the

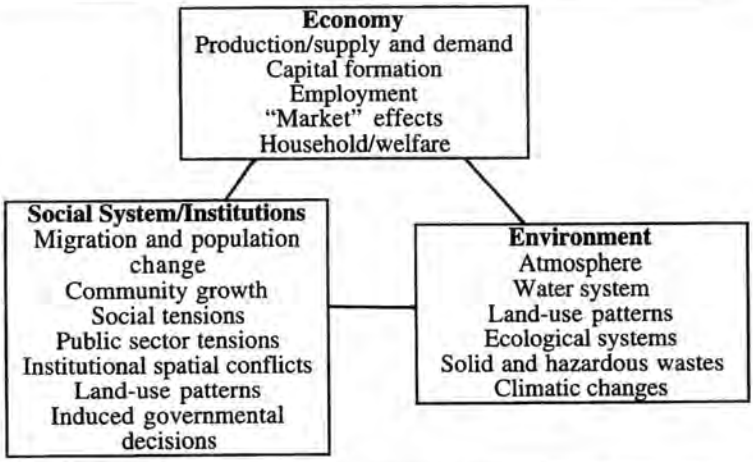
question of **should**. Which begs the question: Why are economic impact studies undertaken?

According to Finsterbusch and Van Wicklin III (1988) impact assessments usually precede project or program implementation and are a decision tool for policy makers. They serve to determine whether a project should be implemented, to guide its design, to develop mitigation measures, and to guide future related projects.

> Impact assessment can identify political forces that losers can use to stop a policy. It also could more clearly define winners so they could be informed and motivated to support the change. Or, other policy options (e.g., subsidies rather than taxes) could be devised that are both politically feasible and economically sensible. ... The field of impact assessment has developed tools to look as broadly as possible for secondary and higher order effects. (Mason, 1988, p. 170)

Exhibit 2

Factors for Study



Source: Adapted from a table by T.R. Lakshumanan and B. Johansson (1985), *Consequences of Energy Developments: An Approach to Assessment and Management*, in *Large-Scale Energy Projects: Assessment of Regional Consequences*, T.R. Lakshumanan & B. Johansson (Eds), Holland: Elsevier Science Publishers B.V., p. 11.

Koppel (1988) discusses the role of EIA in policy analysis in Asia (especially the Philippines) and why the role has traditionally appeared insignificant. He concludes that in Asia, EIA is seen as a way to further de-politicize technological decisions, to prompt open debate about the political consequences of the decisions (further supporting Koppel & Oasa, 1987), while impact assessments are often used in the US to politicize a policy decision (being used to highlight successful/beneficial aspects). This also apparently true for Canada. The EIA of the tar sands project was concerned with implications after the fact, and the focus of the analysis seemed to be on implications for an impacted region as a gesture toward conflict resolution. Wilbanks and Lee (1985, p. 280) concluded that "a major part of the motivation was a need to satisfy regulatory requirements" and they contend there is a need for even less quantitative (but still systematic) approaches to policy analysis.

Lakshumanan (1985) summed it up:

> More often, in the public policy arena, economic modeling is inadequate in that it does not yet provide a method for strategic analysis that allows, in a context of adversarial procedures and bargaining, an orderly approach to balancing model results and judgment. (p. 211)

Why Are Port Economic Impact Studies Undertaken?

Port EIA studies generally have a three-fold purpose. Firstly they measure the impact of direct, indirect and tertiary spending at a port, by persons and companies who use the facilities. The most important area of spending is direct and indirect, which are key to identifying and quantifying the actual impact of the port facility. Secondly, the effect of the economic spin-off from this spending is assessed via-à-vis the port itself, the relevant economic hinterland, and the port infrastructure/organization on the regional and national transportation systems. Thirdly, they attempt to provide a strategic approach for future port and/or infrastructure investment.

Economic analysis is important to policy-making, Mason (1988) confirms, because it considers the scarcity of resources. Impact analysts explicitly maintain that resources are not infinite, but impact assessment methods and conclusions are sometimes implicitly based on this idea. The traditional assumption is *ceteris paribus* (other things staying the same). Mason (1988) argues that this should be replaced with the assumption of *mutatis mutandis* (other things changing as they do). By taking an integrated approach when looking at policy decisions—using the tools of impact assessment and economic analysis to ensure all relevant variables are considered—he concludes that more effective policy decisions will be made.

He illustrates this point of view with the following argument:

> The existence of unemployment seems to imply that labour is not scarce. In fact, assessments of technologies and policies consider effects on job creation or elimination as critical impacts, and politicians will go to great lengths to

> save jobs. Yet the number of jobs created or preserved is still viewed as a measure of benefits, and it is still possible for assessments and the policymakers who use them to overlook the importance of making this scarce resource more productive. (Mason, 1988, p. 167)

Impact assessment methodology, it is argued, can array the technical options and the social and political context within which they would be applied (Mason, 1988, p. 170). An even broader approach for port investment is presented by Couper (1992); his investment decision-making process incorporates environmental management elements into the planning cycle. This is in direct contrast to that suggested by Dowd and Jonson (1993); theirs is strategic in its investment planning, with continual review of opportunities, facilities, market needs and revenue sources in order to maximize the likelihood of a successful project and minimize the potential for a "rogue project"—a project which was approved without sufficient review and which generates insufficient return to achieve the objectives of the port authority. Some would argue that the strictly financial assessment implied by Dowd and Jonson (1993). is appropriate for private ports, but ports serving public policy objectives need to be evaluated from a much broader viewpoint—economic, social and environmental—using public policy tools. John (1994) makes an effective argument in favour of using cost:benefit analysis to evaluate the supply of public services. He argues that traditional systems of financial appraisal are "extremely convenient" to use but should not be used to evaluate the supply of public services such as those related to maritime safety. He contends that marine safety does not lend itself to financial analysis as it is non-revenue generating and lacks a normal "market" for the services. Such services should be evaluated on a broader basis, including their social costs as well as benefits. Financial analysis is simply too limited a point of view to take in matters of public interest. As Canada moves towards a new ports policy, modeled after the National Airports Policy announced by Minister Young in the summer of 1994, the issue of appropriate analysis tools will need to be re-visited.

A Review of Two EI Studies

Canada: Port of Vancouver Study

The purpose of this study was to assist the Vancouver Port Corporation in determining the full economic impact of the Port of Vancouver on the city, province and Canada. The results of the study provided a far reaching profile of the direct benefits of the port to the community. Significant details on employment, revenues and taxation were revealed, although a time series or projection was not provided. **This limits the overall use of the impact study as a planning tool for the future.** For the direct benefits and relationships, it was a survey based study which relied heavily on input from the port community. For the indirect and induced benefits, it relied on econometric models including the Statistics Canada Interprovincial Input/Output Model.

There was an extensive examination made of the linkages between the port and industry in the rest of the country, which were also calculated using econometric models. While these models may have been useful for providing an overall picture of the linkages, there were some inherent shortcomings in them which limits the overall quality of the port study.

These limitations, common to many port impact studies which employ econometric modeling techniques, comprise the following:

- The data which formed the basis for the econometric part of the study was over 10 years out of date.
- The production function was linear, meaning that the total effects of a project were directly proportional regardless of size.
- There was no time dimension to the model. (It measured the full impact of all events as if they happened instantaneously.)
- The model did not adjust for supply and demand effects, such as price increases, substitution, and availability of resources.
- The model did not consider the efficiency of expenditure, in that it assumed that a large expenditure always has a larger impact than a smaller expenditure.

Overall, the study provided a snapshot of the impact of the port on its relevant hinterland. However, the lack of a time-series based review and projection, adequate environmental and social impact analysis, and the use of economic modeling techniques with inherent flaws, limits the use of the study for planners. While the mandate for this study may not have required these elements and hence their exclusion, this severely restricts its value to the public as an investment in future data needs. Future studies should incorporate such elements to useful and a wise investment of tax payers funds. The methodology for this study was the same as that used for CPC study and so further commentary on that study would serve little additional purpose.

Caribbean: The Case of Paradiso

A port economic study conducted for the small Caribbean country of Paradiso[2] highlights the problems associated with conducting impact analysis in a small region and emphasizes the importance of conducting the study according to a prescribed format. The impacts associated with developing a port infrastructure in the country are truly necessary for its development, and thus they have far reaching consequences for the economy as a whole.

When the study was undertaken, Paradiso relied on air service for its consumer imports, with transport provided by local sea carriers for most

2 The study was confidential and so we offer this poor pseudonym.

industrial imports. The primary benefits associated with developing an efficient port system were identified to be:

- reduced damage to goods;
- reduced spoilage of food products;
- reduction in external container freight costs;
- reduction in freight for bulk goods and petroleum products
- reduction in the use of air freight allowing imports and staple goods to be more efficiently priced; and
- reduction the cost of imported fuel.

The study noted that the developing of a port system allowing the use of more efficient ocean carriers would reduce the landed costs for all goods for the country. In addition, it provided over 20 sustainable jobs not previously available. The capital requirements were significant (US$3-5 million), but adequate financing was available and the costs associated with financing the product, all to be ultimately borne by Paradiso, were more than offset by freight savings and reduction in spoilage and wastage. While these savings would not probably be as significant for port development in a larger, more prosperous country, they are important for small, under-developed regions. The same principal could be applied to smaller isolated ports in Canada which rely on supply vessels and air freight to service the regions.

An important aspect of the port development scheme was an environmental assessment analyzing the impact of investing in port facilities. The study investigated the following areas:

- impact of sea and wind conditions on the facilities;
- impact of receiving oil products at numerous locations, assuming the risks inherent in the transfer of bulk petroleum products;
- impact of littoral (sea-bed) movement; and
- impact of increased traffic on fishing facilities.

The results indicated that there would be minimal overall environmental risk associated with the project. In fact, environmental risk would be minimized given the investment in newer safer facilities.

In addition, the impact of the port development on tourism, agriculture and fisheries, construction, surface transport, and retail trade and consumption patterns was assessed. This social impact is critical for the project as it is here that the benefits to the country were best evidenced. The development of the port would lead to increased tourism potential, as it would allow cruise vessels

to arrive and a new marina to be built, generating spin-offs for the community. The positive impact of construction, mostly associated with hotels and shops, was assessed along with the development of an improved road system.

Overall, the development of the port would provide the impetus for the sustained economic development of the entire country. The impacts were measured directly, via surveys, since no information existed for a comparable region. The direct impacts were all assessed and quantified, while the indirect and induced benefits were discussed. The result was that the direct benefits to the region were demonstrated by the study and it serves as an excellent example of how port impact analysis should be carried out using the survey method.

Issues and Problems

There are a number of key issues which must be considered when conducting a port economic impact study:

Purpose: The purpose of the study must be clearly understood and stated as it will determine the choice of approach, the level of detail and the study scope. The purpose must consider the full relevance of what economic characteristics are to be identified and what is to be analyzed. It must also take into consideration who the audience is and what use is to be made of the study results. The subject of the study may be either a new project or the measurement of the ongoing impact. The audience may include one or all of the following: decision making bodies or government regulatory bodies; legislators, voter constituencies or the general public; and port users or the port industry, including existing and potential clients.

Approach: The key challenge in any port impact study is to gather the data needed to assess the direct impacts and then performing the calculations required to determine the indirect and induced effects. There are two approaches that can generally be taken when conducting a study: (1) those that use an estimating procedure and (2) those that rely on surveys.

Studies using **estimating procedures** involve the extensive use of coefficients and prove useful primarily for a pre-feasibility studies or public policy review. Because they rely on previously gathered material, the coefficients will not necessarily be applicable to the particular port in question. This is especially the case with small ports either serving only a few industries or existing in small countries. Economic indicators and expansion coefficients based on data from other economic regions are not particularly reliable. The appeal of this approach lies in the ease with which data is found. Input/output models which are the joy of many port economists and the bane of port managers (often heard to exclaim: "Not another Greek equation!"). While the cost of survey work is avoided through their use, the accuracy of the models themselves demands constant attention and substantial funding, raising doubts about their intrinsic cost effectiveness.

Survey based studies rely on direct contact with the port players to identify the economic impacts involved. It is most useful for single port studies or those with a narrower scope where greater detail is required. The approach's

main disadvantages are the time and cost required to carry out the survey. It is also difficult to measure impacts if survey respondents are not forthcoming with information, particularly financial information. Survey based studies make great use of local estimates, especially for spending. While more reliable than expansion coefficients, they still may be affected by the methodology of the survey, the biases of the researchers, time and financial constraints and the nature of the replies given.

Execution: Once the type of approach has been determined, it is critical that resource requirements, including personnel, budget, time frame, and study scope, reflect the purpose of the survey. While personnel and budget are straight forward, and will be dictated by the type of survey used, the time frame must be approached in a careful and logical manner. The scope of the study must define the types of impacts, the study area, economic impact measurements and details of the base year and updating.

It is in the area of execution of the study that problems arise. First, more often than not, historical data will be used to determine the future impact of investment on continuing port activities. Often a study is a snapshot of the existing time and events, and does not take into account the dynamics associated with changes in international and local marine trade, technology and port facilities and organizational structures. The lack of adequate survey data and inaccurate forecasting techniques are a major problem with many port studies which have been carried out, particularly those which justify the continuing operations of a port; they are overly optimistic if the data is based on a period of economic expansion or high growth and, conversely, overly pessimistic if the time frame reflects a period of relative inactivity or changing port utilization patterns.

Second, trouble occurs with induced impacts, especially in studies using estimating procedures. Direct impacts are always addressed as they are specific to the port and hinterland. The induced impacts resulting from the impact of expansion coefficients should be treated with skepticism as they are usually overestimated. It is important to appreciate the impact of the net benefits associated with a project; the quantification of revenues is insufficient as expenses are ignored and it is only the **net** revenues which will benefit a particular area.

Third is the definition of the survey/study area. While it is common to attribute the economic benefits of the port to the entire country, this is not always a sound practice. Shippers and other port users often have a choice of which ports or transportation routes to use. As all of these may benefit the country, it is essentially double counting to attribute the benefits to one port. However, in the case of a single port country or an isolated region where there are no alternate trade routes, it is imperative that benefits associated with the port reflect those enjoyed by the whole country or applicable region.

Finally, there is a significant overestimation problem. The major types of economic impact measurements are revenues (the value of the firms sales linked to the port activity), employment (the number of persons employed in the port related activity), payroll (the value of wages paid to workers engaged in port-related activities) and taxes (national, state, provincial, and local taxes collected

from economic activities). Using the last as an example, whether the national government collects taxes at either Port A or Port B will not have an overall impact on national revenues. While the point of collection is often considered the key determinant when analyzing the impact of taxes, it often overstates the impact, especially at the national level. This is an particularly important consideration when comparing the impact of ports within a region. While new investment will generally create new tax revenues, comparing levels of existing collection is essentially double counting.

The key aspect of measurement is the determination of the net value added of the economic activity, by subtracting the cost of purchased inputs from a firm's total revenues. Value added denotes the returns to factors of production used in economic activity i.e., wages, benefits, profits, interest, and taxes. This concept is critical because it can be directly compared to a national or regional product (e.g., GDP) which represents the sum of the value added of all economic activities in the region. This is particularly applicable to sales revenues, since the product and services purchased do not always originate in the region or are purchased from other firms, resulting in double counting. This is also the case where centralized purchasing by either a port operator or user results in efficiencies being gained by using outside sources. Hence, the value of the port is not always as great to the community as it may appear in some EIA studies.

This is further complicated by the public perception that ports are not a good use of funds. Ports are particularly notorious in arguing for improved or additional facilities citing they must service a lumpy and often volatile demand. Improved capacity utilization is often favoured by the local public who see idle facilities and want to know why taxpayer funds (they assume) are being used to expand the port. Koppel (1988) raises a very interesting question in his exploration of the effectiveness of impact assessment: why is capability development supported much more than capacity utilization? This question has become even more critical in the last decade because of the scarcity of public funds for infrastructure investment.

Ports in Canada are less concerned about the impacts of the disturbance of dioxins in the soil or wildlife habitat disappearance in their decisions about port facility development than are ports in the US or Europe. Therefore, it is clear that resources are not being allocated efficiently. Some corrective mechanism should at least be explored. In the U.S. concepts like mitigation banking are incorporated into legislative requirements in recognition of the importance of environmental impacts. Until the economic impacts of environmental consequences are included in the policy analysis in **all** jurisdictions, port impact studies will not reflect their true economic impact of the 21st century.

Conclusions

The paper has reviewed both the theory and the rationale for undertaking port economic impact studies. The days of economic impact studies as stand alone entities are surely relegated to politicians trying to justify a decision already made. We are entering an era when port managers will move forward with new capital expenditures based on limited (in scope) financial and economic analysis

and when politicians and consumers will seek the broadest possible process to be imposed with environmental impact assessment employed along side EIA. This tension between port managers and other commercially oriented entities, on the one hand, and environmentalists and bureaucrats charged with protecting the public interest, on the other, will grow as infrastructure commercialization pressures question the perspective of the latter. In the post-Rio world of a blue planet, port management must be integrated to incorporate environmental management, as proposed by Couper (1992). As social and environmental elements also have economic impacts, port impact assessments must be expanded beyond just the economic elements so dominant in the past.

To give Mason (1988) the last word:

> If the world were only organized as easily as lists of assumptions are made for economic models, then impact assessment and other policy analysis tools would be unnecessary. (p. 168)

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PORT IMPACT STUDIES,

- Fact or Fiction,

by J.L.Eyre

ABSTRACT and Introduction

Port activities once dominated cities such as London, New York, Rotterdam, Shanghai, Guyaquil, Bangkok, San Francisco, Rio de Janeiro and Hong Kong. Now many of these have outgrown their ports,- pushed them aside. Ports increasingly need large amounts of capital for docks and cranes. They compete against eachother and plead for tax breaks, subsidies, and free dredging. To make their case with a generally un-informed public they make impact studies,- some valid, many slanted. The author wrote New York's first port impact study in 1950 and now questions its foundations. Today geographic, social, and regional planning considerations force port people to base their pleas on very different kinds of evidence, on generally weaker cases. It is even possible that the port of the future will have little right to claim public financial support from a big city.

To date most papers and studies have viewed this and the container revolution through the eyes of port and academic people. This is how it looks through the eyes of a shipowner.

I. The Traditional Port Impact Study

Cities such as Rotterdam, Hong Kong. Marseilles,and Singapore owe their existence to port activities. Early impact studies might show direct and indirect impacts at close to a hundred percent. Now New York's Manhattan waterfront is a jungle of high rise apartments, convention centers, parks, shops and tennis courts. Somehow these show greater impact on the general welfare than ships and cargos. In 1950 the Port of New Authority was able to claim with a somewhat straight face that one job in ten in the port district (loosely defined) depended directly or indirectly on port acvities. The latest 1985 Port Authority (of New York and New Jersey) claim sets at 2.4 percent the port's share of gross regional product and regional employment. (1.) From the above one might imagine the following table for the average large world port:

Table 1. Port Impact in a Traditional Large Port City

Year	Port Impact
1750	90 Percent
1850	50
1900	25
1950	10
1995	2.4
2000	minus

No two situations are alike. New York had a convenient empty swamp in the New Jersey towns of Newark and Elizabeth. Hong Kong devised a system for discharging containers to barges in its vast protected inner harbour. In Guyaquil they found a Puerto Nuevo on another distant branch of the Guayas River. Virginia ports created an inland port at Front Royal. Singapore planners have elected to stay with their inner city location. Often unchangeable berth and channel depths decide. Halifax has sixty feet plus, but shallow draft (35 ft.) up river Montreal has more cargo and better connections. In Manila the port took over the downtown area, and the city moved away,- inland to Makati, once a tree lined suburb.

However, there is a pattern that clearly undermines the foundations of the traditional port impact study. In the old days an average ship employed gangs of longshoremen, twenty five or so for each of five hatches or holds. While a hundred or more men worked cargo. The normal ship crew had forty officers and men. All of these spent money in the town, ate , drank and caroused in local establishments. Masses of clerks and stenographers manned the downtown offices of big port cities. Banks, insurance companies, law firms and ship chandlers added to the story. Shipping and ports generated many local jobs.

The 1950 New York study first added up all of the direct benefits in a massively labour intensive operation. It padded the account a bit by including garbage barges and yachts that might well have been there even without deep sea trade. It then leaned on the advice of social economists to apply a multiplyer in setting so called indirect benefits. Thus, if a longshoreman bought a television set for his mother in law, the electrical appliance store was clearly dependent in some mysterious

degree on the port. Though slanted a bit, this was a reasonably honest effort. Its major weakness was its concentration on the benefits with no mention of the greater benefits that might come from other types of activity. Soon after 1950 shipping began its flight from Manhattan Island to be replaced by big city activities that were clearly more suited, more able to pay high rents and taxes, also to meet social/environment standards.

Other American ports were imaginative.The U.S. Maritime Administration created a computer model that spoke to port impact issues, and that naturally impressed the general public. Few bothered to ask about the inputs. US West Coast ports tended to retain obscure consultants in such far away places as Bridgeport, Connecticut or Dover, Delaware. These naturally stressed the positive in their impact stories and subsequent press releases. Many top consultants refuse to to this kind of work, fearing pressures from port staff and commissioners.

A common trick has been to lump bulk cargo (ores, coal, grain etc.) and oil in the port tonnage totals and to imply that these had the same impacts as general cargos. In fact most bulk cargos are transferred from ships to shore at special dusty smelly capital intensive terminals far away from city centers.

Soon a standard ship's crew will be about twelve, and the only workers on docks will be highly paid machine operators. Already in Rotterdam and Singapore containers are discharged to automated vehicles that move them to place of rest without human participation. In London and New York ship lines have abandoned their downtown palaces for country (and low tax) havens such as Morristown, New Jersey (Maersk), Colchester a London suburb, and for SeaLand Charlestown, North Carolina. Forwarders farm out their record keeping to low wage towns in Haiti and the Dominican Republic. Federal Express abandons congested Manila to set up shop in far away Subic Bay.

Forty years ago a keynote speaker annoyed the American Association of Port Authorities (AAPA) by suggesting that the port of the future might be like the Staten Island (Manhattan,NY)
ferry station, employing just a few maintenance men and ticket punchers. In the old days a ship's port call was a

ceremonial and relaxed affair. Customs, immigration, and port officials would have a few drinks with the captain, and perhaps receive gifts before letting anything happen. Port Commissioners were bank presidents and prominent politicians who (with their families) toured Europe and the Far East giving lush cocktail parties to tout their home towns. In the fifties and sixties port staffs became filled with planners, economists, and naturally lawyers. This ignored the sad fact that most well run ports are no more than landlords renting docks and cranes to more competent professional terminal operators. National and City port bodies (Commissions, Boards and Corporations) have become political plums, especially in Canada and southern USA.

Impact stories are now more than ever important for port organizations faced with attacks from environmentalists and budget cutters who question the traditional study approaches. Query, how can a 1995 port plead for tax breaks, subsidies, and to cover its traditional overhead burdens?.

Before answering this question we might consider the points that ship lines take into account when deciding where to place their main line and feeder vessels.

II. How the Deciders Decide

Most agree that shipowners decide on port selections. This is true, but not completely and not for long. Seeking business like any other service provider, a ship line tries to understand about cargo origins and destinations. However, this is hard because budget cutting governments have been reluctant to fund cargo flow research. This ever changing field must be approached on a trial and error basis. Now ship owners, forwarders,truck and rail lines enrich non government consultants who claim to have origin and destination data banks.

Shipowners have options, New York or Norfolk, Marseilles or Barcelona, Seattle or Vancouver, Tokyo or Pusan. In seeking profitable cargo they try to avoid ports that are expensive, strike prone or inefficient. A modern main line containership
(5,000 Twenty Foot Equivalent Units or TEUs) will cost about a hundred million dollars, and every day or even

hour lost is a disaster. In sailing days and up to about 1970 ships spent most of their time in ports. Now they are at sea (making money) for better than seventy percent of each year.

In the old days ships kept what were called "voyage accounts". That meant that all costs from dock to dock were lumped in one accounting basket. Now it is different, as in the port cost basket are all costs from pilot station inbound to the same outbound. That means that pilots, tugs, all port dues, bribes, SHIP TIME, cargo/container inventory, stevedoring, port free time storage, and any other related costs are in the port account. For any visit the gross port costs are divided by the number of tons or containers handled.

Now, for example shipowners worry about the long run up the Delaware River to Philadelphia delays passing through locks in Antwerp, a half day in Chesapeake Bay en route to Baltimore, chronic strikes in French and Australian ports, ice in the St. Lawrence River approaches to Montreal, and the bribes that are routinely extracted in Latin American harbours. Reading a port tariff is a waste of time as so many of the elements mentioned above are omitted or varied in special deals, for example big volume discounts.

While there are wide variations, the following is a rough indication of gross port cost levels based of the 1994 files of an anonymous shipowner;

Table 2. Sample Gross Port Costs (in 1994 US Dollars)

Singapore	$ 150/TEU	New York	380
Panama	600	California	320
Marseilles	480	Caribbean	800
Santos	650	Dubai	190
Calcutta	700	Colombo	290

On average rich OECD countries (including Japan) have gross cost levels at about $350/TEU, while those in Latin America India, Australia, France and Africa are at $550/TEU, and good Asian main line terminals at $225/TEU. A twenty foot container carries about ten revenue tons of cargo. Terminal costs for big forty foot boxes (FEUs)

are about 1.5 of those for the twenties. The above cannot be better than rough indications, as so much depends on such variables as currency values. However, most shipowners calculate their ship times, container and cargo inventories in US dollars. Note that ships must call at high cost ports in Japan and New York because there is so much rich cargo within three hundred miles of their docks.

Costs at sea are easy to calculate. A 3000 TEU containership can move cargo for about one cent per ton mile, not much more that the cost of a bulk carrier with grain or a tanker with gasoline. The well published key elements are finance (35%est) fuel (25%) est.), Crew (15%), and the rest for maintenance, management and insurance. Containerships are traded in an open market which is reported daily in the trade press. Generally they are chartered (rented) "fully found" which means that the owner manages the vessel and pays for everything except fuel, consumables and port costs. The charterer then tells the ship where to go and pays the variable costs mentioned above.

III Future Port Impact (value added) Considerations

Happily modern impact studies have become more honest. This new situation is part of a general worldwide shift in power away from carriers and ports (service providers) and towards their shipper customers. Shippers Councils now can destroy Conferences and other shipowner cartels. Federal governments wonder about the "Pork Barrel" billions that they spend dredging ports. Environmentalists complain about the toxic muck that is being sucked from the bottom in New York and Boston, to later feed nearby fishes and wildlife

The finest recent discussion was in the lead paper at the 1994 TRF Conference, that by Prof. Brian Slack of Concordia University in Montreal. There he explains that;

"Although Canadian transport terminals are more efficient than ever before, their local impacts have diminished. The loss of jobs in the yards has impacted negatively on many communities. Manufacturing activities adjacent to transportation terminals have largely disappeared,.." (2.)

Prof. Slack joined a worldwide group of geographers in producing a complete volume called "Containerization and the Load Center Concept", this as the July-September 1994 issue of Marine Policy and Management. (3.)

Now urban and regional planners,geographers, sociologists, environmentalists, and unbiased economists are looking behind the press releases of port politicians seeking big bites from the public purse. Always they reflect the need to avoid high labour, land and tax costs in big cities, also the ease with which work can be switched away from ports to inland points. The container has made this possible.

But the container revolution has not run its full course. That adds even more confusion to the study of port impacts.

IV. The New Deciders

A dramatic battle is under way in New York and New Jersey where local politicians want the Federal Government to spend millions (maybe billions) dredging and maintaining a winding channel from the Atlantic Ocean through the Kill Van Kull to Port Newark , New Jersey. This is to accomodate what are called "Post Panmax" ships that may one day require depths of fifty feet or more. These are ships too big to pass through the Panama Canal, but able to come from Asia via the deep sea level Suez Canal. While the political powers are vocal, not much is heard from those who think that the status quo is acceptible. Impact "studies" suggest that the port must be able to receive whatever monster containerships come along, but this may not be so.

At some point ships must (and will) bow to geographic reality. There is a highway tunnel (route 13) under the entrance to Norfolk and Baltimore. The Straights of Malacca (between Indonesia and Malaysia) have a rock bottom which limits tanker sizes. Japanese super tankers often scrape their bottoms there en route from the Persian Gulf. There is a rock shelf at Sorel down river from Montreal. The million ton tanker was never built, because no port could or would accept it. In fact ULCCs (ultra large crude oil carriers) are fading from the world tanker fleet.

Adding to the confusion is the fact that containership owners will care less about what port gets dredged, subsidized or given tax breaks. This is true because, by about Year 2000 their power to design logistic systems will have passed to cargo owners and their servants who are forwarders, agents , and what are called NVOs. These are large organizations like forwarders (Non Vehicle Owners) that may own containers and terminals, but not be carriers by truck, rail ship or plane. Some see them as a fifth mode of transport.

Though ship lines now select ports, this will be less so as forwarders, NVOs and logistic firms learn to hire ships in the open market, as they now do with truck, rail and air services. Already American SeaLand and APL (American President Lines) own and operate vast inland activities engaged in forwarding, logistic planning, and movement by all modes. Dutch NEDLLOYD is linked to the CONTAINER PORT GROUP which operates inland container depots throughout the USA mid west. SAFMARINE (South African Marine) owns and manages a vast network of forwarding, truck and other facilities in Sub Saharan and South Africa. Once these lines owned and operated all of their ships. Now they go into the open charter market for about a quarter of their containership tonnage. Soon most of them will tire of the complex business of running ships and (as with bulk cargo owners) they will turn over ship operations to more skilled (mostly Asian) hands. Containers are homogenius, one much like another. Already some ships carry them at FAK (Freight All Kinds) rates. This means carrying a big box from point A to point B whthout much caring what is in it.

At this point sophisticated computer programmes will determinine cargo flow patterns, usually accepting whatever geographic limitations exist. NVOs care little about dredging or impact studies.

Conclusions

1. LESS JOBS

Port cities will continue to lose employment as shippers and carriers use containers that pass through to places where land, labour and taxes are cheaper.

2. LESS MARKETING

Trade missions, advertizing, conferences, and overseas offices will become surplus and too expensive. Carriers and shippers will base decisions on realities,- port location, costs, and cargo flow patterns all as determined in sophisticated software programmes increasingly available.

3. LESS PORT OVERHEADS

Since Port Authorities are generally no more than providers of hardware and infastructure (docks and cranes) they need fewer lawyers, planners, sales persons, and managers. Downsizing has begun in California and New York.

4. IMPACTS BASED ON ACCESSIBILITY

Hub or mainline container port communities will enjoy faster and cheaper transport for exports and imports. Secondary or feeder port communities will suffer,- say by about five days in delays and added costs of about a hundred dollars a ton.

Appendix;

1. The Economic Impact of the Port Industry on the New York-New Jersey Metropolitan Region, The P.A.of NY/NJ, April 1985

2. Enhancing the Value Added; Terminals and Logistics in Canada
Prof.Brian Slack, Department of Geography, Concordia University, with excellent bibliography.-CTRF 1994

3. Containerization and the Load Center Concept;
A special issue of Maritime Policy and Management (Vol.21, Number 3. July-September 1994) Taylor and Francis Ltd. Basingstoke, England

Note especially Prof. Slack's introductory comments;

" The first four articles approach the subject of strategic location at different geographic scales. Yehuda Hayuth and Douglas Fleming examine ideas about centrality, accessibility. gateways, junctions and transit points in their article on the location of container ports from a global perspective. Issues of location, competition , and dominance are observed next in a regional setting, where Claude Comtois explores the world's most rapidly growing container region,- East Asia. Robert McCalla takes a close look at container traffic to and from one country- Canada - to see how differeent ports have acheived dominance and which might be expected to remain strong. John Starr, examining a sub-national region - the United States' mid-Atlantic coast, identifies a set of criteria by which the fierce competition between two ports appears to have declared one port a winner.

The final two papers apply the load center concept to the location of inland centers. " (from the Guest Editorial)

4. The author is a former President of CTRF and of the Canadian Shipowners' Association. Originally a merchant marine officer, he has worked mainly in ship and port operations. His CTRF paper entitled "Maritime Impact Studies" (St.Johns, Newfoundland, June 10, 1987) discussed both ports and shipping which is subsidized and protected.

Open Skies and Canadian Aviation Policy: A View from the Consumer's Perspective

Edward R. Bruning, Transport Institute, University of Manitoba

I. Introduction

National loyalty is expected to have a direct bearing on the competitiveness of Canadian air carriers in international markets given an "open skies" policy orientation. Are Canadian air travellers inclined to support their national carriers given a competitive, unregulated international airline market? Through the employment of conjoint analysis, this research seeks to identify the role of national loyalty in air carrier choice and to explain variations in national loyalty across a sample of respondents according to differences in demographic, attitudinal, and usage characteristics of a sample of air travellers. Arguments are proposed which link national loyalty to the country of origin effect. The critical hypothesis of the study is that one's felt "national loyalty" impacts international airline choices.

II. Literature Review

Country-of-Origin (COO) Effect

A growing body of empirical literature in marketing suggests that one's country of origin is a factor influencing the decision to purchase local versus foreign made products and services. Researchers have reported that advertising campaigns, such as "Made in the USA", "Buy Canada", and the like are effective in persuading consumers to opt for locally-made goods rather than foreign imports (Bilkey and Ness, 1982; Erickson, Johansson, and Chao, 1984; Han and Terpstra, 1988; and Hong and Wyer, 1989). Country of origin is thought to serve as a cue from which consumers make inferences about products and product attributes. The country-of-origin cue triggers a global evaluation of quality, performance, or specific product/service attributes.

Country-of-origin has been observed to operate in several ways. First, consumers simply use the country of origin cue as an additional variable to form product evaluations (Hong and Wyer, 1989). Alternatively, the country label may be viewed as a form of halo effect whereby it impacts consumer's

attention and evaluation of other product attributes (Hong and Wyer, 1989; Han, 1989). Finally, the country of origin cue may be conceptualized as a form of country stereotyping which consumers use when other product-specific information is not easily available (Bilkey and Ness, 1982; Hong, 1987). The literature largely favours the latter two approaches since empirical evidence clearly suggests that the country of origin cue does affect consumers' evaluation of products and product attributes.

National Loyalty Effect

National loyalty has been used as a construct to separate factors which explain consumer product choices (Bruning, Hu, and Hadjimarcou, 1991; Bruning, Lockshin, and Lantz, 1993; and Hadjimarcou, Hu, and Bruning, 1993). Based on original work by Shimp and Sharma (1987), the authors argue that specific socio-psychological processes are invoked whenever the country of origin cue is provided to consumers. These processes emanate from fundamental predispositions towards ethnocentric attitudes which are different from typical stereotyping processes in that the values ascribed to the country of origin cue are based on whether the cue supports ones ingroup identity (Bruning, Hu, and Hadjimarcou, 1991). The creation of the national loyalty construct follows the work of sociologists and psychologists studying ethnocentrism, authoritarianism, and nationalism. Campbell and Levine (1972) present a variety of social science theories related to ethnocentrism that have bearing on national loyalty's role in consumer choices. They argue that the phenomenon could be studied comparatively at several levels: across cultural groups, among groups in a given region, or among diverse trading groups or nations. In marketing applications, theorizing and empirical testing have focused on consumer choices between products from competing nations.

Group influence upon individual behaviour has been an important issue in consumer behaviour research. Calder and Burnkrant (1977) report three types of studies which focus on group influences to individual consumer behaviour. One type explores the linkage between direct group pressure and product evaluations (Burnkrant and Cousineau, 1976; Cohen and Golden, 1972; Witt, 1969; and Witt and Bruce, 1970). A second focus has been to examine the nature of indirect pressure to conform to group norms (Cocanongher and Bruce, 1971; Bearden and Etzell, 1982; Bearden, Netemeyer, and Teel, 1989; and Bearden and Rose, 1990). The third research type is represented in the work which assesses the normative beliefs about what other people think the individual ought to do (Fishbein and Ajzen, 1975; Miniard and Cohen, 1983; Ryan and Bonfield, 1974; and Warshaw, 1980). In each of these research thrusts the objective is to offer rationalizations for group influence upon

individual behaviour.

Based on the socio-psychological literature on ethnocentrism, authoritarianism, and nationalism, and the marketing literature dealing with group influences on product evaluations, Shimp (1984) and Shimp and Sharma (1987) developed their seventeen-item CETSCALE that purports to measure a dimension of behaviour termed "consumer ethnocentrism." Briefly, developers of the CETSCALE do not espouse a theory of group action so much as present a means for empirically testing the extent to which group influences, (i.e., national affiliation), impact upon product evaluations and choices in the case of own versus foreign-made products. Although limited in its account of ethnocentrism, nonetheless, the CETSCALE taps a facet of behaviour which is referred to as "economic nationalism" or "national loyalty" (Bruning, Hu, and Hadjimarcou, 1991; Hadjimarcou, Hu, and Bruning, 1993).

Country of Origin and National Loyalty: An Integration

The country of origin and consumer ethnocentrism literatures have developed independently, however, the two streams of research merge when addressing the role of national loyalty in the purchase decision process. While the country of origin effect serves to convey global impressions to users about the product or product attributes when knowledge is lacking, it also serves as an indicator of one's group identity. Attachment to an in-country versus foreign produced product will be stronger the more salient the sense of national affiliation and loyalty (Bruning, 1994). For instance, a person with a low sense of national loyalty is not as likely to respond to promotional campaigns focusing on a national theme as are individuals possessing a strong sense of loyalty for her nation. Brand name, store image, specific product attributes, or other non-country specific cues to product quality may persuade less nationalistic consumers to prefer foreign products as opposed to their locally-made substitutes. But, the aforementioned factors are not related to national loyalty. On the other hand, a staunch nationalist may respond to the country of origin cue because of close association of "nation" with one's own self-identity. "A true patriot should always support local versus foreign-produced goods and services" represents an attitude reflective of own-country bias which is activated by exposure to the country of origin cue.

Shimp and Sharma's CETSCALE serves as an instrument for decomposing the country of origin effect into discreet components. One component is informational and provides cues to consumers regarding the value of product attributes which are difficult or impossible to assess, or for which there exists no prior information for assessment (Han and Terpstra, 1988; and Hong and

Wyer, 1989). Simply put, the country of origin cue serves to convey impressions of quality, dependability, economy, etc., about the product or product attributes when more specific information is not readily present. A second component of the country of origin cue relates directly to one's group affiliation (i.e., national loyalty) and reinforces the sense of group identity. It is the second component of the effect which this research focuses on.

III. Research Methodology

Conjoint analysis is employed in the empirical portion of the study. Widely used in marketing research, the technique represents a consumer side approach to evaluating product attributes, individual characteristics, and situational factors on consumer preferences and choices. Conjoint analysis has been found to be both practical and unbiased (Green and Srinivasan, 1978; Carmone, Green, and Jain, 1978).

Model Development: Ordered Probit

It is helpful to identify the values people place on various product attribute combinations as they proceed through the weighing and balancing to derive preferences and, ultimately, product choices. The conjoint procedure allows such an assessment; however, the process is only partly reflective of the actual process in that the rating or ranking criterion factor we empirically measure is only a proxy for the true value (utility) people place on a specific attribute combination. A more direct method for modelling utility would improve our understanding of the choice process. Outlined below is a technique used in economics and behavioral sciences that provides a clearer depiction of the product attribute-utility relationship. The technique is a variant of the probit model, termed the ordered probit.

In 1975, McKelvey and Zavoina developed a model called ordered probit which is an extension of the probit model. The fundamental difference between ordered probit and the probit model is that the choice alternatives are unlimited, R_r , $r = 0,1,2,3,...w$ for the former and limited to two, R_r , $r = 0,1$ for the latter. An ordered probit model consisting of U as an unobservable dependent variable, R_r choice alternative or observable dependent variables, S,π as blocks of independent variables, and γ threshold level factor is:

$$U = \alpha + Sv + \pi\beta + e \qquad (1.0)$$
$$e \sim N(0,1)$$

and,

$$R = 0 \quad \text{if } U < 0$$

$$
\begin{aligned}
R &= 1 \quad \text{if } 0 < U < \gamma_1 \\
R &= 2 \quad \text{if } \gamma_1 < U < \gamma_2 \\
&\cdot \\
R &= w \quad \text{if } \gamma_{w-2} \leq U \\
r &= 0,1,2,3,\ldots,w
\end{aligned}
\tag{1.1}
$$

where U is a J X 1 vector of unobservable utility of a set of trip attributes to a traveller; and R_r is a vector of preference ratings. The γ_r's are threshold variables or cut-off points which provide the ratings of the alternatives.

The threshold concept is central to economic theory of consumer behaviour as typically modelled in conjoint analyses (Doyle, 1977). The theory asserts that a buyer responds (buys or rates alternatives) when utility exceeds a threshold or critical level of 'satisfaction'. For example, variations in the independent variables of equation (1.0) would change a traveller's utility which, when it reaches a certain level, $U > \lambda_r$, triggers the rating to switch from one level to another.

The system of equations (1.1) shows the relationship among the preference ratings, utility, and the threshold variable. It demonstrates that a producer would rate a trip attribute set r^{th} only if the utility of that trip to the traveller belongs to the r^{th} category (Maddala, 1983). For example, a traveller would rate a trip attribute set combination zero (e.g., strongly dislike) if the utility derived from that trip attribute combination is 'negative'. On the other hand, a trip attribute set would be rated w^{th} (e.g., strongly like) if the utility derived from that trip attribute set is greater than any other utility from other trip attribute sets in the choice situation.

The ordered probit technique is used to estimate partworth values of the trip bundle attributes. Two equations are involved in the estimation: an underlying model with unobservable dependent variable, U, and a second equation with an observable dependent variable, R. The independent variables with attribute levels are presented in Table 1. In equation form:

$$U = XB + e \tag{1.2}$$
$$R = i \tag{1.3}$$

where:

U = an unobserved dependent variable representing utility;
X = independent variables (usage, trip purpose, attitudes, demographic factors, conjoint main effect attributes);
β = estimated coefficients or partworth values;

e = error term;
R = preference ratings of air travellers;
i = value of the preference ratings (i.e., 1,2,3 ..., 10).

Research Instruments

There are two instruments used in securing data: a conjoint exercise where subjects are presented with multiple attribute bundles and asked to rate preferences for each of the bundles, and a questionnaire to collect demographic, attitudinal, and usage information. The development and implementation of the two instruments are discussed below.

Conjoint Experiment. The instrument for the conjoint exercise involves twenty-seven separate cards with various trip attribute combinations and a rating form for subjects to indicate trip bundle preferences based on a ten-point strongly prefer to strongly not prefer scale. Attributes selected for inclusion in the experiment are suggested by previous research in marketing and transportation Green and Wind (1975), and Bruning and Hu (1984). Four trip attributes are selected for use in the conjoint experiment: price, type of aircraft, number of stops, and country-of-origin of the air carrier. The last attribute, country-of-origin of the carrier, is included in order to assess the relative importance of carrier domicile (i.e., country of origin) as a factor in carrier selection. Levels for each of the trip attributes are identified following three waves of pre-testing. In each of the pre-tests, respondents from the travel population are asked to assess the extent to which the levels for each of the attributes differ.

Table 1

Conjoint Experimental Attributes and Attribute Levels

	Attribute Level		
Attribute	Low	Moderate	High
Price	50% of Coach	25% of Coach	Coach Fare
Aircraft Type	TurboProp	727	DC-10
Number of Stops	Two-Stops	One-Stop	Non-Stop
Country of Origin	Mexico	U.S.	Canada

The conjoint experiment is composed of a one-third fractional factorial design (Cochran and Cox, 1957). A full factorial exercise would produce 81 different combinations, a fairly large and unreasonable number of scenarios for respondents to consider. Orthogonal arrays are used to determine the appropriate combinations necessary for effectively estimating main and first level interaction effects. The individual ratings associated with each of the twenty-seven scenarios serve as the dependent variable while the various levels are effect dummy coded (1, 0, -1) independent variables representing the various levels of each of the three travel specific factors and the one country-of-origin factor.

Survey Questionnaire. A questionnaire is employed to solicit usage, attitudinal, and demographic information from respondents in order to complete the respondent profiling component of the research design. The questionnaire is composed of three sections. Section one captures information relative to respondents frequency and patterns of air travel. The second section of the questionnaire comprises twenty-seven statements respondents are asked to evaluate on a seven-point strongly agree (7), strongly disagree (1) Likert scale. Seventeen items make up the CETSCALE (coefficient $\alpha = .97$). Attitudes regarding mergers between major Canadian air carriers, between Canadian and foreign air carriers, and the role of economic regulation in Canada's air transport sector are captured in the ten remaining questions. Finally, section three of the questionnaire focuses on demographic information, such as respondent age, gender, occupation, income, participation in travel plans, and location of domicile. Data were collected at a major international air terminal

in Western Canada. Respondents participating in the study represent all the western provinces (British Columbia, Alberta, Saskatchewan, and Manitoba), the central provinces (Ontario, Quebec, and New Brunswick), and the eastern province of Nova Scotia. A total of 427 respondents were interviewed during a two-week period in 1994.

IV. Results

Partworth Coefficients

By standardizing partworth values of attribute levels on a 0 to 1 scale, it becomes possible to compare traveller preferences for levels across attributes. Figures 1, 2, 3 and 4 show the relationship between utility and attribute levels for trip bundles using the same scale. Traveller preferences for a particular level of attribute can be read from the utility graphs. However, the more critical information resides in the economic interpretation of the slopes. With the minor assumption that changes in attribute levels (improvements of attributes) are continuous, the slopes of the utility functions could be referred to as the marginal contribution of improved attributes on travellers' preferences. The size of the contribution is then determined by the slope.

For example, in Figure 1, the relationship between price and utility is inverse. That is, increases from low, to moderate, to high price levels decreases utility. Furthermore, the slope of the line decreases at higher levels of price indicating a non-linear relationship. The interpretation from Figure 1 is that the greatest marginal contribution associated with changing price is from the low to moderate levels. Further increases beyond the moderate level has less of a negative impact on utility in comparison to a shift from low to moderate prices. The price-utility curve thus implies significant price sensitivity for airline travellers at lower prices, but price insensitivity at the higher levels.

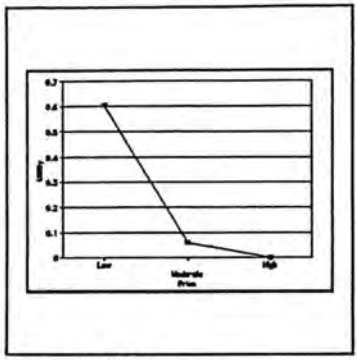


Figure 1 Price

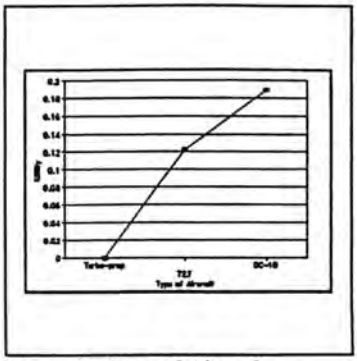


Figure 2 Type of Aircraft

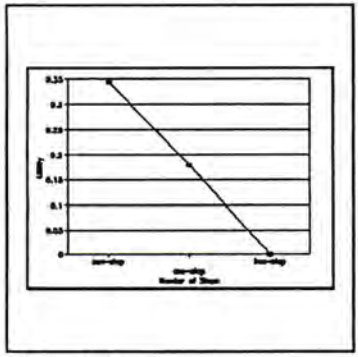


Figure 3 Stops

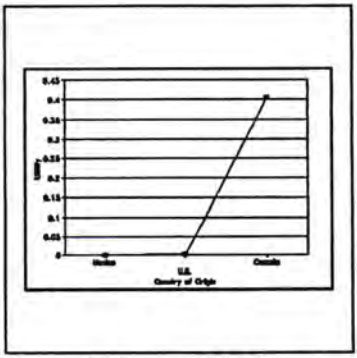


Figure 4 Country of Origin

Figure 2 reflects the relationship between the number of stops and utility. The inverse relationship between the two factors is as expected. A greater number of stops increases the total time involved in the trip as well as adds to physical discomfort. The data represent a constant downward sloping function for the stops-utility curve.

As the size of the aircraft increases, from the turbo-prop, to the 727, to the DC-10, utility increases as indicated in Figure 3. Furthermore, the function appears to be linear among the three levels. The slope of the function is consistent with past research which points to the fact that travellers feel they receive more service, are more comfortable, and are safer in larger aircraft (Bruning and Hu, 1984; and Green and Wind, 1975).

Finally, Figure 4 presents the country-utility function which signifies national loyalty's role in the country-of-origin effect. As indicated in the figure, the slope of the function is not uniform across levels of country. The change from a Mexican to a U.S. carrier increases respondent utility slightly. The shift to a Canadian carrier, however, results in a very strong improvement in utility, thus indicating the preference for own-country carrier. But, is preference for own-country carrier a result of carrier specific attributes or due to nationalistic predispositions of the air traveller? Answers to this question are offered in the following section.

Segmentation based on National Loyalty

The results reported in Figure 4 indicate that country plays a significant role in the selection process for international air carriers. But, is preference for "own-country" carrier based on brand name, or other indicators of service or performance quality? Or, does national loyalty of the air traveller play a determining role in the selection of air carrier? In other words, is carrier preference based on traditional notions embodied in the country of origin literature or in the consumer ethnocentrism notions espoused by Shimp and Sharma (1987)?

In order to assess national loyalty's role in the carrier selection process, mean values for the national loyalty measure are categorized according to levels of the following profiling variables: 1) sex, 2) income, 3) flying frequency, and 4) occupation. Mean values are reported in Table 2. For each profiling variable, the univariate F-statistic from a one-way analysis of variance is significant at the 95 percent level or better. As indicated in Table 2, females incur a higher national loyalty score than do males. With respect to income levels, national loyalty scores decline as income levels increase. Similarly, national loyalty scores are highest for individuals with the lowest levels of flying frequency and steadily decline with increases in flying frequency. Finally, national loyalty scores are lowest for managers, sales persons, and professionals, and are highest for persons unemployed, self-employed persons, housewives, students, and retirees. From the data it appears that the profile of the nationally loyal air travel consumer is someone who is female, tends to earn in the lower income levels, is an infrequent air traveller, and whose occupation tends to be non-administrative and less tied to the private sector of the economy, i.e., more dependent upon the public sector for employment or economic assistance.

Table 2

Mean Values of National Loyalty By Demographic Variables

Variable - Levels	n	National Loyalty Mean	Significance
SEX	396	69.72	.000
Male	241	65.66	
Female	165	75.65	
INCOME	380	69.20	.033
Below $10,000	15	76.00	
10,000-19,999	16	81.5	
20,000-29,999	26	73.92	
30,000-39,999	34	73.18	
40,000-49,999	43	68.70	
50,000-59,999	51	75.31	
60,000-69,999	50	66.34	
70,000-79,999	30	67.47	
80,000-89,999	38	68.32	
90,000-99,999	22	59.55	
100,000-over	55	61.84	
FLYING FREQUENCY	406	69.81	.000
Less than 1 per year	39	78.26	
1-4 times per year	184	74.10	
5-9 times per year	82	69.12	
10-15 times per year	46	60.35	
16-20 times per year	24	58.42	
21-30 times per year	16	47.63	
over 30 times per year	15	69.80	
OCCUPATION	393	69.65	.008
Not Employed	2	85.00	
Self-Employed	9	83.78	
Homemaker	6	82.17	
Labourer/Service Worker	24	79.33	
Retired	36	78.33	
Public Sector	15	76.53	
General Office/Clerical	16	74.50	
Student	42	74.14	
Technical/Skilled Worker	37	70.43	
Military	9	65.89	
Professional	90	63.58	
Sales	48	63.42	
Management	36	63.00	

V. Conclusions

The data presented in this study confirm the importance of national loyalty as a component of the country of origin effect. Results from the ordered probit analysis clearly indicate that the country attribute is second only to price in terms of relative importance in the specific airline respondents select. Canadian respondents measuring high in national loyalty prefer a national carrier for an international flight when other foreign carriers are in competition with the national carrier. These results do not suggest that the country of origin effect reflects the strength of national loyalty alone; however, they do indicate that the traditional notion of the country of origin includes a component which functions to cue one's "felt" national loyalty. Thus, while the country of origin effect relates to cues about product attributes, the national loyalty effect relates to one's group affiliation and the strength of allegiance or loyalty to country in the purchase decision context.

While price dominates all other attributes in terms of relative importance, country of carrier is second, followed by number of stops and type of aircraft flown. Furthermore, the data indicate that the partworth utility curves for the price and country attributes are curvilinear, while number of stops and type of aircraft functions are linear. The essence of the nature of the utility function is that sensitivities (for price and country) vary across levels of the two attributes. Travellers are less sensitive to price between moderate and high levels; however, they are very sensitive between low and moderate prices. Similarly, with respect to country of carrier, Canadian travellers are marginally supportive of a U.S. carrier over a Mexican carrier; however, they indicate overwhelming support for a Canadian carrier when considering international air travel. This preference for own-country air carriers is not equally strong across air traveller segments: differences are recorded based on sex, income, flight frequency, and occupation. Those most loyal tend to represent the smallest segment. A much larger segment appears eager to trade off country loyalty for either lower prices or better services offered by foreign carriers.

The study also presents the ordered probit as an alternative method of modelling consumer choice in a conjoint experiment. With the ordered probit, the analyst has the opportunity to observe attributes as they impact directly upon utility rather than indirectly as in the typical regression approach where preference ratings or rankings are utilized as dependent variables. The model tested in this study meets all the conditions for aptness and, therefore, reflects biased and efficient partworth utilities for the several levels of the four attributes.

The results of the research has several implications for Canadian air carriers. First, moving to a more competitive regime as regards air transport policy may not bode well for national carriers in terms of securing ridership through national loyalty. While a certain segment will remain loyal, nonetheless, those travelling most frequently will seek price and service advantages in selecting air carriers. Holding all factors constant, the frequent fliers prefer travelling with a national carrier, but will switch to a foreign carrier given service and price advantages. Furthermore, price is by far the dominant factor for a substantial portion of the travelling public. Therefore, regardless of service advantages and a quasi-loyal market segment, Canadian carriers will find it imperative to be price competitive with American carriers in securing traffic on a continuous basis.

The findings also have public policy implications. While competition brings forth a number of advantages to carriers as well as the public, certain costs need to be acknowledged as well. First, we have witnessed an intense era of price competition in the airline industry during the 1980s. Associated with this competition has occurred the demise of a number of traditionally strong domestic and international carriers. The down side of a purely "open skies" policy relates to the likelihood for a similar wave of competitive exuberance to reappear and dramatically affect the financial stability of Canada's two commercial passenger air carriers. While most everyone wants improvements in travel choices, particularly for major routes and times of day departures and arrivals, are we prepared to accept the potential problems that possessing such choices brings forth? Open skies will challenge Canada's carriers. Perhaps the new regime will make them stronger. But, Canadian air travellers can not be counted on to provide support simply because they are Canadian carriers.

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THE RESHAPING OF AVIATION REGULATION

1. INTRODUCTION

Since 1991, Transport Canada's Aviation Regulation program has been reshaping in partnership with its principal clients - Canada's aviation community. Working more closely with those in the aviation community to create a climate which enhances safety is a "not too revolutionary innovation" based on creating a climate of mutual trust and respect.

Historically, the primary role of the regulator has been one of "establisher and enforcer" of regulations. In light of this tradition, it is difficult to imagine that real change can occur. Nevertheless, it is - and its significance lies in the fact that it is pervading not only government itself, but also those it serves.

The impetus for the "reshaping" of Aviation Regulation was, and continues to be provided by both externally-driven factors (e.g. international efforts to harmonize aviation regulations) and internally-driven factors (e.g. an overall shift in the federal public service to a focus on client needs). Also, the impact of the recent federal budget on Transport Canada cannot be ignored. As an "affected" department, Transport Canada, will be going through major change, including a significant reduction in size. In part, this is due to the commercialization of the air navigation system. Throughout the process, maintaining safety will be of paramount importance. This time of transition provides an ideal opportunity to find new ways to meet safety objectives.

2. RESHAPING THROUGH PARTNERSHIP

The reshaping of Aviation Regulation is based on forging a partnership between the aviation community and the government. It represents a fusion of ideas and experience, and introduces new thinking and methods. The success of our reshaping initiative depends on making that partnership work.

Traditionally, the regulator has been regarded as separate from the regulated. As a result, many opportunities to build on different approaches to solving problems have been missed. The reshaping effort differs from what we have done in the past, because it is a planned approach. It is designed to break down traditional barriers between the regulator and the regulated - to change the "us versus them"

outlook to one which reflects our dual commitment to safety. By working together to find solutions to mutual problems, representatives of both the aviation community and Aviation Regulation have a stake in the success of safety initiatives.

Innovative practices are inherent to our partnership approach and have transformed our working culture. The reshaping initiative also includes a change in the way that we work with our own employees - how we communicate, and commit to improving skills so that employees can be more effective on the job.

Regulatory Philosophy

Reshaping began with rethinking our mission, values and operating principles. Aviation Regulation is deeply committed to partnership with the aviation community, rooted in the values of service, respect and professionalism. These fundamental ideas are embodied by our new regulatory philosophy, which highlights our commitment to achieving a balance between safety and service, in cooperation with the aviation community:

"Sharing our commitment to safety and service with the aviation community".

The importance we place on open communication, quality service, and promoting innovation in delivering the regulatory program stems from the message given by our regulatory philosophy. The "reshaped" philosophy has changed the regulator's role, the attitude of the aviation community towards the regulator and the nature of aviation community/government relationships. A closer look at specific reshaping efforts provides insight into how that philosophy is being realized.

Modernizing the Rulemaking Process

The aviation rulemaking process has a history of being slow and cumbersome, lacking in public participation. Change has been driven by the need to harmonize our aviation regulations with those of other countries, as part of the overall effort to create a more cost-effective operating environment for air carriers, other aviation companies and licence holders. Another impetus for change is provided by the need to focus resources on regulatory priorities - and to ensure that those priorities are identified early in the rulemaking process.

Aviation Regulation's new rulemaking process - the Canadian Aviation Regulation Advisory Council process - (or CARAC) is a joint aviation community/government initiative. It represents an innovative approach to consultation in that it involves representatives of the aviation community in the

process - from its earliest stages onward. CARAC's primary goal is to assess and recommend potential regulatory changes. As a cooperative forum with representation from air carriers, manufacturers and professional associations, it has been very successful in making progress, through constructive discussion, in a series of technical committees.

The CARAC process allows the aviation community to be a vital partner in improving and maintaining the regulatory system. It is just one way that our commitment to working with the aviation community is being realized. It has been almost two years since the first technical committee was formed and, by all accounts, the process has been, and continues to be, well received by those involved.

Renewing our Air Regulations

For some time, it has been recognized that the existing Air Regulations needed a "major overhaul" to bring them in line with the way aviation carriers and other aviation companies operate today, and to take account of changes in aviation technology. Developing the new Canadian Aviation Regulations (or CARs) is one example of how we are working in partnership with our clients to find more effective ways to enhance safety, at reduced costs to everyone. Most importantly, we realize that what is really needed is a regulatory environment which reflects the "norms of safety", as perceived by the aviation community.

The message has been coming through "loud and clear" that one of the main reasons why we need regulation is because we need to be able to deal with unsafe operators. We are convinced, therefore, that what is being called for are regulations designed to keep the "bad apples" from operating in an unsafe manner. As a result, we are striving to limit regulation to those areas that clearly contribute to safety and ensure that safety services are delivered as efficiently as possible.

One of the guiding principles in developing the new CARs has been that they must be responsive to the needs of the aviation community and equitable to all. The thrust is to make them more accessible and easier to understand, the result being an extensive consolidation of existing regulations and segregation of rules where applicable. The structure of the new regulations bears this out. They recognize different types of operations, aircraft certification categories and passenger-carrying capacity, and contain rules of conduct, with standards being "called up" where more detail is required.

Implementing the new CARs focusses on the consequences of introducing new regulations. Consultation with internal and external clients will take place to ensure that proposed priorities and recommendations reflect identified concerns and can be used in making decisions about how best to implement change.

Another key element of the reshaping initiative is the comprehensive training program that we have planned for both Aviation Regulation inspectors and our clients. The goal of this intensive, national program is to ensure that the new regulations and their impact are clearly understood by both Transport Canada inspectors and our external clients.

A New Approach to Training

An important element in our reshaping effort involves working with Aviation Regulation employees to make sure that they have been adequately trained to do their jobs effectively. The increased effort that we are placing on partnership with the aviation community has shifted the emphasis of our training.

In the past, we focussed on initial training. Now, to make sure that employees stay "up to speed" with aviation technology and operations, training concentrates on upgrading existing knowledge and skills. This is particularly important given that increased delegation to the aviation community means that we will be playing a greater monitoring role than in the past.

The partnership approach makes training more meaningful through participation of industry personnel on operational training courses - previously available only to Aviation Regulation staff. The mutual benefits are obvious, and include increased knowledge and understanding of each other's safety concerns, work priorities and environment.

Sharing Regulatory Responsibilities

Reshaping is also resulting in shared regulatory responsibilities. Increased delegation of authority means that the aviation community is now taking on work which was previously done by Aviation Regulation.

It reflects an overall shift in thinking - from doing the job ourselves to making sure that the job gets done to established safety standards. This has been driven by the need to better manage our resources, and has resulted in benefits to both those in Aviation Regulation and the aviation community, through increased understanding of each other's concerns and workload. Through delegation, we are also building a base of qualified delegates who are valuable resources trained in safety standards.

Analyzing the Regulatory Program - a Risk Perspective

Resources are a primary concern in effective delivery of the regulatory program. In the past, resources were allocated based on organizational structure. The focus has shifted, with resources now being allocated to those regulatory program components which contribute the most to improving safety, based on risk assessment. A "risk-based" approach to monitoring applies to how we carry out safety audits, inspections and surveillance of air carriers and other aviation companies; how we determine delegations and monitor those with delegated authority; and how we determine our workplans and priorities.

Reorienting Service Delivery

In order to meet client needs, a modernization is taking place with respect to how regulatory services are delivered. This is being achieved principally through increased use of computer technology, access to automated databases, and a commitment to success through partnership, which allow us to provide clients with faster, on-site inspection and certification services. For example, personnel licence issue is being decentralized to regional offices and the number of District Offices where regulatory services are delivered has been increased.

Communication

The success of all the efforts described depends on good communications. Partnership has been instrumental in reshaping how we communicate with each other, and the aviation community. This is evident not only because we are changing the way we get the information that we need to do the job, but also because the information is more accessible to those who need it. This is a result of increased production of audio-visual material, new management and operational information systems (including a bulletin board devoted to CARAC), and a "1-800 CARs hotline" which provides people in the aviation community with answers to questions on the new regulations.

Over the past year, every Aviation Regulation employee has had the opportunity to attend a course entitled "The Power of Communications". Originally designed to help our inspectors improve techniques for communicating with clients, the course's overall benefits soon became apparent. As a result, all employees were invited to participate so that they could learn to be more effective in conducting interviews, resolving conflicts, and managing group dynamics - particularly helpful for participating in joint consultations with industry.

3. NEW CHALLENGES

Many organizations face new challenges in their future. Aviation Regulation is no different. The reshaping initiative will go a long way to ensuring that the professionals who work in the regulatory program are prepared to meet these challenges. The following section describes three new challenges which, while vastly different in scope, all capitalize on the partnership approach.

North American Free Trade Agreement

The North American Free Trade Agreement (NAFTA) has had an impact by extending regulatory initiatives beyond our borders. For example, NAFTA includes provisions for air operators from partner countries to provide specialty air services in other partners' countries. Work in this area is ongoing with both the U.S. and Mexico.

One of the key principles of the Agreement has affected the development of the Canadian Aviation Regulations. Given that one partner country cannot treat an operator from another partner country in any different manner than its own nationals, we have had to be very cognizant of the requirement to harmonize Canadian and U.S. rules, where practical. This is not always easy, given that if certain U.S. rules were adopted directly, there would be significant disruption to Canadian air operators. The flight training industry provides a good example. If Canadian standards were to be harmonized with those of the U.S., more economical training would come at the risk of losing students who seek the high quality training for which the Canadian flight training industry is renown worldwide.

As more experience is gained, and work with the Americans and Mexicans continues on NAFTA, the possibility for harmonization of respective regulations increases. The need to facilitate inter-country commerce, without excessive disruption to the Canadian aviation community is an ongoing objective.

Regulating a Commercial Air Navigation System

The air navigation system is being commercialized to provide better service in Canadian airspace, at less cost to users and the Canadian taxpayer. This must be achieved, however, while maintaining safety. Commercialization introduces a new regulatory requirement - regulating the air navigation system corporation.

Historically, as part of Transport Canada, the air navigation system has been "governed by directive". Existing regulations relate to the basic airspace structure and the operation of aircraft. With the commercialization of the system,

an "arm's length" relationship will exist, and it will be necessary to regulate how air navigation services and facilities are provided. The challenge will be to effectively regulate safety, while allowing the new corporation to meet its service and cost objectives.

To do this, the air navigation system corporation will be regulated in the same manner as are other aviation companies. The regulations governing the air navigation system (CARs, Part VIII) will be developed through the CARAC process, with active participation from both those in the new corporation and system users.

Recreational Aviation Review Project

The Recreational Aviation Review Project provides an excellent example of joint consultations. The Review began in the summer of 1994, with participants from both Aviation Regulation and the recreational aviation community. Its overall objective is to create a climate within the Canadian aviation community that will renew interest in, and revitalize recreational aviation. The challenge is to develop a new regulatory framework for recreational aviation which will allow the recreational aviation community to pursue recreational flying, while maintaining an acceptable level of public safety.

Together, project team members have identified issues and are examining them in-depth, with a view to recommending solutions to problems and developing a recreational aviation policy. A possible "paring" of regulations governing recreational aviation is being considered, through the potential establishment of a new recreational pilot permit with training requirements tailored specifically to the recreational flying environment. Also, innovative methods of certifying new recreational aircraft types, and ways to increase the involvement of recreational aviation associations in administering certain elements of the regulatory program are under review.

4. CONCLUSION

Balancing service and safety requires a commitment on the part of both Aviation Regulation employees and those in the aviation community. Since the reshaping initiative began, a high level of commitment, cooperation and involvement has been exhibited by the aviation community. This is due, in no small part, to the fact that the reshaping initiative is based on an awareness that different segments of the aviation community often have distinct needs - and employees are encouraged to seek cooperative solutions that respond to those differences.

The partnership approach to delivering the regulatory program creates a sense of commitment on the part of the aviation community and mitigates the effect of traditional regulation-making barriers which still exist in the legislative process. The reshaping initiative is pivotal to securing the willingness of the aviation community to assume more responsibility for managing its own affairs, and cooperate with the regulator to face new challenges.

Performance of Class I Railways[1] in Canada and the United States

Yasmin Sheikh, Statistics Canada

In recent years, Canadian railways have been struggling, trying to deal with the dual problem of excess capacity and high labour costs. In 1993, Canadian railways carried 90% of their freight on only 40% of their lines[2]. They also spent 42% of their operating expenses on labour.

During the 1970s the U.S. railways, particularly in the northeast, faced similar problems. Today the U.S. railroad system is the most productive in the world and one of the most productive industries in the United States[3]. Although the size of the U.S. industry is much larger, it would be useful to study the American experience, look at the gap in the performance of the two systems and get an indication of the future of Canadian railways.

Section 1 of this study presents a comparison of the relative size of the Canadian and U.S. railways for 1993.

Section 2 comments on important changes in major variables, such as freight revenues, employment and track, between 1984 and 1993.

Section 3 compares the performance of the Canadian and U.S. railways with the help of such standard measures as revenues and expenses per tonne kilometre and operating ratios.

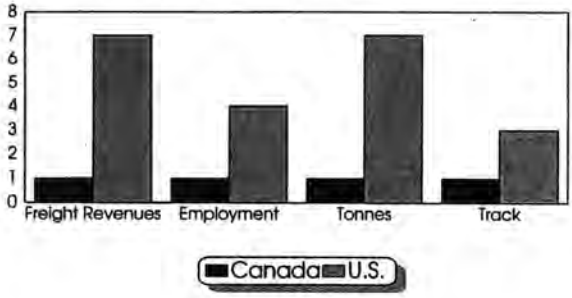
Section 4 looks at labour productivity and excess track.

Section 5 provides summary and conclusions.

SECTION I: SIZE OF THE CLASS I RAILWAY INDUSTRY IN CANADA AND THE U.S., 1993

Keeping in perspective that the U.S. economy is ten times the size of the Canadian economy in terms of Gross Domestic Product (GDP), a number of indicators suggest that the Canadian railways play a proportionately bigger role. The Canadian Class I industry is one-seventh the size of the U.S. Class I industry measured by freight revenues and in terms of tonnage. However, it employs one-fourth the number of employees and operates one-third the length of track indicating relatively larger workforce and more track.

Figure 1
Relative Size of the Canadian and U.S. Railways, 1993



SECTION 2: MAJOR CHANGES BETWEEN 1984 AND 1993

Following are the highlights of changes in major variables between 1984 and 1993:

. Railways on both sides of the border experienced declines in traffic, resulting in lower freight revenues[4].Tonnage transported in Canada declined more than in the U.S..

. With falling tonnages in both countries, an increase in the average length of haul resulted in an increase in tonne-kilometres.

. Freight revenues of U.S. carriers decreased by 2.1% while operating expenses declined further, by 5.3%, thus improving their financial situation.

. The financial situation of the Canadian railways deteriorated as operating expenses increased marginally while freight revenues decreased by 3.9%.

. Total increase in revenues per employee was higher in the U.S. than in Canada (64% v.s.61%). Overall labour productivity gains for both countries were considerable.

. Over the ten year period the Canadian and the U.S. railways reduced employment by 40%.

Figure 2
Major Variables, Percentage Change Between 1984 and 1993

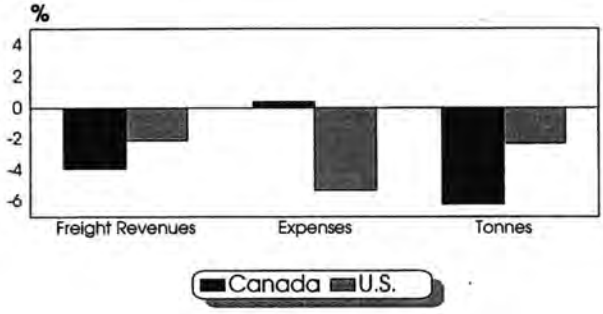


Figure 3
Major Variables, Percentage Change Between 1984 and 1993

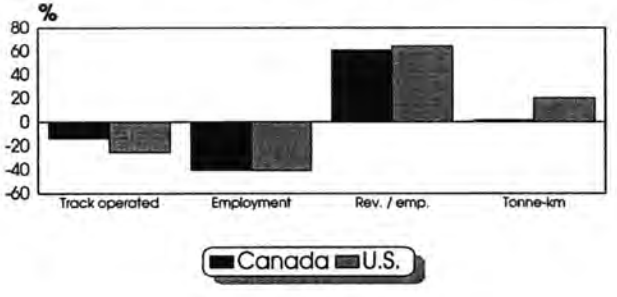


Table 1: Selected Variables, Canadian and U.S. Class I Railways

	Freight Revenues		Tonnes		Track Operated	
	Canada	U.S.	Canada	U.S.	Canada	U.S.
	$ millions		millions		kilometres	
1984	5,645	36,866	197	1 296	85 764	265 897
1985	5,579	36,434	188	1 197	85 761	259 164
1986	5,654	35,213	190	1 185	84 166	249 955
1987	5,999	34,207	203	1 244	84 733	237 484
1988	5,985	33,348	204	1 297	81 391	226 543
1989	5,491	32,043	187	1 273	78 963	221 291
1990	5,443	32,053	185	1 292	76 572	214 347
1991	5,604	30,878	190	1 254	75 761	208 956
1992	5,361	33,238	182	1 269	74 969	203 159
1993	5,425	36,103	185	1 266	74 152	199 137

Note: Freight revenues, tons and miles for American railways have been converted to Canadian dollars (using the Bank of Canada average annual exchange rate), metric tonnes and kilometres.

SECTION 3: PERFORMANCE OF THE CANADIAN AND U.S. CLASS I RAILWAYS

Expenses per tonne-kilometre

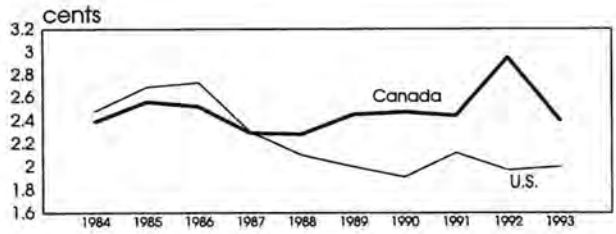
U.S. rail carriers had a higher unit cost than Canadian carriers during the 1984 to 1986 period. This cost decreased rapidly for the U.S. carriers during the 1986 to 1990 period from 2.7 cents in 1986 to a low of 1.9 cents in 1990, as U.S. railways progressively carried freight over much longer distances.

The Canadian unit cost, with its ups and downs, remained much more stable between 2.3 cents and 2.6 cents throughout the study period.

Shippers today are competing in a more globalized economy. With lower costs the U.S. railways are able to offer lower shipping rates than Canadian carriers. As a result, some Canadian traffic is being diverted through the U.S.[5]

The years 1992 for Canada and 1991 for the U.S. were unusual as the railways incurred special charges for work force reduction and other rationalization initiatives.

Figure 4
Expenses per Tonne-kilometre



Revenues and Expenses per tonne-kilometre

Revenues per tonne-kilometre are higher in Canada compared with the U.S., but not sufficient to meet expenses per tonne-kilometre for the last four years. Canadian railways have complained about the debilitating costs associated with the maintenance of excess track and the fuel, property and sales tax burden[6]. These factors drive their expenses up and hinder their competitiveness, not only against the U.S. railways but other modes of transport as well.

With the exception of 1991, when U.S. railways incurred special charges, their revenues per tonne-kilometre were higher than their expenses per tonne-kilometre.

Figure 5
Revenues and Expenses per Tonne-kilometre, Canadian Class I Railways

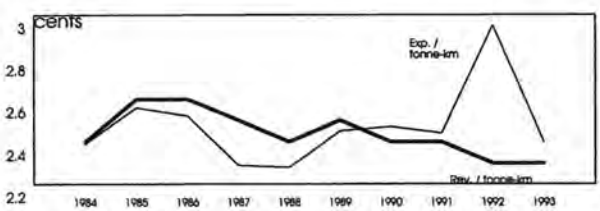
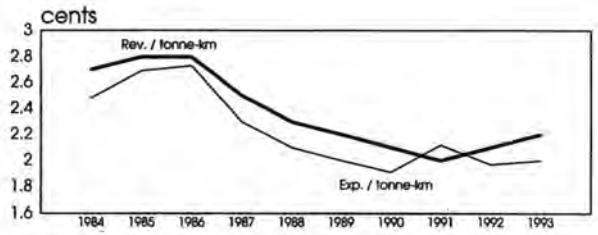


Figure 6

Revenues and Expenses per Tonne-kilometre U.S. Class I Railways



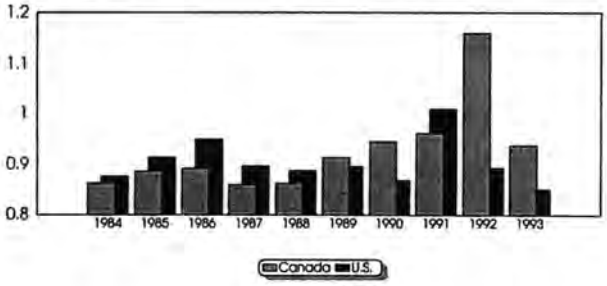
Operating Ratio

. The performance of the Canadian railways as measured by this ratio (the proportion of operating revenues absorbed by operating expenses) was better than the U.S. railways from 1984 to 1988.

. Since 1989, U.S. railways have out-performed Canadian railways, with the exception of 1991 when U.S. railways included special charges in their operating expenses.

Figure 7

Operating Ratio



SECTION 4: LABOUR AND TRACK

Labour Costs

. In the last decade both Canadian and U.S. railways have made efforts to reduce labour costs. These costs as a percentage of operating expenses have in general declined.

. Canadian railways spend a higher proportion of their expenses on labour than U.S. railways.

Figure 8
Total Compensation as a Percentage of Expenses



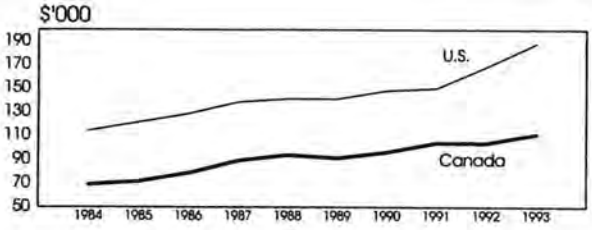
Productivity

Since labour costs account for a major portion of the operating expenses of railways, the most commonly used measure of productivity is that of labour productivity defined in terms of revenues generated per employee.

Revenues per employee in the U.S. have been persistently higher than those in Canada. The gap has widened in the most recent years as freight revenues in the U.S. recovered much more rapidly from the recession.

During the study period both Canadian and U.S. railways made significant improvements in productivity as shown by an increase of 61% and 64%, respectively in revenues per employee.

Figure 9
Revenues per Employee



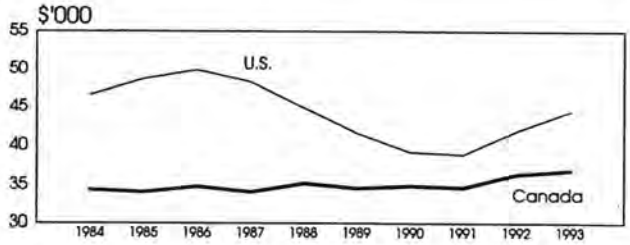
Employment

. During the study period, the number of employees in the Class I railway industry on both sides of the border, decreased by 40%.

. The average compensation was higher in the U.S. than in Canada both in real and nominal terms. The gap has narrowed in recent years.

. Real average compensation of Canadian carriers has been much more stable compared to the U.S. carriers.

Figure 10
Real* Average Compensation



*** Canadian and U.S. Consumer Price Indices were used as deflators**

Table 2: Employment, Canadian and U.S. Class I Railways

	Employees		Average Compensation		Revenues per employee	
	Canada	U.S.	Canada	U.S.	Canada	U.S.
	Number		dollars		dollars	
1984	81,710	323,030	31,777	44,106	69,086	114,124
1985	77,960	301,879	33,022	47,769	71,559	120,692
1986	72,028	275,817	34,766	49,870	78,503	127,668
1987	67,216	248,526	35,538	50,009	89,256	137,639
1988	63,705	235,880	38,221	48,536	93,951	141,375
1989	60,193	227,548	39,480	47,062	91,227	140,820
1990	56,590	216,424	41,689	46,656	96,183	148,104
1991	53,936	206,386	43,896	48,272	103,902	149,614
1992	51,738	197,421	46,679	53,572	103,611	168,361
1993	48,855	192,526	48,181	58,499	111,040	187,522

Note: Revenues per employee and average compensation for American railways are expressed in Canadian dollars.

Track Operated

. Canadian railways have too much track in proportion to the traffic. In 1993, they transported one-half the U.S. tonnage per kilometre of track.

. Canadian railways generated one-third the U.S. revenues per kilometre of track in 1993.

Figure 11
Revenues per km of Track

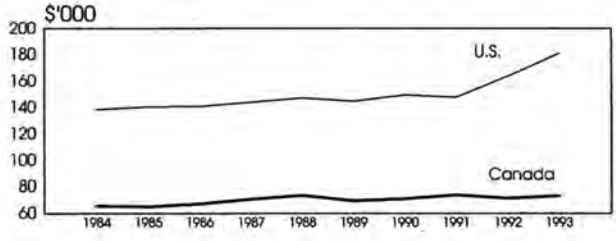
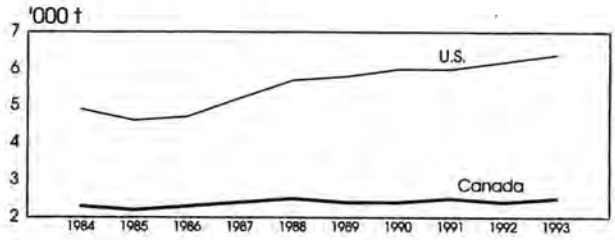


Figure 12
Tonnes per km of Track



SECTION 5: SUMMARY AND CONCLUSIONS

Summary

- Canadian Class I railways have an extensive length of track and a large number of employees in relation to the amount of traffic.

- The U.S. railways have lower expenses per tonne-kilometre compared to Canadian railways. This enables them to offer lower shipping rates than the Canadian carriers. As a result, some Canadian traffic may be re-routed through the U.S.

- Revenues per tonne-kilometre, although higher in Canada, have not been sufficient to meet expenses per tonne-kilometre, especially in the last four years.

- Both Class I Canadian and U.S. railways have made major productivity gains as measured by revenues generated per employee.

- The Canadian railways have been quite successful in reducing employment and cutting the payroll. In order to compete with the U.S. railways they will have to either reduce labour costs further or increase productivity.

- Since 1988, with the exception of 1991, U.S. railways have experienced better operating ratios, thus out-performing Canadian railways.

Conclusions

The cost of maintaining extensive infrastructure by Canadian carriers and high labour costs make it difficult for them to compete against U.S. railways and other modes of transport.

In recent years, railways have addressed these issues by restructuring their activities and have managed to improve productivity. But there were huge costs in separation payments to employees and other restructuring charges which affected their financial situation adversely. The onset of the recession in 1991 and the slow economy, thereafter, made things worse. However, in 1993 there was an improvement in the operating ratio. The future depends on the strength of the economy, the railways' success in shedding excess track and controlling labour costs and/or improving productivity.

ENDNOTES

1. involved in the transportation of freight only
2. MacLean's, Special Report: Shifting Tracks, April 18, 1994
3. Association of American Railroads, Railroad Facts, 1994 edition.
4. Canadian freight revenues include Western Grain Transportation Payments
5. a) WESTAC Briefing, September 1994, Volume 20, No. 1.
   b) MacLean's, special report: Shifting Tracks, April 18, 1994.
6. CP Annual Report, 1993

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2. CP Annual Report, 1993.
3. National Transportation Agency, NTA Annual Review, 1993.
4. Statistics Canada (1984 to 1986) General Statistics, Catalogue 52-215.
5. Statistics Canada (1987 to 1993) Rail in Canada, Catalogue 52-216.

The opinions expressed in this paper are solely those of the author and in no way reflect those of Statistics Canada.

Long Term Capital Input Trends and Financial Performance Measures for CN and CP Rail

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Productivity measures focus on *quantities* of outputs compared to *quantities* of inputs; financial measures focus on the *value* of outputs compared to *expenditures* on inputs. The two differ from each other, and often the difference can be dramatic. This paper draws on portions of our previously developed long term productivity performance measures of CN and CP Rail, to examine some long term financial trends for the two railways. It focuses on capital input trends, their costs, and implications for measures of financial performance. This includes a comparison of capital input use between CN and CP Rail. Of special importance are differences between financial measures based on book values of capital stocks, versus measures based on constant dollar replacement values. The latter is developed from our productivity data base.

The study period covers 1956-1991. This 36 year period encompasses a number of major events for the railways, from the end of steam power up to the present. Rail policy underwent major changes, when railways received substantial pricing freedom under the National Transportation Act of 1967. The railways went through two energy crises when fuel prices rose considerably. The Canadian railways faced greatly increased competition when U.S. railroads were largely freed from regulation in 1980. The late 1970s and early 1980s saw rapid inflation but included a period when interest rates and costs of capital lagged the increase in real asset prices. Holders of real assets gained during this transition phase of inflation. More recently, the National Transportation Act of 1987 sought to foster greater competition between the railways,and currently, the need for restructuring and cost-cutting is a major theme in the rail industry.

How have Canadian rail rates of return fared over the years and periods of disruption? That is the purpose of this paper. Of central importance in addressing this issue is proper measurement of the capital inputs (and corresponding costs) of the two Canadian railways. Part I of the paper outlines the measurement of rail capital inputs (capital stocks) and their revaluation to constant dollars. Part II explains the measure of capital service prices, compares the trends in these prices with prices of other rail inputs, and examines how

capital has been substituted for other inputs by both railways. Part III compares an accounting measure of financial returns for the two railways with a measure of economic rates of return, the latter utilizing a full cost of capital to estimate total economic costs -- and the implied financial returns (losses) are compared. A brief conclusion summarizes the major points.

I. The Data Base and Measurement of Capital Inputs

The data base employed in this study is documented in some detail in Tretheway, Waters and Fok, 1994 (henceforth TWF). Only a brief summary is provided here since only parts of the data base are being used. Output was measured as an index number of aggregate revenue tonne-kilometres (because more disaggregate freight traffic statistics were not available for the whole period), intercity passenger-kilometres and commuter passenger-kilometres. It was necessary to impute VIA rail outputs to CN and CP to be consistent with early years' data (VIA Rail inputs and costs are not included; only revenues received and costs incurred by CN and CP are in the data base).

Input categories included: (1) fuel and energy; (2) labour hours (an index of four labour categories); (3) way and structures (W&S) capital; (4) equipment capital (rolling stock); (5) land; and (6) "materials" or "other purchased inputs" (defined as residual expenses deflated by a price index). Input indices were constructed for each category, and a weighted aggregate input index was used for productivity measures.

Measuring real capital inputs

Capital Stock Measurement. Capital inputs cannot be measured in physical units. Our approach to capital measurement used the "perpetual inventory method" (Christensen and Jorgenson, 1969). It required developing a constant dollar measure of rail capital stocks. Starting from the earliest records (1890 for CP Rail), the capital stock is accumulated by adding new investments, deducting an assumed economic rate of depreciation, and converting these to constant dollars by use of rail asset price indices.[1] Fortunately, Statistics Canada has maintained long term rail price indices for both W&S and equipment capital for railways.

The real capital stock at the beginning of year t is the previous year's real stock K_{t-1}, plus real investments I_{t-1}, less real economic depreciation D_{t-1}. These

[1] The Canadian rail capital stock data originated from Caves and Christensen (1978) and updated by ourselves in Freeman, et al. (1987). This data series was further modified and updated in TWF, 1994.

can all be adjusted by the price of rail assets pk_t to bring the new capital stock up to current year dollars.

$$K_t - K_{t-1} + I_{t-1} - D_{t-1}$$

Capital Service Flows. Capital is a stock from which a "flow" of capital services is derived. For owned capital, we assume the flow is proportional to the size of the stock of capital employed. Hence, the growth rate of the capital stock provides a measure of the growth rate of the flow of capital services.[2]

Capital assets provide a flow of services over a number of accounting periods. For some assets, that flow of services may be fairly constant over the life of the asset, such as a light bulb which provides undiminished amounts of light per time interval until it expires.

Many assets, including most rail assets, provide a declining flow of services over the years. That is, the annual flow of services is reduced as it "wears out." Aging track, for example, requires reduced operating speeds. The flow of rail capital services is assumed to be proportional to the depreciated value of the asset. Depreciation here refers to *real* or *economic depreciation*, the real decline in the future flow of services which can be provided by a capital asset. Economic depreciation is distinct from accounting or financial depreciation for income tax purposes.

Depreciation Rates. Our formula for the perpetual inventory method of measuring capital inputs generally assumes a proportional or "geometric" rate of depreciation, i.e., the real depreciation rate (or required replacement rate of investment) is assumed to be a constant proportion of the existing capital stock. This assumption is adopted for two reasons: (1) empirical investigations show that this depreciation assumption is consistent with empirical investigations; and (2) there is no need to keep track of the acquisition years for specific capital assets, all can be grouped together (in constant dollars) and the depreciation rate applied to the cumulative constant dollar capital stock.

There have been various studies of appropriate depreciation rates for rail assets (see TWF, 1994, Appendix A, pp.74ff.). In our previous study (Freeman, et al., 1987), we adopted depreciation rates originally proposed by Caves, Christensen, et al. of 0.03 and 0.06 for W&S and equipment capital, respectively. These correspond approximately to assumed lives of about 67 and

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[2] The railways also make use of rented or leased capital, especially for equipment. Nominal rental expenditures were deflated to constant dollars as the measure of the rental service flow (details in TWF, 1994, Appendix A, Chapter 4).

33 years, respectively (proportional depreciation rates were set at twice straight line rates; proportional depreciation never fully depreciates an asset, but the residual value becomes very low eventually).

Our previous calculations of the accumulated values of rail capital stocks had left us suspicious that the assumed depreciation rates of .03 and .06 were understatements. That is, the implied current market value of accumulated rail capital stocks (converting the accumulated real stocks to current values using the asset price deflators) produced figures which we judged to be too high. Communication with CN and CP officials indicated that they too thought the previous depreciation assumptions were too low.

There is no precise way of determining the appropriate depreciation rates of rail assets, particularly aggregated collections of rail assets grouped into two categories. Ultimately assumptions must be made. We increased the base depreciation rates from .03 and .06 to .04 and .08 for way and structures and equipment capital, respectively. Further, we hypothesized that the economic life of rail assets has shortened in recent years. Specifically, we assumed that, starting in 1975, the economic depreciation rates increased gradually to 0.055 and 0.10. These rates are more consistent with recent information from the railways which indicate that assets are either being used up more quickly (e.g., shift towards higher proportion of heavy haul traffic wears out capital faster) or are becoming obsolete due to technical innovation.

Results. **Figure 1** shows total owned W&S capital for the two railways in 1956 constant dollars. Both railways show an increasing way and structures capital stock until recently, with CN showing a much larger growth in capital stocks in the early years; however, this followed a prolonged period of under-investment so part of CN's post-1956 investment might have been "catch-up." Indeed, CN starts the period with a lower level of capital stock than CP. CP's increase in W&S was most noticeable in the late 1980s, reflecting their major tunnel investment in the Rockies. Owned equipment capital stocks (not shown) have fluctuated but not grown over time, with noticeable declines for both railways in the 1980s partly reflecting increased reliance on leased rolling stock.

Land. Land is treated similarly to physical capital. Stocks of land are accumulated in constant dollars. These are land holdings in connection with rail operations and, as far as we know, exclude land connected with real estate developments per se. There is no consistent land price index over this century to revalue land each year. We had to chain link three different price indices to develop a land price index. Farm land price indices were available from 1926 through 1991, but we shifted to a residential land price index after 1976. This was cross-checked against trends in property taxes paid which, while not exact,

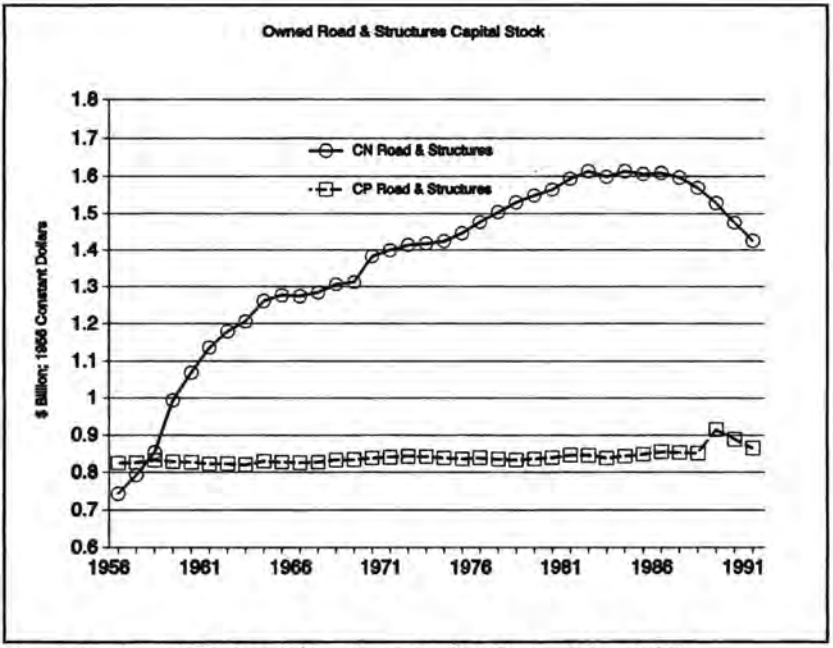


Figure 1: Owned Road and Structures Capital Stock, CN and CP

supported the use of the residential land price index for recent years. Land retirements were deducted from land holdings although it was not possible to revalue the retirements into current dollars. (Further discussion in TWF, 1994, Appendix A, p.80ff).

Current Dollar Valuation of Capital Stocks. The constant dollar capital stocks can be converted to current dollars via the appropriate capital asset price index. The three asset price indices are shown in **Figure 2**. Note the faster growing and more volatile land price compared to the other two capital asset categories. The implied 1991 valuation of the railways' capital stocks is shown in **Table 1**. W&S capital is the largest component, with implied total capital stock valuations of $11.55 billion for CN and $7.37 billion for CP.

We have no way of cross-checking the validity of these estimates. They are based on historical data on investment levels and respective asset price indices. The methodology makes no provision for "writing off" assets except through the assumed economic depreciation rate. Insofar as these valuations overstate the true current value of assets, our calculated economic rates of return (later) are proportionally understated.

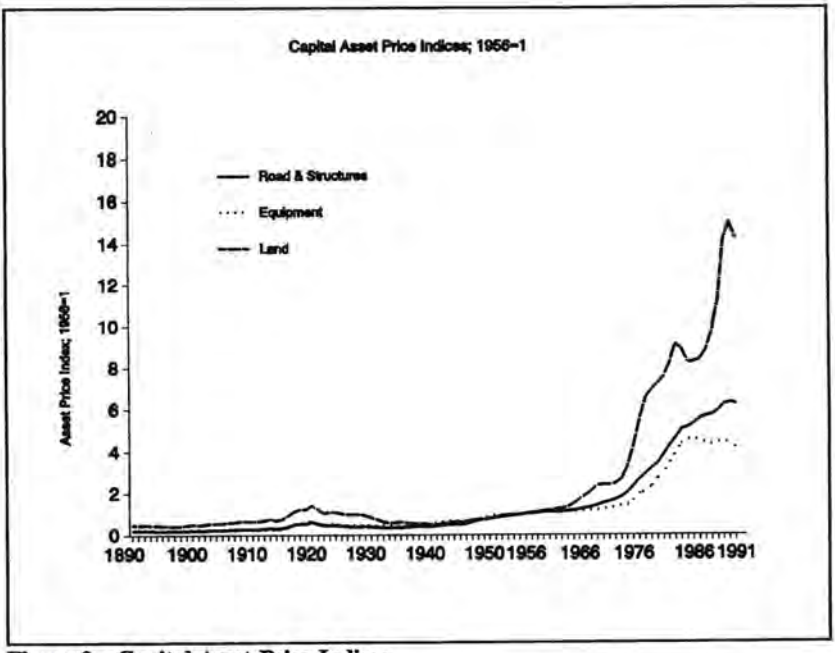


Figure 2: Capital Asset Price Indices

II. Input Prices and Trends

Before examining measures of financial returns based on book values versus our current dollar valuations of capital stocks, we comment on capital investment and other input use in relation to long term trends in input prices.

The service price of capital

The service price of capital is the imputed price of *using* capital. This consists of a) the financial costs of capital (opportunity costs), plus b) economic depreciation, net of c) appreciation of existing capital assets due to inflation, all this modified by d) tax rates recognising any accelerated depreciation and investment tax credits.[3] (See Appendix for a mathematical formulation). Land has an opportunity cost the same as physical capital. The one difference is that land does not depreciate, so this element is excluded from the land service price

[3] The taxation component of the service price formula uses accounting depreciation allowed for tax purposes. An appendix explaining the service price formula is available form the authors.

Table 1 1991$ Valuation of Capital Stocks		
CN	way and structure capital	$ 8.92 Billion
	equipment capital	$ 1.48 Billion
	land	$ 1.15 Billion
	Total	$11.55 Billion
CP	way and structure capital	$ 5.41 Billion
	equipment capital	$ 1.03 Billion
	land	$ 0.93 Billion
	Total	$ 7.37 Billion

calculation.

The financial opportunity cost of capital is a major component of the service price. The financial structure of both CN and CP Rail include both debt and equity capital. The respective company bond rates are readily available. The cost of equity capital is more difficult. For some years the actual return on equity is less than the bond rate, especially for CN. An "expected" or "required" return on equity is the appropriate concept for a service price. A convenient basis for CP is to use the regulatory-approved return on equity. This was available for 1984-90, and a regulatory-approved overall cost of capital was available for more years. An equity rate equal to 1.25 times the bond rate was a workable approximation.

A required return on equity for a crown corporation is more difficult. There is no market of tradable shares for CN. The expected returns from a government shareholder could be different from a market process. Equity injections from government are rare and tend to emerge during periods of financial stress. The shareholder (government) may not have the same expectations or requirement for earnings that are found in the private market. However, even if the shareholders' expectations were zero, that is not necessarily an appropriate figure to use for a required return on equity. Equity can be increased by retained earnings and surpluses transferred from subsidiary companies. These are still not subject to market review, but at a minimum, the equity-provided funds have an internal opportunity cost in the company. We decided that the bond rate is probably the best guide to the internal opportunity cost to be considered by Crown corporation management. Hence we adopted

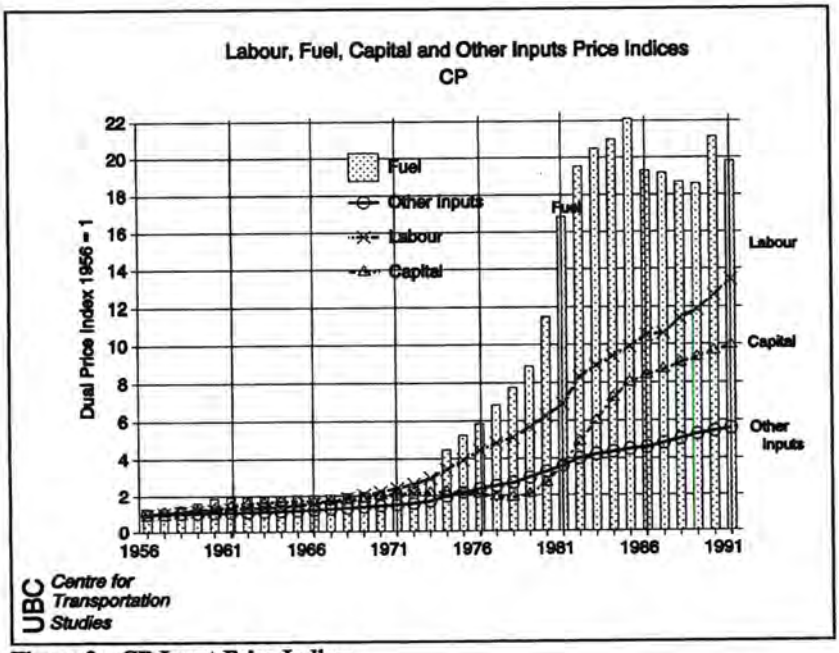


Figure 3: CP Input Price Indices

CN's bond rate to serve as its equity rate in the service price formula.[4] Figure 6 (shown later) shows the CP capital service price to be proportionally larger than that for CN.

Input price trends

Dividing the expenditures on various input categories by their respective input quantity indices produces the "dual" input price index for each category. The trends in input prices are instructive. **Figure 3** presents the input price indices for CP (the graph is very similar for CN). Only one service price is graphed for capital: an aggregate of the three capital service prices.

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[4] An appropriate cost of capital may differ depending on the purpose of the analysis. Our service price is supposed to represent the costs of capital perceived by management. If calculating the opportunity costs to society of resources employed in the rail industry, whether by CN or CP, we would use CP's cost of equity capital as a more appropriate guide to the opportunity cost of resources which could be utilised elsewhere in the economy. Indeed, in our calculation of economic rates of return, we do apply CP's service price to CN for that analysis.

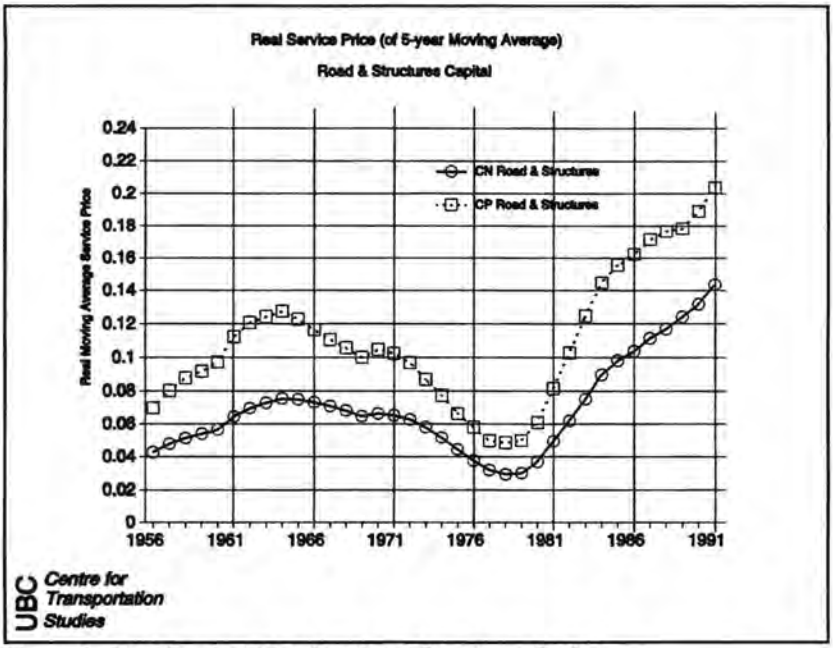


Figure 4: Real Service Price, Road and Structures Capital

The increases in energy prices in 1973-74 and again in 1979-81 are well known and can be seen in Figure 3. Also evident is the steady rise in unit labour costs over time. The "materials" or "other purchased inputs" price index is an indicator of the general inflation rate because we use the GNE/GDP deflator for the materials price index. Thus we can see that fuel, labour and capital all increased faster than the rate of inflation over the period, although energy prices stabilized in the 1980s.

The movement of the capital service price is particularly interesting. The service price of capital declined in the late 1970s. This reflected the strong capital gains due to inflation which partially offset the financial costs of interest rates if that period. This was followed by historically high costs of capital, and reductions in capital gains. The result was a pronounced swing in this very important input price in the rail industry. The high costs of capital have meant that service prices have remained high throughout the 1980s. The rate of increase of the capital service price exceeded that for labour from the late 1970s to the mid 1980s. The variation and continued high level of the capital service price is far more important to the rail industry than the much more publicized fluctuations in fuel prices. **Figure 4** plots the real W&S service price for CN

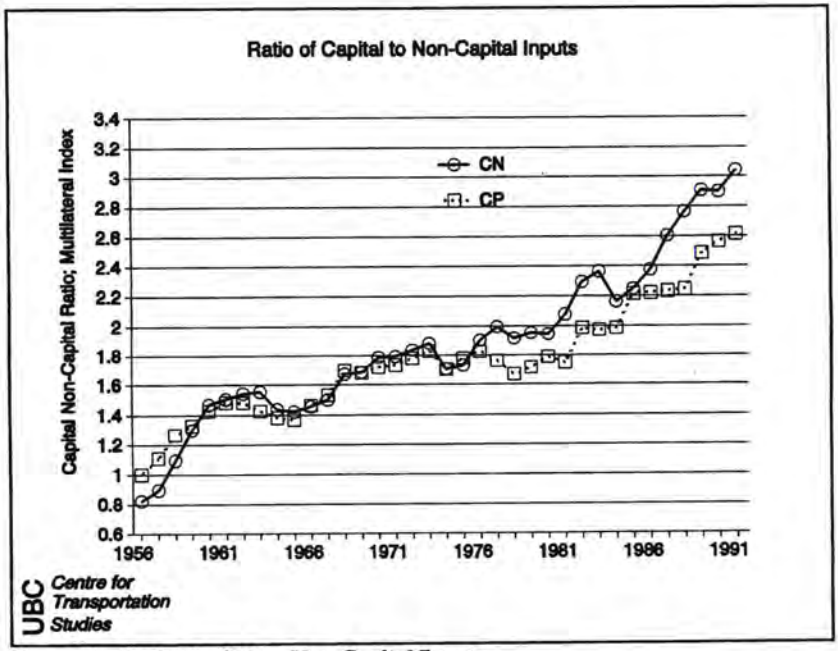


Figure 5: Ratio Capital to Non-Capital Inputs

and CP (the nominal service price divided by inflation). The sharp decline in the late 1970s is evident, as is the climb to historical highs subsequently.

Input prices and input use

The changes in relative input prices are expected to be accompanied by changes in input use. Over most of our study period, the price of labour has risen relative to capital, and not surprisingly, there have been steady reductions in labour inputs compared to capital. **Figure 5** shows the ratio of capital to non-capital inputs over the period. Note that the trend is slightly higher for CN relative to CP, consistent with the differential in capital service prices: the lower service price of capital may have induced CN to substitute capital for labour at a faster rate. A more detailed trend is revealed in **Figure 6** which plots the ratio of CN to CP capital/output ratios along with the capital service prices (right hand axis). An upward trend in the CN to CP ratio appears (except for a downturn during the 1980s), i.e., CN Rail capital inputs grow more rapidly than those of CP during the recent period.

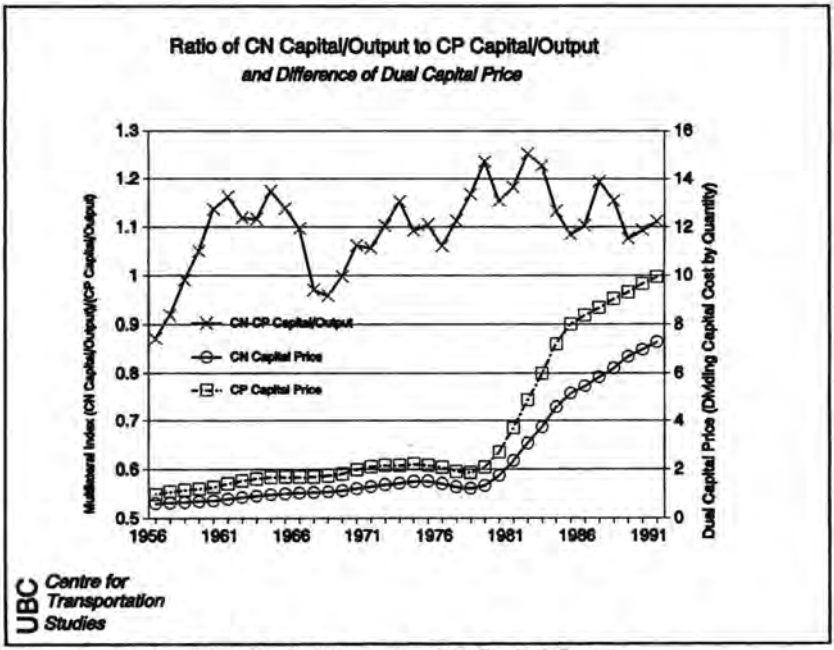


Figure 6: Ratio of CN Capital/Output to CP Capital/Output

Combining the trends in Figure 6 with the trend in real service prices (Figure 4) presents an interesting historical picture. During the late 1960s through the 1970s, real costs of capital were declining. This corresponds to CN's period of major capital expansion.[5] CP Rail's major capacity expansion came during the 1980s, but this was the period when real capital prices were soaring. Looking back, a purely economic decision may have called for deferral of the major tunnel project to a time when the costs of capital would be lower. But political realities probably intervened: the passage of the Western Grain Transportation Act and the long-awaited compensation for grain movements probably necessitated going ahead with the project despite the high capital costs. It is may be an historical accident, but CN's period of capital expansion turned out to be more favourable than CP's.

[5] CN's propitious timing of investment does not in itself justify the capital investments, only that it was a period when falling capital prices made investments more attractive than during other periods.

III. Measures of Rail Rates of Return

Having a measure of a revalued capital stock in current dollars enables a comparison of traditional book value rates of return with ones based on the revalued capital stock. We can also calculate an economic rate of return which allows for a full economic cost of capital in calculating net earnings.

Figure 7 shows net income (deducting interest and depreciation) relative to book values of capital stocks. CP Rail shows a low positive return and CN is negative prior to the late 1970s. Both railways show improved performance thereafter, especially during the early 1980s, especially for CP, with a tendency to decline in more recent years. It also appears that returns are more volatile in recent years. Replacing book values of capital with revalued capital stocks does not change the pattern shown in Figure 7, but the scale is changed (not shown). CP Rail's rate of return increases slightly for some early years, but the peak returns during the 1980s are more than cut in half if current valuations of capital stock are used (further discussion in TWF, 1994, p.50 ff. and Appendix A, Chapter 7).[6]

We also calculate an economic rate of return, defined as total revenues less total *economic* costs. The latter includes full opportunity costs of capital on a current dollar basis. Our estimate of current dollar valuation of rail capital is an approximation rather than an exact calculation; nonetheless, this provides a useful perspective on the real rates of return in the industry. For this calculation, we applied CP's service price of capital to CN, rather than use CN's favoured access to capital – i.e., a social opportunity cost of rail capital concept. The numerator in this expression is economic profit, which is expected to be zero in the long run in a competitive industry.

The economic rates of return are shown in **Figure 8**. Not surprisingly, it shows negative values for nearly all years. The exceptions are the period from 1976-1981 when the value of capital assets were appreciating rapidly due to inflation, i.e., there were substantial capital gains realized by holding assets. During this disequilibrium period, the railways show a positive economic rate of return. The subsequent disappearance of capital gains is a factor in the higher service prices of capital for most of the 1980s. The economic rates of return have been negative and large, with both carriers dropping below a negative 10 percent economic rate of return. The downward trend in economic rates of return during the 1980s is much more pronounced than the trend using

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[6] TWF (1994) (p.52ff. and Appendix A, Chapter 7) also calculate returns on equity over the years. Trying to establish the debt/equity portions of rail operations is somewhat speculative in places and is too involved to describe here.

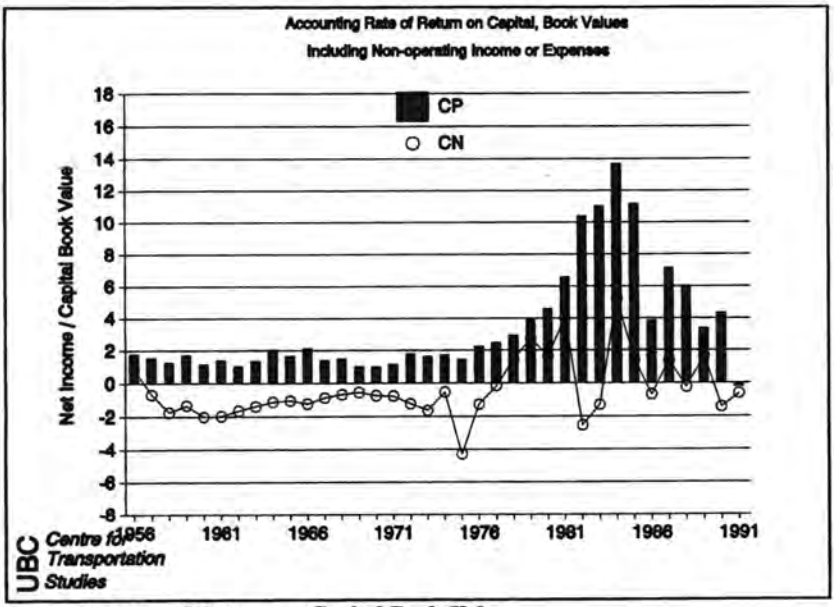


Figure 7: Rate of Return on Capital Book Value

accounting measures of net income. The high real costs of capital in recent years imply even greater forgone returns than for previous years with lower costs of capital.

IV. Conclusions

Some of the conclusions come as no surprise. The long term low returns to rail investments are well known. The temporary high returns in the late 1970s may be more of a surprise; this reflects a period when the real costs of capital were unusually low as with high inflation, and holding appreciating real assets was advantageous.

The long term trend of substituting capital for labour is not surprising, and many have thought that CN tended to use capital more extensively than CP.

Plotting the actual rates of return for the two railways shows improvement in accounting rates of return in the 1980s, but also reveals apparently greater volatility in year to year earnings in recent years. Using a measure of total economic costs and a current dollar valuation of capital stocks reveals a substantial decline and negative returns during the last decade or so. Despite

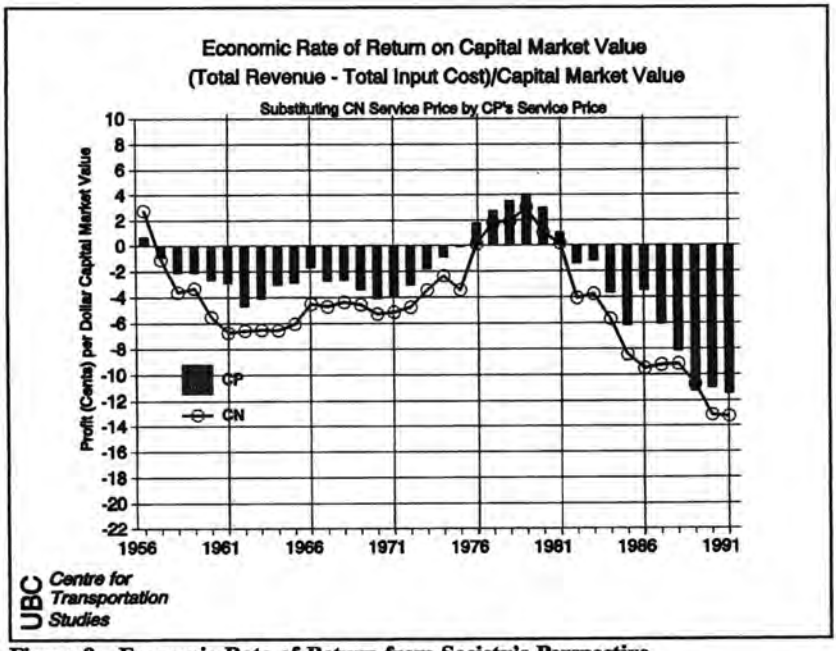


Figure 8: Economic Rate of Return from Society's Perspective

improved accounting rates of return, recognizing the much higher service price of capital during the 1980s shows that the economic health of the two companies is much weaker than that indicated by accounting measures. This confirms the pressures felt by both companies to streamline operations and improve their competitive position.

Appendix: The Service Price of Capital

The derivation of the service price of capital is explained in detail in TWF, 1994, Chapter 4. This Appendix merely presents the final formula and identifies its components. This formulation is from Christensen and Jorgenson (1969) but has been modified to separate debt and equity capital. Returns on equity are subject to income tax whereas debt (and property taxes) are deducted before income taxes. The effective income tax rate must be adjusted for depreciation allowances and any investment tax credits.

The service price is:

Service price - P_t

- *tax multiplier (Equity Ratio x Equity Rate + depreciation - capital gains)*
  + *Debt Ratio x Bond Rate* + *Property tax*

$$P_t = TX_t((1-B)p^a_{t-1} r^e_t + p^a_t \delta - p^a_{t-1} c_t) + B r^b_t p^a_t + p^a_t s_t$$

where:

B	=	Debt to Equity, expressed as % debt
p^a_t	=	price index of capital type a in year t
r^e_t	=	Equity Rate
r^b_t	=	bond rate
δ	=	the rate of replacement or real depreciation (zero for land)
c_t	=	average capital gains rate per year for equipment: 5-year period
s	=	the property tax rate
TX_t	=	Tax Multiplier

$$= \frac{1 - u_t z_t - k_t(1 - u_t z_t)}{1 - u_t}$$

where:

u	=	the marginal rate of corporate income taxation
z	=	the present value of future tax deductions per dollar of investment, based on accounting depreciation rates
k	=	the investment tax credit rate

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L'approche stratégique de la répartition

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1. Introduction

La spécialisation de l'opération de transport, l'augmentation des distances moyennes de transport et la baisse de la productivité du matériel sont parmi les impacts les plus importants du contexte économique actuel sur le secteur des transports.

En effet, la concurrence que se livrent les entreprises les oblige à adopter une démarche logistique pour assurer la fluidité de la production vers la consommation tout en exigeant l'adaptation du transport aux spécificités des produits fort différenciés et le respect des délais de livraison dans des points de plus en plus éloignés.

La répartition est la fonction de l'entreprise la plus affectée par ces impacts dans la mesure où elle répresente la tâche de gérer l'opération de transport elle-même.

Dans cette communication, nous présentons une approche stratégique de la répartition comme pouvant apporter des avantages concurrentiels importants aux entreprises de transport routier de marchandises.

Nous proposons également des stratégies de répartition pouvant être mises en oeuvre par ces entreprises afin de mieux les coûts d'exploitation et la différenciation des services. Ces stratégies sont fondées sur une logique de "circuit de transport" [GUI 91] et s'appuyent sur l'information, la coopération avec les concurrents, la ''commercialisation jointe'' et l'innovation.

2. Méthodologie

Les propositions présentées dans cette communication représente les conclusions de nos travaux de recherche basé sur la mise en oeuvre de l'approche méthodologique suivante:

1. Élaboration d'un cadre théorique de référence sur l'opération de transport et son rapport avec le cadre actuel des échanges économiques et les pratiques d'exploitation des entreprises de transport routier de marchandises.
2. Enquête auprès des dirigeants et responsables d'exploitation de ces entreprises à propos de leur vision de la répartition et les stratégies utilisées dans la réalisation de cette activité;
3. Proposition d'une "approche stratégique" visant à distinguer les éléments essentiels de la répartition pouvant participer à la stratégie globale de l'entreprise; et
4. Proposition de stratégies de répartition concernant un ensemble d'actions que l'entreprise peut réaliser afin d'améliorer sa compétitivité économique.

3. Le transport routier de marchandises dans le contexte économique actuel

La maîtrise des enjeux de la compétitivité économique repose de plus en plus sur les réponses que les entreprises sont capables d'apporter aux contraintes d'un environnement caractérisé par la fabrication de produits à fort degré de différenciation, par l'élargissement spatial des échanges et par l'accomplissement de délais de livraison plus exigeants.

Ces réponses se traduisent par la prise en compte d'une démarche logistique sur le plan de la production, à l'intérieur de l'entreprise, et sur le plan des approvisionnements et de la distribution, à l'extérieur. En plus de tenir compte des produits adaptés aux besoins des consommateurs, ces réponses doivent surtout concilier les délais de livraison et la situation géographique de la consommation .

Ainsi, la valeur des objets économiques possède, encore plus dans le contexte économique actuel, une composante morphologique, assurée par la fabrication proprement dite; une composante spatiale liée à leur disponibilité dans un point de l'espace; et une composante temporelle liée à leur disponibilité à un moment donné, ces deux dernières étant assurées par le transport.

La mise en valeur des originalités spatio-temporelles des produits en plus de leurs singularités morphologiques donne une dimension majeure au secteur des transports dans la réalisation de la valeur des échanges économiques et se repercutera certainement dans la façon de gérer les transports en tant qu'activité économique.

En effet, les caractéristiques physiques des produits exigent de l'activité de transport un effort de spécialisation en ce qui concerne l'emballage, le conditionnement et le groupage de produits ainsi que les types et la taille des véhicules les plus adaptés aux marchandises à transporter, donc *la spécialisation de l'opération de transport* (dans le sens des activités nécessaires au déplacement des marchandises d'un point A vers un point B) en ce qui concerne son processus de production lui-même.

De plus, la rationalité du "juste-à-temps" impose le respect des cadences des chaînes de production ou des rytmes de la consommation et exige que la gestion des moyens de transport soit basée plutôt sur la logique du "départ à l'heure" que sur celle du "départ à plein" telle comme pratiquée auparavant. La conséquence immédiate de cette rationalité est *la diminution du taux de remplissage des véhicules.*

Enfin, le besoin de mettre les produits à la disposition de marchés plus éloignés va entraîner l'expansion géographique du secteur des transports par *l'augmentation des distances moyennes de transport.* Comme le taux de remplissage diminue, pour une quantité donnée de marchandises à transporter, la charge moyenne de chaque véhicule diminue. L'hypothèse la plus probable est que *le nombre de voyages va augmenter*, autrement dit, on transporte moins, en plus de voyages et plus loin.

Si l'on tient compte:

1. qu'au niveau de l'opération même de transport, le déplacement du véhicule plein de marchandises entraîne aussi celui des principaux facteurs de production (matériel et chauffeur) vers les points de destination;
2. que les demandes de transport sont inégalement réparties dans l'espace (désequilibre des flux économiques);
3. et que les entreprises réalisent souvent des déplacements à vide ou non-rentables pour repositionner ces facteurs vers les points de nouvelles demandes de transport;

4. alors, l'augmentation du nombre de voyages évoquée précedement va certainement entraîner *l'augmentation du nombre de voyages à vide* et, ces voyages se faisant sur des distances moyennes plus grandes, *le nombre de kilomètres parcourus à vide croîtra d'autant.*

C'est dans ce contexte que la gestion de la flotte prend toute sa valeur mais aussi rencontre ses limites: l'adaptation aux caractéristiques physiques et spatio-temporelles de la demande exige un arbitrage plus ou moins drastique entre la gestion efficace des ressources et le maintien de la qualité de service de transport.

Il apparaît clairement que la baisse de la productivité du matériel due à la spécialisation de l'opération de transport, à la diminution du taux de remplissage des véhicules et à l'augmentation du nombre de voyages et de kilomètres parcourus à vide, influenceront surtout et fortement la répartition (ou dispatch), fonction de l'entreprise responsable de la rentabilité de chaque opération de transport, étant donnée sa mission de réaliser la valeur par le choix adéquat des matériels et chauffeurs, par la composition des trajets économiques et par les affectations optimales des marchandises-chauffeurs-matériels.

C'est la raison pour laquelle la fonction de répartition des entreprises de transport routier de marchandises a pris une importance de plus en plus stratégique et constitue actuellement l'une des références économiques majeures dans la gestion de la flotte.

L'une des solutions habituellement pratiquée par les entreprises pour minimiser les pertes dues aux voyages à vide est l'incorporation partielle ou totale du coût de ces voyages dans leur prix. Cela peut entraîner évidement l'augmentation du prix du service rendu aux clients, et par conséquent, la perte de compétitivité économique.

Lune autre solution consiste à utiliser l'offre excédentaire due aux déplacements des facteurs de production cité ci-dessus comme un avantage concurrentiel et à faire des profits par le biais d'une approche stratégique de la répartition.

4. L'approche stratégique de la répartition

Pour aboutir à la compréhension du caractère stratégique de la répartition, nous partirons de l'acception plus courante de ce terme, en l'étendant plus largement.

Ainsi, Andrews et Christensen [MON 91] reposent leur notion de stratégie sur une vision globale de l'entreprise qui établit des liens

entre ses fonctions internes et les actions qu'elle mène sur l'environnement économique. La notion de stratégie y est prise comme l'outil permettant de réaliser cette liaison, celle-ci étant centrée sur l'utilisation des ressources et des compétences propres à l'entreprise.

Cette notion met en évidence les ressources et les compétences de l'entreprise et permet de distinguer celles ayant un caractère stratégique et celles qui ne l'ont pas. La question qu'elle pose est donc d'identifier, parmi l'ensemble des ressources et compétences de l'entreprise, celles qui participent plus directement à l'existence même de la firme.

Ainsi, la première extension de cette notion est nécessaire si l'on veut rendre compte du fait qu'une fonction est d'autant plus stratégique qu'elle a une participation plus importante dans l'accomplissement de la mission de l'entreprise.

L'analyse de l'activité des transports offre quelques traits symptomatiques des ressources et compétences à caractère stratégique dans les entreprises de transport routier de marchandises, parmi lesquels l'identification des fonctions primaires de ces entreprises, à savoir:

1. Commercialisation ou vente des services de transport visant l'identification de la demande en termes de caractéristiques du transport à réaliser (genre de marchandise, client, origine, destination etc.);
2. Répartition ou dispatch, dont le résultat attendu est l'opération de transport elle-même;
3. La gestion des plates-formes (quais), responsable des groupages et dégroupages de marchandises et des chargements et déchargements de véhicules;
4. La gestion de l'état mécanique des véhicules, dont le résultat attendu est la mise à disposition des véhicules dans de bonnes conditions d'utilisation;
5. La facturation, responsable du règlement financier des services;
6. Les fonctions de soutien aux fonctions ci-dessus telles que la comptabilité, la gestion du personnel, la gestion des installations physiques, etc.

Parmi ces fonctions, la répartition se présente comme l'élément essentiel de la mission même de l'entreprise dans la mesure où elle est

responsable de la réalisation de l'opération de transport proprement dite.

Une seconde acception s'impose si l'on considère les fonctions qui participent à la chaîne de la valeur des échanges économiques.

Comme souligne Porter [GIL 88], l'analyse de la chaîne de la valeur est l'une des alternatives pour interpréter la structure d'une entreprise et évaluer le poids de leurs ressources et compétences. Ainsi, il décompose l'entreprise en des sous-activités qui ajoutent de la valeur au service rendu ou dont les clients sont disposés à payer.

Or, dans le cadre des échanges économiques, l'opération de transport déclenchée par la répartition est la principale responsable de la valeur spatio-temporelle des marchandises à transporter, donc elle participe à la chaîne de la valeur de l'entreprise et des clients.

La compréhension des liens entre ces "activités à valeur ajoutée", ou bien l'étude de la chaîne de la valeur à l'intérieur de la firme et son prolongement aux chaînes des clients, permet d'optimiser une activité en particulier et de faire répercuter cette optimisation à l'ensemble de l'entreprise soit pour assurer la survie, soit pour avoir des avantages compétitifs, d'où son caractère stratégique.

Il est évident que la répartition étant à la charnière des toutes les autres fonctions de l'entreprise, l'optimisation de cette fonction offre le plus de possibilités de faire répercuter ses effets sur l'ensemble de l'entreprise.

Une troisième acception s'impose si l'on veut tenir compte de l'intégration de la fonction répartition à la stratégie globale de l'entreprise afin de dégager des avantages sur les concurrents

En fait, si l'entreprise adopte une stratégie de domination par les coûts, c'est dans l'exécution de la tâche de répartition qu'elle peut dégager des avantages plus importants, vu que l'avantage par les coûts se produit lorsque l'entreprise réalise ses "activités à valeur ajoutée" avec un coût plus petit que celui de ses concurrents, la recherche de ces avantages impliquant l'identification des "centres de coûts" ou des "conducteurs de coûts" dans l'univers de ses activités et l'analyse de ces coûts par rapport à ceux des concurrents.

Or, si les prix de vente du service de transport et des facteurs de production sont déterminés par le marché, alors, c'est sur la façon de gérer ces facteurs que l'entreprise doit agir pour minimiser les coûts des services. Plus précisément, comme la répartition se présente comme la fonction qui réalise la gestion des ces facteurs nous

pouvons conclure qu'elle est le principal "centre de coûts". Elle offre plus de possibilités de faire des économies au niveau des coûts par rapport aux concurrents.

Il s'agit là de chercher une combinaison optimale de marchandise-chauffeur-matériel-trajet capable de réaliser l'opération de transports avec un coût minimum et d'éviter des déséconomies comme le remplissage incomplet des véhicules et les retours à vide des matériels.

Si la stratégie de l'entreprise est celle de différenciation des services, c'est-à-dire, le service est perçu par les utilisateurs comme unique ou original, la répartition peut aussi y jouer un rôle important surtout dans le respect des délais de livraison, les services d'informations aux clients, la gestion des aléas en cour de route, dans la fiabilité du transport etc...

Si la stratégie de l'entreprise est centrée sur la concentration, dans le sens de Porter [POR 82], visant à "se concentrer sur un groupe de clients particuliers, sur un segment de la gamme des produits, sur un marché géographique", la répartition peut la rendre viable en se spécialisant dans les affectations matériels-chauffeurs plus adaptées au groupe de clients, à un service spécifique ou à une zone géographique déterminée.

Sur ces dimensions présentées jusqu'ici, il en ressort que la fonction répartition possède un caractère stratégique car:

1. elle assure l'existence même de l'entreprise;
2. elle participe à la chaîne de la valeur des échanges économiques;
3. elle peut placer l'entreprise dans des positions plus avantageuses vis-à-vis les concurrents par la maîtrise des coûts de production le plus bas ou par l'offre des services différenciés ou par concentration.

5. Les stratégies de répartition

Nous avons parlé jusqu'à maintenant du caractère stratégique de la fonction répartition vis-à-vis de l'ensemble de l'entreprise. Mais il faut approfondir l'étude de l'opération de transport afin d'y détacher les actions à mener au sein de la tâche de répartition pour que l'entreprise soit en mesure de "maximiser la valeur des capacités qui la distinguent de ses concurrents" [POR 82].

C'est ainsi que la mise à disposition d'un produit sur un marché exige non seulement le déplacement physique de ce produit entre les points de production et de consommation, mais aussi celui des principaux facteurs de production de l'activité même de transport, à savoir, pour le cas du transport routier de marchandises, le travail du chauffeur et le capital immobilisé dans les moyens de transport tels que le tracteur, la remorque ou semi-remorque, la caisse-mobile ou le conteneur.

Lorsqu'on considère le service de transport comme le seul mouvement "aller de A à B", chaque franchissement de l'espace nécessaire pour cette activité génère une offre excédentaire du service de transport qui ne fait pas partie de la demande considérée.

Ceci engendre une sorte de paradoxe de l'activité économique en général vis-à-vis de l'activité économique des transports: afin de rétablir les conditions initiales de sa production, pour recommencer un nouveau cycle de production, l'activité de transport est obligée de réaliser un autre déplacement de ses facteurs de production, sans pour autant que ce déplacement soit intégré à la chaîne de la valeur de l'opération.

Il arrive que les sources d'approvisionnement de matériels ou de chauffeurs se trouvent dehors des flux d'échanges. Il faut déplacer les véhicules et/ou chauffeurs pour rattraper ces flux, cela pouvant se réaliser avant, durant et après les échanges de marchandises.

Ainsi, on constate que toute offre de transport en elle-même correspond, à vrai dire, à deux services joints différents, le premier se réfère au service "aller de A à B" pour une demande donnée et le deuxième pour "aller ailleurs", dû à la délocalisation des facteurs de production.

Ce deuxième service joint est souvent considéré par les entreprises, plus particulièrement par les répartiteurs, comme un "retour", parfois à vide, pour des questions liées au contrôle ou à l'état mécanique des véhicules.

Cependant, l'analyse de la chaîne de la valeur des entreprises de transport montre que ce service "aller ailleurs" n'oblige pas forcement à un retour. En outre, il peut être utilisé comme une source d'avantage compétitif si on l'insère dans la chaîne de valeur de l'entreprise, si on l'utilise comme élément de maîtrise des coûts de production.

Si l'on ne tient pas compte de cette caractéristique, la déséconomie sera d'autant plus grande que la productivité des matériels diminue et les distances s'allongent, du fait que la diminution du taux de

remplissage signifie moins d'utilisateurs du service, donc moins d'économies d'échelle; et que l'allongement des distances entraîne l'accroissement des coûts des déplacements, l'augmentation des délais d'utilisation des capacités de transport et la réduction de l'offre à des nouveaux services.

Sur cette perspective, pour que l'opération se réalise sans perte et ne provoque pas une déséconomie interne, la vente d'un service de transport doit considérer les deux produits joints à la fois. Autrement dit, l'offre excédentaire du service "aller ailleurs'' ne sera annulée que si et seulement s'il existe une deuxième demande dont le point de départ est le point d'arrivée la première.

Mais cela n'annule pas encore l'effet de l'offre excédentaire pour la deuxième demande, ce qui implique que cette annulation n'est possible que si les demandes sont successives et circulaires, la dernière ayant comme point d'arrivée le point de départ de la première, d'où la "logique de circuit" qui doit prévaloir dans la nouvelle façon de gérer la flotte.

Cette "logique de circuit" est au coeur de la stratégie de base proposée ici concernant la répartition dont l'essence est que les entreprises aient la capacité de transformer le service "aller ailleurs" en d'autres demandes spatialement complémentaires, autrement dit, transformer des demandes virtuelles en demandes solvables ou exprimées.

Pour rendre viable la stratégie de répartition basée sur la logique de circuit, il faut mettre en place d'autres stratégies auxiliaires, à savoir:

1. stratégie fondée sur l'information;
2. stratégie fondée sur la coopération;
3. stratégie fondée sur la commercialisation jointe;
4. stratégie fondée sur l'innovation.

La stratégie fondée sur l'information regroupe les actions concernant la mise à disposition des informations nécessaires à la prise de décision dans la tâche de répartition et concerne un effort important de traitement du flux de données à l'intérieur des entreprises pour les rendre disponibles avec qualité et dans le temps requis.

Deux axes s'imposent à ces actions: le premier concernant les connaissances sur le marché, c'est-à-dire, les informations sur la demande, et le second concernant l'opération de transport, les informations sur l'offre, tous les deux devant tenir compte des aspects qualité et rapidité des ces informations.

De ce fait, la mise en oeuvre d'une telle stratégie implique des investissements significatifs dans l'automatisation du processus de saisie, traitement et présentation d'information et exige l'utilisation des nouvelles technologies d'information comme les codes barres, les systèmes à références spatiales, l'échange des données informatisées (E.D.I.), le repérage des véhicules par satellites, etc.

La difficulté majeure concernant l'adoption de cette stratégie est liée au degré d'intégration des flux de données à l'intérieur de l'entreprise permettant d'établir les liaisons informationnelles entre les divers fonctions internes, et à l'extérieur, concernant les échanges de données avec les clients et les fournisseurs.

La stratégie fondée sur la coopération consiste en l'établissement d'alliances avec ceratins concurrents afin d'obtenir des effets de synergie économique. Ce positionnement coopératif entre concurrents d'une même activité économique peut paraître paradoxal à première vue dans la mesure où il remet en cause la notion même de concurrence entre firmes autonomes qui cherchent à s'arracher des parts de marché les unes des autres.

Mais, ce n'est pas le cas du secteur des transports où les entreprises opèrent généralement sur des marchés géographiquement limités et plus ou moins spécialisés.

Ainsi, les alliances fondées sur la "complémentarité des demandes du transport", telle que définie auparavant dans la stratégie basée sur la "logique de circuit", peut jouer un rôle décisif dans l'amélioration de l'exploitation des capacités de transport. Il s'agit là de répartir les coûts d'exploitation des offres excédentaires ("aller ailleurs") en s'associant avec ses concurrents.

Dès lors que les concurrents exploitent des aires différentes du marché du transport ou d'autres genres de spécialisations au niveau de charges à transporter, ils sont en mesure d'offrir des véhicules pour compléter la flotte dans le cas de manque, ou bien des demandes de transport pour compléter le chargement sur un itinéraire économique en cours d'une opération de transport.

La formation de ces alliances est bien entendu liée aux objectifs de chaque partenaire. Ainsi, si l'entreprise de transport veut bénéficier des avantages dus à une taille plus importante ou de l'expérience d'un marché international, l'alliance permet de le faire, même partiellement, sans pour autant que la firme soit obligée de mettre en oeuvre des stratégies de croissance externe et les investissement conséquents.

Les alliances entre entreprises de transport avec la participation des clients peut s'avérer aussi envisageable, si elles peuvent contribuer à l'organisation des flux de déplacements de marchandises et capables de répondre économiquement du moins à l'offre excédentaire théorique du groupe de transporteurs.

La vente des deux services joints cités auparavant est l'essence de la *stratégie fondée sur la commercialisation jointe*, étant donné que la manière dont le service est vendu se répercutera sur la réalisation de la tâche de répartition. Le problème qui se pose concerne l'existence de demande concernant le deuxième service.

Ceci renvoi à la notion de "besoin" dans le domaine des transport, étroitement liée à la nature et à l'existence des moyens pour les satisfaire, autrement dit, l'offre de transport ne se justifie, au sens économique, que s'il y a une demande respective.

Cependant, ce besoin peut se manifester sur le marché et donner naissance à des demandes exprimées par les utilisateurs, les "demandes connues ou manifestes", ou bien ne pas être exprimées, les "demandes virtuelles ou potentielles.

Cela veut dire que l'offre de transport est influencée par et influence la demande instantanée du transport, ceci étant le deuxième paradoxe de l'activité de transport: une demande ne peut se manifester que s'il existe l'offre correspondante et vice-versa.

Étant donné les influences réciproques de l'offre et de la demande de transport, le transporteur doit traiter l'adéquation entre celles-ci tant pour les demandes exprimées par le marché que pour celles induites par l'activité de transport elle-même.

Encore plus nettement, le transporteur a la possibilité de créer des nouveaux marchés par le biais des demandes virtuelles dont les moyens sont déjà disponibles, d'où la nécessité des efforts de commercialisation tenant compte à la fois de deux services joints.

La stratégie fondée sur l'innovation touche surtout l'une des caractéristiques plus vigoureuses du contexte économique actuel, celle qui rend encore plus complexe le processus de prise de décisions compte tenu du nombre de paramètres en présence.

En effet, l'exploitation d'une flotte de véhicules exige désormais la prise en compte des paramètres tels que la configuration du réseau, la localisation de l'expéditeur et du destinataire, les flux en termes quantitatifs et qualitatifs, le type de véhicule plus approprié à chaque produit, le temps minimum de parcours, le délai de livraison exigé par

les clients, le coût du transport, le prix du fret, la taille de la flotte, l'état mécanique des véhicules, la disponibilité des chauffeurs, la réglementation sur les impacts du transport sur l'environnement, la réglementation sur les heures de travail des chauffeurs, la règlementation douanière, etc.

Dès que le coût d'exploitation est le résultat du prix et de la quantité des facteurs de production, il est clair que la façon dont l'entreprise utilise et combine ces facteurs va montrer sa capacité d'atténuer les effets des incertitudes de la demande et de programmer l'affectation des chauffeurs et des matériels.

En plus de la réduction des coûts d'exploitation, l'un des résultats le plus significatif de la répartition est celui de réduire la taille de la flotte, donc, de limiter les surcapacités et le capital immobilisé dans les moyens de transport.

Au-delà de l'usage de nouveaux procédés de traitement d'information évoqués précédemment, l'effort d'innovation consistera en l'utilisation d'outils d'aide à la décision capables d'assister les répartiteurs au cours du processus de prise de décision, y compris la génération des affectations les plus rentables et leur évaluation.

Enfin, comme l'approche stratégique présuppose l'intégration des actions, les stratégies présentées ci-dessus peuvent, bien entendu, être utilisées de façon complémentaire pour viabiliser la stratégie de base fondée sur la notion de "circuit de transport".

6. Conclusion

Cette communication avait pour but de proposer une approche stratégique de la répartition et des stratégies que les entreprises peuvent adopter afin d'obtenir des avantages concurrentiels.

Ces stratégies ont des rapports étroits avec les obstacles souvent présents dans la gestion de la flotte, à savoir, la disponibilité d'informations, la commercialisation du service, l'utilisation coopérative des moyens de transport et la mise en place de nouvelles technologies.

Nous avons présenté un cadre théorique de l'opération de transport permettant son utilisation dans l'analyse d'autres modes de transport afin de traiter leurs problèmes de qualité et de productivité.

Quelques voies de recherche s'ouvrent avec ce travail. Plus précisement, nous voulons étendre cette approche à la répartition de vagons du transport ferroviaire, à la gestion de ressources du transport

multimodal. Cependant, c'est sur la gestion des conteneurs et le transport maritime international, où le problème de pertes de productivité sont encore plus importantes, que la suite de cette recherche pourra être, à notre avis, plus prometteuse.

7. Remerciements

Les travaux de recherche dont il est fait mention dans cette communication sont supportés par le Ministère de l'Industrie du Commerce de la Science et de la Technologie, dans le cadre du programme Synergie.

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Measuring Capacity Utilization in the Trucking Industry

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Capacity and utilization measures are produced for a variety of goods producing industries, however very little work has been done to develop measures for service industries such as truck transport. In this paper, four capacity utilization models with associated data sets, adjusted to conform to theoretical considerations, are presented for the For-Hire Trucking industry over an eighteen year period from 1975 to 1992. Preference for one model and data set over another is determined by how well their resulting utilization rates agree with predicted levels of economic indicators such as prices, investment, outputs, and profits.

Introduction

Competitive pressures are forcing firms everywhere to re-examine the way they do business. A key element in the drive to increase productivity and efficiency has been to ensure the resources available for a particular activity are fully utilized, subject to economic and physical constraints. For example, Deloitte & Touche concluded that higher equipment utilization was a prime factor explaining the competitive advantage of US-based transborder freight carriers over their Ontario counterparts.[1]

Utilization rates are also a useful indicator reflecting changes in demand for an industry's product or services. As the utilization of a particular process peaks, prices for the associated goods or services are expected to increase, reflecting the reduced available capacity to meet the increased demand. The increased utilization of resources and/or production processes is also expected to lead to increasing outputs and profits, and finally to new investment to expand capacity. Likewise, falling utilization rates should be reflected by falling outputs, falling or stable prices, and a reduced (or replacement) level of investment. Measures of utilization are also important for understanding macro economic characteristics of an industry relating to the timing of the business cycle and the impact of recessions and expansionary peaks.

[1] "The Competitiveness of the Ontario Transborder Trucking Industry, Final Report," Deloitte & Touche, September 1991, p.11.

Concept of Utilization

Capacity utilization rates indicate the extent to which the resources and production processes available to an industry have been used. They consist of comparing actual outputs to what could be produced: a maximum, potential, or capacity output. The ratio of actual to capacity output is used to define capacity utilization. The difference between the potential output and the actual output provides an estimate of the surplus or lost capacity in the system, due to idle resources and production processes.

Whereas actual output is readily available, the potential or capacity outputs must be estimated. Capacity outputs can be measured according to maximum yield, or normal operating, assumptions. Maximum yields or engineering approaches are most appropriate for continuous operations, such as steel mills or electrical generation plants, which operate around the clock. Normal operating assumptions, reflecting work shifts, overtime, equipment repair and maintenance scheduling, etc., will produce more useful measures for the trucking activity. Peak observations over the business cycle, assumed to reflect optimal use of the inputs, can then be used to determine capacity output in other periods.

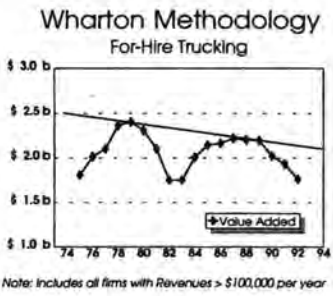
Methodologies to Measure Capacity Utilization

Capacity utilization methodologies are generally classified as survey, or, model based. With survey based approaches, respondents are asked to estimate their capacity utilization rates. In 1991, Statistics Canada (STC) undertook a one-time survey of transborder trucking activity. Drivers at border crossings were asked to estimate what percentage of their vehicle's capacity was being used, based on the commodity mix being hauled. Since 1987, the percentage of capacity at which manufacturing plants were operating, based on maximum production attainable under normal conditions, has been part of STC's Capital and Repair Expenditures Survey.

Model based methodologies rely on raw data from which capacity and utilization measures are constructed. This approach allows for greater control (and consistency) in measuring activity between firms, time periods, etc. than with survey approaches. Four models are presented in this paper with the objective of determining which, if any, are good indicators of capacity utilization. The Wharton, output-capital, production functions, and physical capacity models are, respectively, more descriptive of the trucking activity. Each in turn includes one more of the following fundamental variables reflective of the trucking activity: output, capital, labour, and volume.

Wharton Methodology

Fig. 1



This is one of the first widely used measures of capacity utilization, developed by the Wharton School of Finance. It is also known as an output, or, a "through-the-peaks" method. Capacity output is defined as the line tangent to the peaks in output observed over the period being studied (Fig. 1). Utilization is calculated by dividing actual output by the capacity value taken from the derived line.

The Wharton methodology is based solely on an output measure. If changes in resource inputs are not adequately reflected in outputs, this method will lead to an over or understatement of capacity.

Output-Capital Methodologies

Output-capital methods correct for the apparent weakness in the Wharton method by relating outputs to the capital inputs. This approach is appropriate for industries or processes for which non-capital resources, such as labour, are fixed with respect to the capital resource, so that capital can act as a proxy for the other inputs; or, if the supply and prices of the other inputs are such that they do not limit output.

An early formulation for calculating capacity using output-capital methodology was based on peak productivity.[2] The highest output-capital, or productivity, ratio over the study period, Pr*, is multiplied by the capital stock available each year, K_t, to yield an estimate for the potential output, Y'_t, equation (1) below. Actual output, Y_t, divided by this estimate of capacity output gives the desired measure of capacity utilization, equation (2). Equation (3), describing the residual between capacity and actual outputs, is a measure of idleness in the production system.

(1) $K_t \times Pr^* = Y'_t$ (Capacity Output)

(2) $Y_t / Y'_t =$ C U (Capacity Utilization)

(3) $(Y'_t - Y_t)/Y'_t =$ Capacity Idleness

[2] "Estimation of capacity utilization in world shipping," *Maritime Policy Management*, Y.C. Kalindaga, 1990, Vol. 17

The main assumption of this method is that the highest ratio of outputs to inputs observed over the study period indicates a period of full capacity utilization. Its validity is based on limited technical change, implying that the maximum productivity ratio observed over the study period can be used to estimate maximum output in any year of the study.

Fig. 2

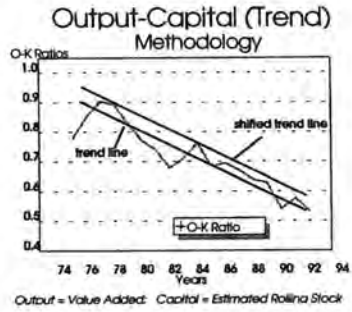


Figure 2 shows a declining output-capital ratio for the For-Hire trucking industry over time. Because a constant maximum productivity ratio does not reflect industry conditions, the peak productivity output-capital model described above should not be used. Technology change can be accounted for, however, by trending the output-capital ratios using ordinary least squares linear regression. When shifted upwards, tangent to the highest output-capital ratio observed, the output-capital trend line represents maximum utilization in any year. Capital utilization is the ratio of the actual output-capital ratio observed in a given period to the adjusted trend line value for the same period. Some analysts use the unshifted trend line as representative of 'normal' capacity output. Given this, capacity utilization will exceed 100% for periods where the observed output-capital ratio exceeds the unshifted trend line.

Production Functions

The output-capital methodology described above assumes capital to be the rate determining input. This assumption may not hold. In the United States, labour shortages have lead to tractors being sidelined. A growing aversion to long haul trucking on the part of drivers, and growth in intermodal alternatives may lead to a similar phenomenon in Canada.[3]

Where there are several inputs to consider, production functions may be a workable alternative. Production functions describe the relationship between the mix of inputs that go into generating the designated outputs. As well, unspecified variables, or those which are difficult to measure, can be accounted for by the inclusion of 'time' or 'dummy' variables. In this study, the Cobb-Douglas production function, described in more detail in Appendix A, was used.

[3] see "Parked: Trucking industry faces driver crisis", The Financial Post, September 10, 1994: p.14

Typically, production functions include capital and labour variables based on flows (amounts used), rather than stocks. Whereas labour flows are generally available, capital flows are harder to come by. As a proxy for capital flow, the equivalent amount of fully employed capital stock needed to produce output in a given period, based on a capital utilization rate, is commonly used. For many applications, the requirement for a measure of capital utilization, very similar in concept to capacity utilization, can be difficult in itself to estimate, rendering this approach somewhat futile. In the case of truck transport however, a capital utilization rate can be calculated based on fuel usage (see Appendix A); or, fuel expenses can be used as the capital flow measure. The coefficients for the capital and labour variables are determined through multiple regression estimation. Capacity output can then be derived by inputting estimates for capacity capital and labour flows into the function.

Physical Capacity (Volumetric-Time) Methodology

Methodologies based on physical production processes are based on deconstructing the designated activity into its constituent parts to develop an accounting framework whereby maximum output can be estimated. Although intuitively strong, and considered by some to be the truest reflections of capacity,[4] difficulties arise in trying to approximate reality with the data available. For this reason, a capacity measure reflecting physical capacity was not calculated. Theoretical considerations are never-the-less presented to round out the discussion of different methodologies and to sketch out a plausible approach using physical measures. For truck transport, the proposed framework ought to reflect the following fundamental industry characteristics:

a) Inputs: The primary inputs that determine efficiency, productivity, and output of the truck transport activity are power units (tractors and straight trucks), trailers (and/or containers), labour inputs, and fuel. Because power units are the only input directly interfacing with the other primary inputs, their total number is considered fundamental to determining capacity output.

b) Volume:. Volumetric measures are considered to provide the 'purest' reflection of capacity utilization.[5] For example, most payloads will 'cube-out' before the regulatory GVW capacity of the truck /trailer combination is reached. Alternative weight based capacity measures would therefore tend to overstate the potential capacity of the trucking fleet.

[4] "The Concept of Capacity," *Journal of the American Statistical Association*, F. De Leeuw, December 1962

[5] see "Task B Draft Final Report, For-Hire Trucking Industry Size Study," Trucking Research Institute, Alexandria, Va.(1994), for elaboration and discussion concerning transportation measurement variables.

The main challenge to using a volume measure is associating a volumetric capacity with the power unit. Not only do trailer, box, or container lengths vary, but the rolling stock configurations (i.e., the number of linked trailers, e.g. Rocky Mountain Doubles, Turnpike Triples) must be considered. In addition a volumetric measure needs a standard unit such as container equivalents (e.g., TEUs- Twenty foot container Equivalent Units). This would pose a difficulty for non-volumetric trailer units such as rack and flatbeds and auto carriers. These problems are not insurmountable, but would probably require additional questions on existing surveys or field-based enumerations.

c) Labour: The capacity of each power unit is also affected by the labour input. If a carrier employs more than one shift of drivers then the capacity of each power unit is effectively increased by the 'shift' factor (estimated by taking the ratio of full-time equivalent drivers to power units). The highest number of shifts observed over the period could be used as the capacity shift level in the industry.

d) Time: Capacity has a time dimension as well. A potential volume is available for a period of time, after which it disappears. Total capacity is the product of the volumetric capacity and the period that capacity is available, yielding a volumetric-time unit, possibly expressed in container-days or container-day equivalents.

Taking the above into account, a capacity estimation equation could be:

❶ Power Units (tractors or straight trucks) x ❷ Volume (average TEUs per power unit) x ❸ Working Shifts (per power unit) x ❹ Annual Operating Period (days)

When multiplied together, these four components measure total container-day capacity theoretically available in the industry in a year.

Actual Output Used: The units describing actual and capacity output must be the same if they are to be compared, as required by the capacity utilization formula. This means that raw data from STC's Trucking Origin and Destination survey (TOD), an important source of 'physical' transportation outputs, would have to be transformed from a weight-distance format (tonne-kms) into a volume-time format. Weights can be translated to volumes based on product density tables and distances would need to be transformed to estimated travel times for each shipment. Once actual capacity is determined, capacity utilization could be calculated based on the familiar ratio of actual physical output to capacity physical output.

Data

Each of the different methodologies proposed are based on a different set of data. The Wharton model requires only a measure of output, whereas output-capital methods, as their name implies, require a measure of output and capital, and lastly, production functions, require measures of output, capital, and labour.

A variety of data were used with the objective of finding a capacity utilization measure most in tune with the pre-determined economic indicators: outputs were defined as total transportation revenues or values added;[6] capital measures were based on industry balance sheets, estimates of the value of rolling stock (straight trucks, road tractors, and trailers),[7] STC Investment & Capital Stock Division (I&CS) measures,[8] and fuel expenses; and lastly, labour inputs were based on salary and wages for drivers and helpers.

Only data that was compatible with all the methodologies was considered. Production functions, for example, are subject to certain mathematical specifications in order to be valid. If the data are not compatible with the model's requirements, either they must be switched, or a different model must be considered.[9] Considering the specifications of the production function used, value added was preferred over revenue as an output measure. Salary and wages for drivers and helpers, as well as the capital measures described above, were found to be acceptable for use as labour and capital stocks and flows.

Time series data were used so the different methods could be evaluated against the movement of macro economic indicators over time. Economic (monetary) measures from STC's motor carrier surveys[10] (1975 to 1992 inclusive) were used because they were found to be easier to work with and more available than physical measures such as tonne-kms. The study limited its scope to the For-Hire Trucking industry and included all of the designated revenue classes (Classes 1, 2, and 3).

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[6] defined as the sum of net motor carrier freight revenues, salary and wages of drivers and helpers, and revenue equipment depreciation expense.

[7] based on STC rolling stock prices and inventories (provided by STC's Prices and Transportation Divisions respectively)

[8] for Truck Transport industries' machinery and equipment (includes rolling stock)

[9] see Production Functions, David F. Heathfield, Macmillan Press, London, 1971.

[10] see Trucking in Canada, Statistics Canada, Catalogue 53-222 Annual (Annual Motor Carrier Freight survey (AMCF). Other Statistics Canada sources were used, as noted.

Data Adjustments

A number of adjustment to the data were required to ensure consistency across years and adherence to theoretical precepts. For example, inputs and outputs were made to conform to a uniform revenue class structure over the period, as well, all data were converted to constant dollars (1986 = 100): output figures were adjusted using the IPI (implicit price index) for the Truck Transport industry from STC's Input-Output Division; revenue equipment and fuel were adjusted using deflators from STC Prices Division; and, labour values were deflated using the consumer price index.

Where capital inputs could not be matched to the resulting outputs, crucial for ensuring an accurate output-capital measure, unmatched outputs were eliminated. All capital values were adjusted to include the value of leased equipment based on price data described above. Capital stocks were also netted of depreciation using an I&CS delayed depreciation method, and I&CS estimates of service life and average ages of capital equipment.[11] More detail regarding data transformations can be found in Appendix B.

Results

Capacity utilization rates were calculated for each data set and model to determine which combinations, if any, were strongly correlated with the economic indicators related to capacity utilization. Where the different models relied upon the same variables, the same data sets were used. Assessments of the models could therefore focus as much as possible on the inherent strengths and weakness of each model, free from complications arising from differences in data.

The best capital measure to apply to the different models was selected by determining which one yielded the most highly correlated utilization rates to the measures of new investment. Where measures of new investment were not available, such as those based on balance sheet valuations and estimates of rolling stock (trucks, tractors, and trailers), year over year changes in the value of net capital stock were used. The investment measure for the I & CS capital input was based on actual gross fixed capital additions.

Table 1, below, lists correlations between capacity utilization derived from different model and data combinations (rows) and measures of new investment (columns). Correlations indicate how well two variables move together. Models considered included the Wharton, trend shifted output-capital (O-C),

[11] Fixed Capital Flows and Stocks, Statistics Canada - Catalogue 13-568, p. 43ff

and production function (P Fn). The investment measures consisted of *values* for owned trucks and tractors (Trk/Trc), rolling stock (RS)(the former plus trailer values), and I&CS gross fixed capital additions. Correlations based on industry balance sheet values were found to be weak and/or inconsistent and therefore have not been shown.

Correlations were run on lagged and unlagged utilization rates. Utilization rates based on output-capital and production function models were better correlated with investment when lagged a year, whereas Wharton utilization rates were more highly correlated with annual investment expenditures if not lagged. This suggests that utilization rates based on capital-based models are more useful as indicators of future behaviour.

Table 1
Correlation Coefficients for Capacity Utilization and Investment

Model, data \ Investment	Owned Trucks & Tractors	Rolling Stock	I & CS
Wharton (Val Added)	.336	.526	.681
O-C 'Shift' (Est RS)	.653	**.754**	.463
O-C 'Shift' (Trk/Trc)	**.626**	.785	.456
O-C 'Shift' (I&CS)	.337	.522	**.611**
P Fn (Est RS)	.483	**.550**	.137
P Fn (Trk/Trc)	**.525**	.610	.140
P Fn (I&CS)	.447	.552	.244

Correlations of about .50 or better indicate an acceptable level of correspondence between capital utilization and new investment, as required by a good measure of capital utilization. The output-capital 'trend-shift' models produced consistently high relationships between utilization and investment, although the Wharton and production function measures also performed well depending on the capital and investment variables.

The weak I&CS - production function correlations are likely related to the I&CS investment and capital measures which cover all industry machinery and equipment and not just rolling stock. These measures may not translate well to the production function approach, where capital and labour flows were related to rolling stock concepts.

Strong relationships are evident between investment and utilization rates based on capital values related to the investment variable (bolded values in Table 1). Because of the logical connections inherent in this relationship, there is a strong argument that they are also the most important to assess in determining whether a good fit exists, or deciding which capital measure produces the best available fit. Using this criteria, rolling stock would be the preferred capital measure to apply in inter-model comparisons, and for assessing utilization fits with the other economic indicators: inflation, output, and profits.

Fig. 3

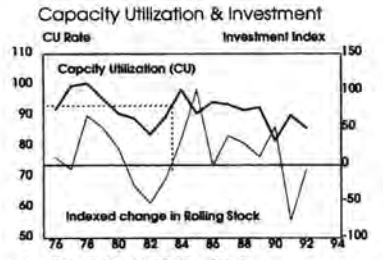


Figure 3 maps out the movement between capacity utilization and an index of investment (100 = peak investment) over the eighteen year study period. On a macro level, the capacity utilization measure proved to be consistent with the major downturns (recessions) in the economy, bottoming out in the early 1980s and 1990s.

Until the first recession, capacity peaks and troughs were coincident with investment peaks and troughs. Since then, it appears the capacity measure has been a leading indicator of investment peaks and troughs. Local capacity peaks occurred in 1984, 1986, and 1989, followed by investment peaks in 1985, 1987, and 1990. This pattern was observed in 13 of 22 major industry groups over the same period.[12] Likewise, utilization troughs occurred in 1985, 1988, and 1990 with investment troughs occurring one year later. Year over year increases in the value of the rolling stock are indicated when the investment index is positive. The dotted line above shows that additions to capital are triggered by capacity rates just over 90 % of peak values.

Fig. 4

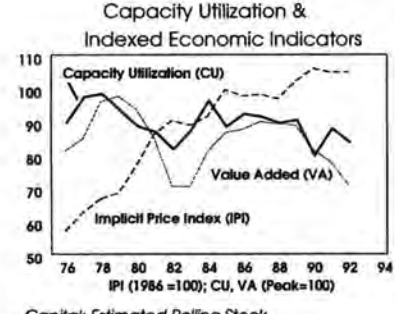
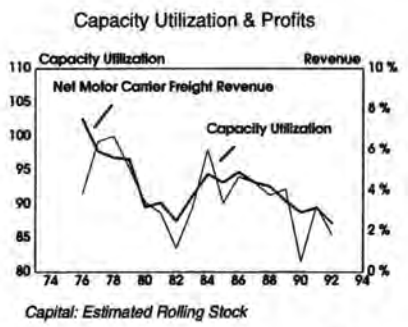


Figure 4 shows utilization against price and output measures. Prices of transport services (broken line) have shown an upward trend over the period, exhibiting a classic "stickiness" to downward movements. Breaks in the price spiral are evident however, coincident with the capacity utilization troughs, as expected. Increasing prices finally stop and go into decline coincident with the first utilization trough in 1982. A similar deflationary pattern is observed from 1985 to 1989, triggered by the 1985 trough. The last break in price increases is coincident with the period's historical utilization low observed in 1990, and from which prices were yet to have recovered.

[12] "New Survey Estimates of Capacity Utilization," David Wallace, Canadian Economic Observer, Statistics Canada, December ,1991.

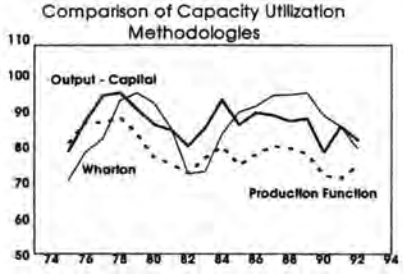
The capacity utilization rate leads the value added output measure (shaded line) in the early part of the study period, but moves more in tandem in the period's latter half. In 1984 utilization dropped sharply although output continued to rise. This is within the bounds of what one would expect. As utilization increases, investment would expand, leading to an increase in potential output. Under these circumstances, a decline in capacity utilization could still be associated with an (albeit moderated) increase in output based on the expanded potential capacity. This was borne out empirically.

Fig. 5



The axis for the capacity utilization figures has been adjusted in Figure 5 to better show the movement of the capacity measure with profits, measured by net operating revenues (operating revenues less operating expenses, as a percentage of revenue). The close relationship between capacity utilization and profits corroborates the study cited in the introduction relating equipment utilization and competitiveness in the trucking industry. Whereas utilization was a leading indicator of investment, it appears to be a coincident indicator with profits. Investment, a behavioral variable which responds to current conditions, would be expected to lag measures describing current conditions, while macro variables such as profits, descriptive of current conditions, are expected to be coincident with the current measures.

Fig. 6



The 'trend shifted' output-capital time series is shown in relation to the other models in Figure 6. The Wharton method is out of sync with the other two measures and does not seem to as finely record changes in utilization. On the other hand, the production function moves strongly with the output-capital measure (correlation = .67), displaying the same period inclines and declines; it is also smoother, i.e., not displaying the sharp changes of the output-capital measure, and peaks at a more realistic level than the other models.

Fig. 7

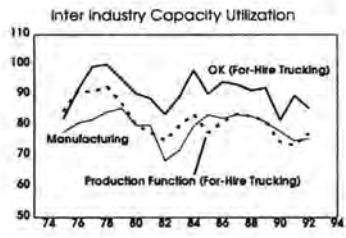


Figure 7 shows For-Hire capacity measures with those for an 'all manufacturing' measure. For most of the period under review, the production function is within the range recorded for the manufacturing industries. Whereas the production function model estimates a maximum output that is likely to exceed observed outputs, the output-capital measures are constructed such that the highest peak observed is assumed to reflect 100% utilization. Rather than considering this level to be 100 % utilization, it is better to refer to this level as peak usage, so this method really is an index of capacity utilization.

Given this, surveys can be useful adjuncts to output-capital measures. Presumably peak periods for the two methods will correspond. Peak index rates can be benchmarked to actual rates by shifting the index peaks so that they coincide with the survey peaks. The other periods can be then be shifted by a similar amount. It would also be very useful to see how the production function estimates compare to the survey rates. If the survey rates are in line with the estimated rates, then the production function approach would have the added appeal of 'self benchmarking.'

The one-time 1991 STC study of *transborder* (Canada-US) trucking reported capacity utilization rates of 72% for outbound movements and 61% for inbound movements.[13] Both the Wharton and output-capital models recorded utilizations at 89.7% of maximum (unbenchmarked) utilization, whereas the production function yielded a measure of 73.3%. It should be noted however, that these figures are based on intersecting but not identical populations: the capacity utilization measures produced in this study reflect domestic as well as international For-Hire activities.

Fitting the different models' utilization trend lines so their peak periods coincide (with no period exceeding 100% utilization) reveals that the Wharton method tends to overstate values of peak utilization, and understate values associated with trough utilization compared with the other two models. The variance of the differences between the fitted Wharton and output-capital series was four times that of the fitted production function and output-capital series. Average annual absolute differences in capacity utilization rates for the Wharton and output-capital methods were 5.0 percentage points versus 3.4 percentage points between the production function and output-capital series.

[13] "Transborder Trucking Survey, 1991," Transportation Division, Statistics Canada

Conclusions

This paper set out to describe the theory and mechanics behind developing a measure of capacity utilization. It was intended to be a contribution to the discussion concerning the development of a measure that could be used to enhance our understanding of the industry.

Any measure that is to serve this purpose is expected to conform to relevant economic indicators. As such, all three models show good potential as meaningful measures of capacity utilization. Output-capital methods have particular promise in that they yielded strong correlations regardless of the capital or investment measure used. Production function rates were likewise highly correlated with output-capital rates, and possibly have the additional attraction of 'self benchmarking.' Because the Wharton model is based solely on output measures it was found to over and under estimate utilization rates with respect to the other models.

Furthermore, for each of the models, their data requirements are such that capacity utilization measures could be provided for private carriers, carriers based on inter- and intra- and provincial characteristics, and by commodity, given existing information collected in STC surveys. This provides this measure with greater diagnostic capabilities, such that it ought to considered as a standard operating measure to describe industry performance. The introduction of a new operating measure however will require a consensus among its prospective users. It is important that there be further applied research, particularly with respect to a physical measure, for which measures have yet to be produced.

The author wishes to acknowledge the valued feedback provided by his colleagues, particularly that of David Wallace, Senior Analyst, Transportation Division, Statistics Canada. Any errors or omissions are, however, strictly his own

Appendix A **Production Function**

The Cobb-Douglas production function, (1), below, was used to show how the mix of inputs, K (capital flow), and L (labour flow), would impact output, Y (value added). This relationship is described by the respective coefficients for the capital and labour flows, α and β (and the constant, a_o), which are estimated by linearizing the production function using logarithms and running an ordinary least squares multiple regression on the variables, equation (2). The coefficients α, and β, indicate the *percentage* change in output, Y, associated with a 1% change in an explanatory variable. The specifications of this production function require the coefficients to add up to one.

(1) $Y_t = a_o K_t^{\alpha} L_t^{\beta}$, where $_t$ refers to the time period, and

Y_t = Output (value added)

K_t = Capital flow (equivalent value of capital stock being fully used to produce the given output)

L_t = Labour flow (salary and wages of drivers/helpers)

(2) $\ln Y_t = a_o + \alpha \ln K_t + \beta \ln L_t + \varepsilon_t$ (error term)

The capital flow variable was calculated based on fuel usage. The highest fuel expense to capital value ratio signified maximum equipment utilization. Each periods' fuel:capital ratio divided by the peak ratio observed indicated the equipment utilization rate that year. The equipment utilization rate multiplied by the annual capital stock value yielded the capital flow variable: the amount of the capital stock being fully used each year.

Below is the estimate of the production function using rolling stock as the capital input (all of the capital inputs yielded very similar results, except for truck and tractor value, whose coefficients added to 1.06):

(3) $\ln Y_t$ = .311 + .236 $\ln K_t$ + .763 $\ln L_t$ R2 = .84

(t -stats) {Prob values} (4.19) {7.95 E-4} (8.80){2.61 E -07}

As can be seen, the results, equation (3), are exceedingly robust. The capital and labour coefficients total .999. Capacity output is calculated by inputting capacity labour and capital values, determined by calculating a salary and wages value based on one driver (and proportional helpers) for every power unit, and capital stock equal to the value of capital stock in each year (i.e. assuming all existing capital stock was being fully used). Capacity utilization was thus the actual output observed divided by the estimated capacity value.

Appendix B **Data Adjustments**

Most of the changes to the revenue classes over the study period proved to be inconsequential to this study. Because the data used was based on the combination of the three revenue classes, until the lower limit for the smaller firms (Class 3) changed, no adjustments had to be made. For the 1990 - 1992 period values for all variables were reduced to eliminate firms that were introduced by lowering the Class 3 revenue threshold from $100,000 to $25,000. The eliminations were based on ratios from a 1990 STC study on these smaller firms, and applied to subsequent years.[14]

An important principle, particularly for the output-capital measures, was to match the capital inputs with the output measures. The revenue figures, and by extension the values added, include outputs derived from owner operators (OOs) contracted to For-Hire carriers. Revenues also reflect the value of purchased transportation (e.g., when goods are interlined or transportation services such as rail services are billed through the For-Hire carrier). Because the capital assets used in producing these revenues however are not part of the For-Hire companies operating records, either the value of the revenue equipment associated with OOs and purchased transportation had to be added to the existing measure of capital stock, or the associated outputs had to be extracted. The latter was considered simpler, and was therefore followed.

For-Hire revenues derived from OOs were estimated by dividing the OO expenses by the operating ratio (ratio of operating expenses to operating revenues). Revenues were then reduced by this amount. The value added figure was similarly reduced for net operating revenue attributed to OOs: OO revenues less OO expenses. It was assumed that purchased expenses were passed on to the transportation clients and not subject to a mark-up. For this reason, transportation revenues were reduced by the amount of the purchased transportation expense, but no further change was required to correct value added.

It should be noted that in 1990 STC excluded trucking firms with revenues under $1,000,000 from its surveys, relying instead on administrative data (tax files) to account for these firms. The exact impact of this change, if any, is not known.

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[14] "Small For-Hire Trucking Industry in Canada," Larry McKeown, Trucking in Canada, 1990 Cat. No. 53-222, pp 149ff. The ratio of revenues and expenses for firms earning between $25,000 and $100,000 has been falling as a percentage of industry totals for the 1987 -1989 period. It is not known if this trend would have continued. The actual values for 1989, the lowest observed for the 1987 - 1989 study period, were used for 1990, and the resulting ratios for this year were applied to 1991 and 1992.

THE ECONOMICS OF AUTOMOBILE TRANSPORTATION IN LOW DENSITY MARKETS*

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I. Introduction

Market forces have replaced government regulation of transportation in many countries over the last three decades. The United Kingdom, the United States, Canada and Japan are among the countries that have deregulated major segments of their trucking industries. Trucking is viewed as an industry that closely approximates the perfect competition model with its low threshold costs, mobility of assets and perceived absence of economies of scale. An area of concern, however, is service to low density markets such as rural communities outside of major urban areas. Many of these transport markets are still subject to regulation in Canada as provincial regulatory commissions retain residual authority to regulate within their borders. Although many provinces have followed federal initiatives to reduce or eliminate trucking regulations, some jurisdictions still maintain varying levels of control. This control is particularly significant for small communities since many of the movements to these destinations originate and terminate within such jurisdictions.[1]

The economics of low density markets has been relatively unexplored. This paper utilizes a simulation approach to examine the haulage of automobiles in British Columbia in order to explain the service, productivity and competitive relationships that are likely to be encountered in low density markets. The results are found to be consistent with empirical analyses of other, larger volume trucking markets. Implications for public policy are also developed.

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* The authors gratefully acknowledge the assistance of David G. Weiss, Roderick C. Turner and Andrew Lloyd. An earlier version of this paper was presented at the 1994 Australasian Transport Research Forum. The authors thank the participants at this conference for their comments.

[1] With respect to the United States, the Federal Airport Improvement Act of 1994 (effective Jan. 1, 1995) prohibits states from economic regulation of trucking. This federal preemption of state trucking regulation has been upheld in several court challenges and continues to be litigated.

II. Transportation and Low Density Transportation Markets

A market is composed of the sellers and buyers of a product. The product in transportation is often referred to as a service which can be defined as the capacity to move a defined commodity from a specific origin to a specific destination at a certain quality of service level.

The concept of quality of service is highly significant. The transportation of a product from one point to another produces time and place utility; it adds value to the product by making the product available at the right place at the right time. If the product is damaged or delivered late, the product will have less or no value and the value added by transport will be rendered insignificant. Shippers demand transportation service characterized by a certain transit time and other attributes. The market is efficient when buyers are able to obtain the quantity and quality of transport service desired at least cost.

Density is normally used to distinguish between a high volume transportation market and a low volume market. A low density market is a transportation market which cannot support frequent and efficient service. We shall use daily service (during business days) as the benchmark for frequent service. Efficiency is achieved when products are transported in the type and size of vehicle appropriate to the market and in full loads. The minimum vehicle size varies with the mode of transport but, within a mode, a number of vehicle options exist. For example, the optimal vehicle size for trucks in low density markets depends on distances and stop frequencies. A market with few stops and long distances is most economically served by large over-the-road vehicles while markets with many stops over short distances are more economically served by smaller vehicles.

Low density transport markets are often synonymous with rural and small communities. Such communities are outside major urban areas and are characterized by:

- freight movement routed through the nearest urban centre allowing freight to be consolidated for final delivery rather than direct service;
- unbalanced movement, typically inbound movement of consumables and outbound movement of resources; and
- low freight density.

A number of before and after studies have been conducted in the U.S. to determine the impact of deregulation of trucking in small communities (Borlaug, 1981; Interstate Commerce Commission, 1981; Kidder, 1983). These studies generally found that service to small communities did not suffer or in fact

improved after deregulation. However, none of the studies considered simultaneously the cost of service and the rates charged. Chow (1983) addressed this aspect in a cross-sectional study of truck service to small rural communities in Western Canada. That study observed that the province of Saskatchewan used regulation to enforce low rates but, in return, restricted entry so that carriers had a monopoly on individual routes. In contrast, the province of Alberta regulated neither rate nor entry. The result was lower prices and lower service in the regulated environment, and higher prices with higher service in the unregulated environment.

III. The Automobile Haulage Industry in British Columbia

A major hauler of new and used automobiles in B.C. provided information which was used to address issues concerning economic structure and conduct in low density markets. This section discusses some of the economic features of those markets in the B.C. automobile haulage industry.

Competition in short distance markets where the dealer is the destination is typically intramodal, i.e., between different motor carriers. The hauler was the dominant for-hire motor carrier of automobiles originating from railheads or port terminals in Vancouver to dealers in B.C. Existing competition included one 5 vehicle fleet carrier and several used car haulers. Potential competition included private carriage operations of the manufacturers and expansion of terminal companies into the provision of new trucking services.

The trucking industry is commonly viewed as comprised of at least two sub-industries: the less-than-truckload (LTL) segment and the truckload (TL) segment. Research in the area of economies of scale in trucking has conflicted but studies generally agree that what economies of scale do exist are most likely to be found in LTL trucking rather than the TL sector. Economies of scale, density and utilization are unfortunately always measured at the firm level and few studies consider the size of the market served. In many regions or groups of markets, the demand for transportation may only be large enough to sustain one efficient-sized carrier. Economies of scale should be measured for each relevant route since each route represents a true transportation market.

The automobile transportation business can be considered an LTL business because cars can be tendered for a specific destination in less-than-truckload quantities and is done so frequently. However, the auto hauling business is best considered a TL business since there is no handling of freight across docks or extensive freight mixing in terminals. Consequently, the fixed costs of running such a business are not high in terms of overheads or terminal facilities. However, many linehaul costs are fixed per trip. The bulk of the driver, fuel

and other operating costs are the same whether a truck delivers 2 cars or 10 cars. Thus, there are potential economies of utilization on any particular route. When the amount of traffic is high, i.e. a dense traffic market, many carriers can compete effectively. However, in low volume traffic markets, the fragmentation of traffic may lead to lowered efficiency or decreased service. The relationship between the economics of providing service and the demand for service must be examined in order to determine whether one or more carriers can operate efficiently in the market.

Automobiles are generally transported between cities in specialized tractor trailer vehicles with the capacity to carry 8 to 11 automobiles depending on the size of the individual automobiles. Unlike other forms of trucking where capacity utilization varies almost continuously, i.e., a 11,600 kg load versus a 12,000 kg load, etc., the load of the auto carrier will decrease or increase in increments of about 10 percent. That is, if a carrier loses the opportunity to carry one more car, about one-tenth of the potential load factor is lost. Thus, losing the opportunity to transport just one more automobile represents significant losses in operating efficiency.

These route specific economies of scale can be reflected in the quality of transport service as measured by the frequency or speed of service. Ideally, a carrier would dispatch a vehicle load as soon as the capacity of the vehicle is reached. Thus, a carrier can provide daily schedules or dispatch vehicle loads daily if it has access to at least one truckload of traffic for the geographic market in question each day. When the traffic is less than the minimum quantity required to effectively utilize the vehicle, the carrier must make a choice between dispatching the vehicle underloaded or delaying the delivery of existing freight until additional freight is tendered and a more efficient load is consolidated. In dense markets such as Vancouver to the adjacent Lower Mainland areas, such a trade-off between cost or load productivity and service is irrelevant except at the margin. It is likely that most automobiles will be tendered along with enough other cars to justify a shipment within a short time of tender. As the number of cars tendered may not be an exact multiple of the capacity of the vehicles used, short delays for some vehicles may result. At the same time, the cost penalty for underloading is minimized because of the short distance and trip time. However, in low density markets, the tender of enough automobiles on any particular day to justify a vehicle dispatch is less likely and thus this trade-off is real.

IV. A Simulation Study of the Haulage of Automobiles

In 1990, the major B.C. hauler transported approximately 95 percent of all vehicles delivered to dealers in B.C. and virtually 100 percent to areas outside of the Vancouver metropolitan area. This hauler provided a complete listing of

all automobiles shipped from all Vancouver terminals for the first five months of 1990. The average number of vehicles delivered per month was 15,709 with deliveries reaching a peak in May with 17,889 automobiles delivered. Approximately 36 percent of the automobiles were delivered to Vancouver metropolitan locations--high-density, short-haul markets. About 38 percent of the automobiles were delivered to low density markets within B.C. and the remaining 26 percent were delivered to U.S. and other Canadian markets.

A simulation approach was chosen to analyze the impact of fragmenting this business among several competitors. Such an approach would provide a fair assessment of the effect of new market entry because the same traffic base representing the total number of vehicles delivered in a market would be used. The simulation approach also reflects the actual demand and distribution of demand over a selected period of time. It avoids the use of averages by accounting for automobiles tendered for delivery on a day to day basis. As it is difficult to replicate the exact dispatching decision rules that would apply to any and every situation, it was necessary to establish our own set of decision rules. Consistently applied, these rules result in an unbiased estimate of relative service and efficiency produced under alternate scenarios of market fragmentation.

Three separate simulation analyses were performed to study the potential effects of market fragmentation:

(1) The first analysis determines how *efficient* the *industry* will be under different market fragmentation scenarios given the level of service.
(2) The second analysis determines what *levels of service* will be provided by the *industry* under different market fragmentation scenarios while holding efficiency constant. By using this approach, the effects of market fragmentation can be seen more clearly and are not be confused by simultaneous changes in both service and cost or efficiency.
(3) The third analysis expands the first two simulations in order to examine *efficiency* and *service* for *individual carriers* under different market fragmentation scenarios.

In each of these analyses, the data used to measure *efficiency* is the *average load factor* of delivery trucks. Average load factor (or simply average load) is the *number of automobiles loaded on the truck per trip*. The *average age in days* is used to measure the *customer service level*. Average age in days is the time between tender date of the car by the manufacturer to the major hauler and dispatch date of the vehicle trip in which the car is delivered. This is an appropriate measure of customer service since the line haul transit time, once a truck is dispatched, should not differ significantly among competing carriers.

Traffic during the month of May was chosen for the analysis as the effects on customer service level and efficiency from fragmenting segmentation will be minimized under the heaviest volume periods. For periods of smaller volumes, the effects of fragmentation would be even worse. This case, therefore, represents a minimal effect or best case scenario.

The relevant market is route specific and because of the number of markets, it was necessary to choose a sample of markets from which the effects of fragmentation could be measured. Several medium volume and low volume markets were chosen for this analysis. The effects identified would be worse than would be the case in the high volume markets. The size of the six markets chosen ranged from 407 cars delivered to Market 1 down to Market 6 which received only 21 automobiles in May.

Load performance and service were measured under four scenarios for each of the six markets examined. In addition to the actual performance, fragmentation alternatives were chosen to represent some likely segmentations that would occur if the market was fragmented among two competitors. The four scenarios are:

(1) Actual performance of the hauler during May.
(2) Simulated performance with all traffic retained by the hauler (status quo).
(3) Split 1 is the simulated performance assuming that a new entrant captures all the import car traffic of one major Asian car manufacturer. Thus, the incumbent hauler retains all domestic and remaining import traffic.
(4) Split 2 is a simple Asian/non Asian split. The incumbent hauler retains all domestic and import traffic not originating from Asia while the new entrant captures the import traffic originating from Asia.

The number of cars that would be diverted to a new entrant under the two split scenarios in May 1990 are displayed in Table 1.

1. Simulation of load factor impact holding customer service constant

The first analysis looks at each of the chosen markets to determine how different fragmentation alternatives affect efficiency. For each market and for each scenario, *customer service level* is held constant to determine the effects of various fragmentation alternatives on the load factors. The major hauler's desired customer service level of two days aging of the vehicle order is used as the standard for customer service level. Two days aging is defined as dispatching the automobile for delivery within two days of the tender of the vehicle excluding the day of tender. Weekends and holidays are not counted in the service level computation. Truck loads are built and dispatched each day

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based on this level of customer service. This procedure results in different load factors across trucks as the customer service level is reached. For each split in each particular market, the average load factor for all trucks as well as a frequency distribution of the load factors is calculated. The change in load factors over the various splits can then be analyzed.

Table 1 Traffic Volume Diverted Under Alternative Split Scenarios: May 1990

	Number of Automobiles to New Entrant		
Market	Part of Imported Volume: Split 1	All Asian Imported Volume: Split 2	Total Volume
1	32	94	407
2	20	63	362
3	24	54	208
4	20	64	214
5	11	26	60
6	2	9	21

The results of the simulations holding customer service levels constant and comparing average loads for Market 3 are shown in Table 2. Two hundred and eight automobiles were tendered for delivery to this area and 40 truckloads were dispatched. Actual vehicle trips involved deliveries to points outside of the defined market area so the actual average load is higher than the recorded 5.2 automobiles per truck and actual service performance was slightly better than the 2.44 days from tender to dispatch.

Table 2 Simulation of Load Performance Holding Service Constant

	Market 3			
	Actual	No Split	Split 1	Split 2
Total Vehicles	208	208	208	208
Truckloads	40	23	26	26
Mean Deliveries/Truck	5.20	8.83	8.0	8.0
Std. Dev.	2.45			
Mean Age in Days	2.44	2.00	2.00	2.00

The impact of fragmenting the available traffic among several carriers on the Market 3 route is seen by examining the "Mean Deliveries/Truck" row of Table 2. The market fragmentation scenario represented by Split 1 results in an average load factor for all vehicle trips to Market 3 of only eight cars per truck. This is a reduction of about 0.8 automobiles per load or a 9.4 percent reduction

in load efficiency.

Similar calculations of the reduction in load efficiency given the customer service level were made for each market and each market fragmentation scenario. Table 3 shows the percentage decrease in load factors from the No Split to Split scenarios. One can easily observe that there are significant declines in load factors in all markets for all three simulated market scenarios.

Table 3 Load Factor Efficiency Losses Due to Splitting of Traffic

	Load Factor		Efficiency Loss Relative to No Split (%)	
Market	Actual	No Split	Split 1	Split 2
1	6.167	9.927	9.0	4.1
2	7.87	9.78	5.1	7.5
3	5.20	8.83	9.4	9.4
4	6.29	9.30	11.5	11.5
5	5.45	6.67	25.0	30.7
6	3.50	4.20	16.7	28.6

2. Simulation of customer service impact holding load factor constant

The second analysis holds *load factor* constant and looks at the effect of the fragmentation alternatives on the customer service levels. The average load factor actually observed in each market is used as the standard load factor for that market and truckloads are built to that level. This procedure results in varying customer service levels. The average age in days is calculated for each scenario.

The results of the simulations holding average loads constant and comparing customer service defined as age in days are shown in Table 4 for Market 3. Average load was held constant at 6 automobiles per truckload in the simulation. The actual and simulated no split service performance appear to be inconsistent at first observation with actual service of 2.5 days being significantly worse than the simulated service of 0.28 days. However, interviews with the personnel of the major hauler indicate that many automobiles are tendered for delivery towards the end of the day. An examination of the frequency distribution (not shown) underlying Table 4 indicates that none of the Market 3 traffic tendered was dispatched on the same day as tendered. Our simulations dispatched the vehicle on the same day as long as the load minimum was met and did not distinguish between automobiles tendered early in the day versus late in the day. Thus, 161 cars were dispatched at least one day earlier in the no split simulation than in the actual situation. In addition, other criteria are used that

we could not use in the simulation. For example, there may be multiple dealers in the area so that holding one or more automobiles for an extra day will result in building two separate loads each destined to one location in the destination area as opposed to two loads, both destined to several locations in the destination area. These factors help explain why we should expect actual age in days to be higher than the simulated age in days for the no split scenario.

Table 4 Simulation of Service Performance Holding Load Constant

	Market 3			
	Actual	No Split	Split 1	Split 2
Total Vehicles	208	208	208	208
Truckloads	40			
Mean Deliveries/Truck	5.20	6.0	6.0	6.0
Std. Dev.	2.45			
Mean Age in Days	2.44	0.28365	0.65385	0.59135

Two measures of the impact on service times are the absolute and percentage amounts that simulated age in days increased when the traffic was fragmented. For example, if Market 3 were fragmented as assumed in Split 1, the average age in days would increase from 0.28 to 0.65 days which is an absolute increase of only 0.37 days and a percentage increase of 132 percent. These measures of service impact were computed for all markets and market fragmentation scenarios. The results are shown in Table 5. The absolute increases suggest that delivery would be delayed from 0.5 to 3 days under Splits 1 and 2, with the greatest service declines occurring in the medium volume as opposed to light volume markets since these latter markets are already poorly served.

Table 5 Absolute and Relative Impact on Service From Market Fragmentation

Market	Age in Days		Absolute Increase in Age / Percentage Increase (%)	
	Actual	No Split	Split 1	Split 2
1	1.5	0.09	0.24 / 275	0.28 / 321
2	1.8	0.22	0.05 / 24	0.32 / 148
3	2.4	0.28	0.37 / 131	0.31 / 108
4	1.8	0.34	0.25 / 74	0.23 / 68
5	2.3	0.83	0.39 / 47	0.39 / 47
6	1.1	2.10	0.75 / 36	0.10 / 5

In summary, the fragmentation of the market in each of the six geographic markets examined resulted in significant reductions in efficiency holding service constant or in decreased service holding efficiency constant. The simulations purposely controlled for one aspect of performance so that the impact on the other could be clearly seen. In reality some combination of decreased service and reduced efficiency would result from market fragmentation. The magnitude of the negative effects depends on how the traffic is fragmented. If the split is among more competitors, the maximum achievable performance will be less.

3. Simulation of the performance of individual firms

The simulation is expanded to observe the impact of market fragmentation on the efficiency of individual carriers serving the market. Table 6 breaks out the load performance simulation described above for each individual carrier under the market fragmentation scenarios while Table 7 does so for the service performance simulation described above.

Table 6 Load Performance of Individual Carriers Under Simulated Market Fragmentation Scenarios

		Carrier		
Market	**Split**	All	Incumbent	New
1	Split 1	8.66	9.38	4.57
	Split 2	9.25	9.70	7.63
2	Split 1	9.28	9.77	5.00
	Split 2	8.83	9.60	6.30
3	Split 1	8.00	9.20	4.00
	Split 2	8.00	9.06	6.00
4	Split 1	8.23	9.70	3.33
	Split 2	8.23	8.82	7.11
5	Split 1	5.00	6.13	2.75
	Split 2	4.62	4.80	4.33
6	Split 1	3.50	3.80	2.00
	Split 2	3.00	2.40	4.50

Load performance is consistently better for the incumbent major hauler in all but one of the markets. This result is because the majority of the traffic is

new domestic car traffic and the hauler is assumed to continue transporting these automobiles. The results for Market 6 are an exception because the bulk of the traffic originating out of Vancouver during May for this area is new import traffic which is assumed to be captured by the new entrant. Service performance follows the same pattern as load performance. The service of the major hauler is consistently superior to the potential service of the new entrant in all markets except that where the dominant flow is import traffic.

Table 7 Service Performance of Individual Carriers Under Simulated Market Fragmentation Scenarios

		Carrier		
Market	**Split**	All	Incumbent	New
1	Split 1	0.33	0.19	1.97
	Split 2	0.37	0.27	0.71
2	Split 1	0.27	0.17	1.95
	Split 2	0.54	0.28	1.81
3	Split 1	0.65	0.33	3.17
	Split 2	0.59	0.28	1.48
4	Split 1	0.59	0.36	2.90
	Split 2	0.57	0.40	0.98
5	Split 1	1.22	0.96	2.36
	Split 2	1.22	1.09	1.38
6	Split 1	2.84	2.84	0.00
	Split 2	2.19	2.42	1.89

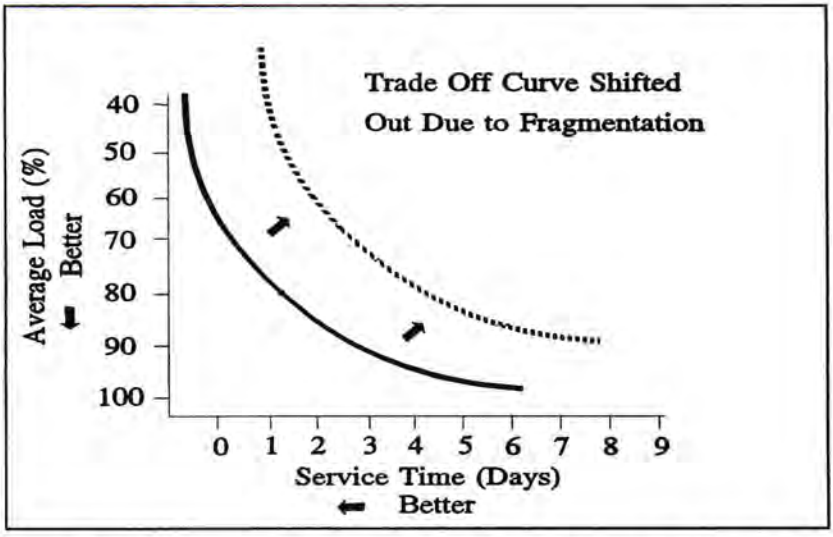
In summary, individual carrier performance is dependent on how the traffic in a particular market is fragmented. The carrier with the larger share of traffic has the greatest opportunity to build vehicle loads and to do so more frequently or quickly. Using Market 3 as an example, the scenario for the new entrant that captures all of the new import car traffic destined to that market results in a load factor of 6 vehicles given a service level of two days aging. This load factor is only 66 percent of the incumbent hauler's simulated load factor of 9.06. Alternatively, with load factors held constant, a new entrant can only achieve a customer service level of 1.48 days versus 0.28 days for the incumbent hauler or approximately 5 times longer aging. Of course, the combined performance of all the carriers under various market fragmentation

scenarios will be inferior to what could have been achieved without any fragmentation of the market.

V. Policy Implications

The market fragmentation scenarios hypothesized in this study will result in significant increases in transport costs, decreases in service to the buyers or some combination of these negative effects. Holding service constant, losses in line haul efficiency range from 5 to over 30 percent for the markets and market fragmentation scenarios examined and summarized in Table 3. There will be markets in which this loss will be greater (i.e., in less dense markets) and smaller (i.e., in more dense markets). An average loss of line haul load efficiency of 20 percent is used to further develop the implications of market fragmentation. As shown in Figure 1, fragmentation of the market essentially shifts the optimal relationship between service and load factor (solid curve) to the right (dotted curve) so that given a service level, two carriers will be less efficient than one (or, given a load factor, two carriers will provide poorer service than one). Line haul costs generally account for approximately 80 percent of total trucking costs. Thus, a loss in line haul efficiency of 20 percent will result in an increase in costs of 16 percent which will be reflected in rate increases of approximately the same magnitude.

Figure 1 Load - Service Trade-off



Should the market be fragmented, there is good reason to believe that the

industry will eventually reconsolidate itself in order to regain the economies of route density that were lost with market fragmentation. The analyses summarized in Tables 6 and 7 show that significant differences in efficiency and service between the potential competitors will result in the short run. Such differences cannot exist in any market in the long run. Thus, the market will be thrown into a transition state in which buyers will be confronted with options which may be priced attractively in the short run but are not viable in the long run. Service disruptions may occur as the industry rationalizes itself through entry and exit.

Ultimately the choice is between a potential loss in short run operating efficiency versus a potential gain in long run technical efficiency. Possible operating efficiency losses are significant under the variety of market fragmentation scenarios in the low density markets examined. In the long run, the natural economies of utilization evident in these markets will encourage and ultimately result in the consolidation of competitors serving these markets. Indeed, the major B.C. hauler is a result of this search for market efficiency as it emerged from the consolidation of two auto haulers into one firm in 1987.

Long run technical efficiency results from competitive pressures, either from existing competitors or potential competitors. The threat that new competitors pose to the business of the existing carrier(s) spurs the existing carriers to provide the service demanded by shippers at a competitive price (i.e., a price that reflects costs and a reasonable profit), to continually seek cost reductions, and to take advantage of new technology. If the incumbent carriers ignore the demands made upon them in a competitive market, they will ultimately be replaced by more efficient carriers who will provide shippers with not only what they demand but also at a lower price. These benefits are real and they are in the public interest although they are hard to measure. The critical issues in a regulated environment are whether such long run gains are worth the short run losses and if it is necessary now to increase the number of competitors in the market to achieve these long run benefits.

The long run versus short run trade-off can be viewed as a breakeven proposition. It was calculated that a loss of 20 percent in line haul efficiency would result in an increase in costs of 16 percent. The price charged by the carrier for a given level of service is basically a function of the cost of inputs (i.e. the cost of labour), productivity (i.e. the load factor), and the profits kept by the carrier (measured by the profit margin or operating ratio). One can use this estimate of short run productivity loss to directly measure what has to be gained or lost in the long run by not admitting the new entrant. It was concluded from the simulations that increased market fragmentation will not improve the productivity of any carrier or the industry as a whole. Since total salaries, wages and fringes are about 40 percent of costs for motor carriers of motor vehicles,

these costs would have to rise by 40 percent (0.16/0.40) to offset the productivity savings kept by not fragmenting the market. Assume the current operating ratio of the major hauler is 97 percent and its margin (before interest costs) is 3 percent. This profit margin would have to rise 533 percent (0.16/0.03) to offset the productivity savings kept by not fragmenting the market.

These trade-off calculations suggest that the short run costs of market fragmentation are high enough to make it unlikely that the benefits of competition that result from such fragmentation would offset these costs in the short term. Of course, the long run benefits probably do exceed the short run costs in the long term, so how can the market work to achieve this? The answer lies in the market power of the buyers who are large relative to the suppliers in the market and the threat of potential competition in form of private carriage, a new carrier or intermodal substitution.

The pattern of regulatory decisions of the British Columbia Motor Carrier Commission since 1988 demonstrate how one regulatory authority has sought to achieve a balance between long run benefits and short run costs (British Columbia Motor Carrier Commission, 1989-1994). During the period 1988 to 1993, the Commission heard numerous applications for operating authority to transport new and used automobiles. The major hauler was continuously threatened by potential competitors ranging from small fleet operators to corporate giants which could quickly capture a significant part of the hauler's business. The Commission consistently looked for indications that the hauler was *not* producing the type of service demanded by shippers, was charging exorbitant rates, earning excess monopoly profits or operating inefficiently, or paying wages far above the worth of their employees. Much weight was placed on the appearance or absence of shippers supporting the new applications. The absence of shipper support indicated that there was little evidence to suggest many long run technical gains from new entry. The Commission concluded that the productivity maintained by avoiding market fragmentation clearly outweighed the benefits of having multiple competitors. The Commission, however, did not completely restrict entry. Typically, the new applicant would be granted operating authority to compete with a small number of vehicles with the knowledge that new vehicle authorities could be applied for in the future. The Commission would, in one case, deny application for unlimited authority but approve a modified application for 10 vehicles. In other cases, where there was concern about capacity utilization, only one vehicle was approved. This incremental approach towards market expansion appears to have increased competition and vehicle capacity within British Columbia commensurate with traffic growth. The British Columbia policy is in sharp contrast to neighbouring Alberta, which does not regulate truck service, and Saskatchewan, which simultaneously strictly regulates rates and entry.

VI. Conclusion

The simulation findings are consistent with the empirical research of Canadian LTL and TL markets reported in Chow and Caravan (1990, 1991, 1993). Market share is generally correlated with lower rates in both market types suggesting that these lower rates result from cost economies achieved from economies of scale or better capacity utilization. In addition, lower prices were found in the more concentrated markets. This relationship reflects the highly competitive nature of trucking. Since it is the carriers with the largest market shares that have the lowest rates, they are likely to be the price leaders. The source of this price leadership could be the economies of utilization which result from having higher market shares.

Regulation that controls market entry is often premised on the impact of fragmentation of the market. Regulators must explicitly make the trade-off between short run costs of fragmentation versus the long run costs of reduced competition, rather than simply protecting the interests of existing carriers. Regulators must continually seek evidence that monopolistic excesses such as service deficiencies, excess profits or supranormal wage rates do not exist. Regulators can use a variety of tools such as the requirement that carriers submit verifiable cost and service records but the most important source of market information is the shipper. Shippers should have a means for providing input into the regulatory process not only in entry applications but also as part of a regular and systematic assessment of the performance of the trucking industry. One such model is the National Transportation Agency's monitoring program mandated by the National Transportation Act of 1987 (NTA, 1989-1993). More rigorous approaches to measuring transport performance from the customer's point of view can be found in customer service literature and service oriented transport studies (Parasuraman, Zeithaml and Berry, 1985; Chow, 1983; Lambert, Lewis and Stock, 1993). Through such a program of regular assessment, regulators can make timely decisions from a point of view unavailable to individual shippers by recognizing the various influences of total freight volume and total number of competitors in the relevant market.

Many political jurisdictions in developed countries have determined that regulators cannot do as good a job as the market in determining shippers preferences. Chow (1983) demonstrated that the unregulated Alberta market resulted in higher prices and higher service quality than what was produced in the highly regulated trucking market in neighbouring Saskatchewan. How can unregulated markets result in meeting shippers preferences for the correct price-service combination, yet avoid unnecessary fragmentation?

In unregulated markets, the transportation selection and purchase decisions

by each shipper regulate the entry and exit of carriers. Although consumer wants are reflected, a system-wide view of the economies of the market is not taken by an individual shipper which only knows how much freight it offers and not the total freight density available in the market. Individual shippers choosing their freight carriers independently could fragment the market and produce the cost or service losses identified above. In contrast, if all decision making for all the freight in a relevant market were consolidated, the market fragmentation impact would be known readily. This centralization of purchasing could be accomplished through voluntary group purchasing. For example, the shippers in a small community or several communities could consolidate their transportation purchasing and make choices to encourage equipment utilization, negotiate lower prices, and reflect the cost/service trade-offs desired.

Such an arrangement effectively controls entry since the threat to the existing carrier is the possibility of losing a significant amount of business or, conversely, the availability of a significant amount of traffic which would support a potential entrant immediately. Group purchasing is of course not new. Co-operatives such as the wheat pools are existing rural examples. If the direction of government is to let markets regulate themselves, there is still a role for public policy. Government programs that educate shippers and facilitate cooperation can lead to consolidated purchasing on a voluntary basis where justified.

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Competition, Cooperation and Commercialization: Free Trade Zones and the Canadian Airports Authorities

Barry E. Prentice* and Melanie M. Rudolph**

1.0 Introduction

The theme "Competition, Cooperation and Commercialization" is very appropriate for a national conference on transportation held near the end of the 20th Century. The affects of increased competition, initiated by free trade agreements and deregulation, continue to propel the private sector of the economy towards global markets and new business strategies. This was expected; what was not as obvious, was the impact that a change in the competitive structure would have on the role of the public sector.

During the period of economic regulation, the Government of Canada was an active participant in the supply of transportation services through Crown Corporations (e.g. CN Rail), direct subsidies (e.g. Atlantic Freight Assistance) and the provision and operation of transportation facilities (e.g. International Airports). The Canadian Government has announced its intention to terminate all transport subsidies and to cease supplying transport services that can be provided by the private sector. This latter policy combines the "privatization" of Crown Corporations, with the "commercialization" of services, such as Air Navigation.[1]

Without economic regulation, subsidies, or the direct provision of services, the government has fewer levers to coordinate economic policy in transportation sector. In the future, government will have to rely more on cooperation with the private sector to achieve such policy goals as efficiency and economic development.

This paper explores the conference theme with respect to the interest of the Canadian Airport Authorities in facilitating their competitive position through

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the development of Free Trade Zones (FTZ). The commercialization of Canadian airports, under the management of local authorities, has given new impetus to the handling of international air freight and the associated problems of customs clearance. Through cooperation with Revenue Canada a great deal can be accomplished under the existing customs rules, but problems still remain. Aspects of Competition, Cooperation and Commercialization merge in the debate surrounding FTZs in Canada.

The first section of this article sets out the history of the FTZ debate. The salient features of the existing Canadian customs programs are briefly outlined. The second section compares the competitive position of Canadian importers/manufacturers vis a vis their U.S. counterparts in FTZs. The penultimate section describes the International Commercial Centre (ICC) created by the Vancouver Airport Authority to encourage the use of its "commercialized" facility. The closing section provides some thoughts on the application of the ICC concept to other local airport authorities.

2.0 The Canadian Free Trade Zone (FTZ) Debate

The Government of Canada has shown great independence with respect to its policy on FTZs. During this century, proposals for the development of FTZ operations in Canada have been submitted to the federal government from virtually every province in Canada. Each proposal has been acknowledged and evaluated, but none has been accepted. This leaves Canada as the only G7 industrialized country that does not have some form of FTZ legislation.

Erickson, Johnston and Hung (1987) provide an authoritative review of the FTZ concept in Canada. They quantify the exceptional nature of Canada's FTZ policy and the history of the debate in Canada. At the time of their study, 480 FTZs operated in 85 countries around the world. There were 120 FTZs throughout Europe, and 141 FTZs and 101 sub-zones operated by our main trading partner, the United States.

The arguments cited for rejecting past proposals for FTZs in Canada are catalogued by Berg (1984).

* Existing customs policies are generous enough, particularly when compared with US FTZs.

* Canadian ports do not have easy access to extensively populated areas.

* The government has argued that additional administrative resources and costs are not justified with respect to the limited extra commercial traffic that is felt would be attracted.

* The government does not want to jeopardize the future of other Canadian ports through the granting of free trade zone rights to one.

* Any proposals that have required the construction of extensive facilities have been rejected outright.

* Alternative programs exist in Canada which offer similar benefits to those of an FTZ.

In 1992, the Department of Finance and National Revenue published a blanket response to proposals for FTZs in Canada. This report concluded that "there is no compelling evidence to suggest that Free Trade Zones should be incorporated in Canada at this time, since most of the key features associated with them already exist under current customs practices or policies, without the disadvantage of diverting local industry".

The next section examines the Canadian Government's position that existing Canada Customs programs provide essentially the same benefits as a FTZ.

3.0 Current Canada Customs Programs

There are currently three Canada Customs programs in place that aim to allow Canadian companies to re-claim or defer tariffs for goods being re-exported. These three programs are as follows.

3.1.1 Inward Processing Program

- purpose is to increase the competitiveness of Canadian industry in foreign markets by reducing input costs

- provides relief from the payment of customs duties on the percentage of imported goods or material used in the manufacture of goods in Canada for subsequent re-export

- a minimum bond of $5000 is held as security for duties payable

- company must have a proven track record of re-exporting goods or an export agreement for specified goods. A detailed application must be made prior to the arrival of the imported goods into Canada

- 100 percent of GST must be paid on goods destined for the domestic market, at the time of import, but if combined with EOPS[2] the GST on re-exports can be exempted

- significant administrative burden

3.1.2 Export Drawback Program

- provides for the retrieval of duties paid on imported goods that are subsequently exported by companies that may not have known of the potential for export sales at the time of importation and payment of duties

- extensive documentation must be prepared

3.1.3 Bonded Warehouse Program

- provides for the duty-free storage of imported goods before their formal entry into Canada. Duty and GST (both of which can be deferred for up to two years) are payable immediately upon entering the domestic market

- while in bond, goods may be sorted, packed, repackaged, labelled, sampled, broken down, and released in smaller quantity lots in the presence of Canada Customs officials. Customs officials must also be present when good enter or exit the bonded facility, resulting operational restrictions for the Canadian manufacturers

- significant documentation is required

3.2 Expected Trade Facilitation Improvements

3.2.1 Customs Tariffs Act

A proposal to change the Customs Tariffs Act is expected to be presented to Parliament in 1995, which would, if enacted, represent a reduction in customs administration requirements as well as include a concession for third parties to perform customs requirements on behalf of clients. The details of these

changes remain sketchy, but the impetus appears to be as much cost control on the part of customs, as it is to reduce the administrative burden for importers.

3.2.2 GST

The present structure of the federal GST and provincial sales tax is currently under review by the Canadian Government and several provincial governments, including Manitoba and Ontario. The effect of any changes on Canada Customs programs or on Canadian manufacturers importing goods is unclear at this time. Nevertheless, it may provide an opportunity to address the issue of tax deferrals for Canadian importers.

3.2.3 Electronic Data Interchange (EDI)

New EDI systems are currently being introduced by Canada Customs that assist Canadian importers. The Pre-Arrival/Release Notification System (PARNS) is an electronic cargo reporting system that allows warehouse operators the opportunity to advise Customs at the destination point that the goods are available for examination and release. The customs broker still has to submit an PARNS release package in advance of the shipment arriving at the warehouse.

The Accelerated Commercial Release Operational Support System (ACROSS) is an electronic RMD (release on minimal documentation) program. This allows the importers and/or agents to transmit RMD items by electronic means. The ACROSS program is scheduled for national implementation in December 1995.

Both programs are intended to reduce the customs administration time required and to allow for the more rapid release of imported goods.

4.0 Competition with U.S. Free (Foreign) Trade Zones

A FTZ in the U.S. has several distinct characteristics:

- the FTZ is in, or adjacent to a U.S. port of entry;
- the FTZ is considered to be outside the Customs Territory of the U.S.;
- no duty or excise tax is ever paid on re-exported merchandise. If intended for domestic sale, duty and taxes are only paid when the product physically leaves the zone; and

- merchandise in a FTZ can be stored, repackaged, manipulated, manufactured, destroyed, or otherwise altered or changed.

The U.S. also provides for "sub-zones", which are single-firm sites normally involving manufacturing. The operation and control of a sub-zone is the responsibility of the manufacturer operating the sub-zone.

4.1 Canadian versus U.S. Customs Programs

The following key findings highlight the differences between a U.S. FTZ and existing Canada Customs programs.

1. Under the Inward Processing Program, a Canadian company is only eligible for a duty deferral on the percentage of goods that is intended for re-export. The remaining percentage of duties must be paid immediately upon import. In contrast, 100 percent of the duty is deferred in a U.S. FTZ.

2. Under existing Canada Customs programs, no manufacturing or processing activities are permissible. In contrast, in a U.S. FTZ, manufacturing and processing activities are allowed without the manufacturer having to pay any duties or taxes.

3. Goods entering Canada must clear customs, or travel in-bond to a bonded warehouse facility. There, entrance and exit documentation must be completed again. In the U.S., goods can travel to a FTZ or sub-zone in-bond and clear customs at that point only. In effect, there is no double-handling in the U.S. and, therefore, less of a threat of delay as well as a more efficient use of customs resources.

4. Canada Customs programs result in a decentralization of the customs facilities and personnel. For example, in Winnipeg, no less than six different sufferance warehouses and bonded warehouse facilities exist to accommodate the goods arriving by the different modes of transportation. Accordingly, each operator incurs capital costs that are ultimately passed on to the end user.

5. The repackaging of goods within a bonded warehouse requires the presence of Canada Customs officials. This creates an operational restriction for companies wishing to perform these activities outside of regular Canada Customs working hours, which are Monday to Friday from 08:00 to 17:00. This restriction is not experienced by U.S. firms

operating under a FTZ or sub-zone, where repackaging can be performed on a 24-hour basis.

6. Of the seven U.S. sub-zones interviewed by telephone, 75 percent reported that manufacturing supply chain logistics involving more than one sub-zone was a significant factor for deciding to establish sub-zone operations. Specifically, the companies reported that each manufacturing plant specialized in one manufacturing process, leading to a reduction in manufacturing costs. By establishing a sub-zone around these plants, a company can utilize zone-to-zone in-bond transfer and continually defer duty. In contrast, Canada does not offer a program that allows for 100 percent duty deferral to facilitate multi-plant transfers. Accordingly, the benefits and flexibility of zone-to-zone transfers in Canada are not realized.

Although Revenue Canada appears to have recognized some of the financial and administrative burdens which Canadian manufacturers are faced with, the proposed changes to customs programs are not sufficient to overcome the cash flow penalties which exist.

5.0 International Commercial Centres (ICC)

Revenue Canada's position that existing regulations provide the equivalent to a FTZ has been put to the test in Vancouver. A partnership involving Danzas (Canada) Ltd., Horizon Pacific Ventures Ltd., International Aviation Terminals Ltd., and the Vancouver International Airport Authority set out to establish an International Commercial Centre (ICC). In 1993 a proposal was put forward to Revenue Canada to establish a multimodal bonded and sufferance B warehouse located at the Vancouver International Airport. Included in the formal proposal was a special request for permission to conduct demonstration, re-labelling, repackaging, and inspection activities within the ICC. These requests were granted and the ICC is not obligated to fill out a C6 Special Service form each time a client wishes to perform these functions.

The ICC operates under both the Bonded Warehouse and the Inward Processing Program. The ICC manages a 14,000 square foot sufferance B class warehouse at the airport.[3] Goods may arrive at the facility at any time, but are normally cleared by Canada Customs officials during their normal hours of operation. The customs documentation is completed by the customs brokers located at the ICC. The documentation is produced via a combination of paper and EDI accounting and inventory control systems.

The permissable economic activities at the Vancouver ICC are presented in Figure 1.

Figure 1 Permitted Activities at the International Commercial Centre, Vancouver International Airport

TYPE OF ECONOMIC ACTIVITY	STATUS UNDER CANADA CUSTOMS PROGRAMS
storage of goods	permissible
testing of goods	permissible
cleaning of goods	permissible
sampling of goods	permissible
relabelling of goods	permissible
repackaging of goods	permissible
displaying goods	permissible
repairing goods	specific area allowed under D8-1-1; not currently performed
manipulating goods	grey area of the act; not currently performed
consolidation of imported goods	permissible
processing of goods	grey area of the act; not currently performed
assembling of goods	permissible
manufacturing of goods	not permissible at this time
salvaging of goods	grey area of the act; not currently performed
destroying goods	permissible
re-exporting goods	permissible
mixing imported and domestic goods	permissible
product demonstration	permissible
normal maintenance/servicing	permissible

Some operations at the ICC are similar to a U.S. FTZ; in fact, the ICC markets itself as such. However, the ICC is not a FTZ. No manufacturing or processing can be done at the ICC, in contrast to a U.S. FTZ. Furthermore, duty and tax deferral treatment in the ICC is significantly different than in a FTZ environment. Even if manufacturing were permitted, the ICC could not offer the in-bond zone-to-zone duty-free transfer that facilitates manufacturing supply chain logistics in the United States. Nevertheless, the ICC has eliminated the need for individual clients to fill out special request forms for granting permission to demonstrate, re-label, repackage and inspect their goods. This reduces some administrative costs, and may serve as a deciding factor for an importer/exporter to locate at the ICC.

The claims of Revenue Canada that their programs offer Canadian importers/manufacturers the equivalent of FTZs would appear to be exaggerated. The most pressing problems remain the administrative burden of the Canadian system and its operational restrictions. Nevertheless, Customs has shown remarkable flexibility and willingness to cooperate in the removal of disadvantages experienced by Canadian companies. The creation of the ICC at Vancouver may signal a shift in the government's previously immovable opposition to anything resembling a FTZ.

6.0 Implications of FTZs for Airport Commercialization

In the mid-1980s, the Government of Canada experimented with the transfer of airport operations to local airport authorities. The first airports to be commercialized were Edmonton, Vancouver, Calgary and Montreal. The airports at Winnipeg and Toronto entered into commercialization transfers, but were stalled by the change in government. Subsequently, the policy of airport commercialization came under review. The outcome is a new Canadian Airports Policy that calls for the commercialization of the remaining 22 large airports that form the National Airports System (Transport Canada, 1994).

The new policy requires all the commercialized airports to become self-sufficient by the year 2000, and to make significant lease payments thereafter. Clearly it is in the interests of the Government of Canada to provide an environment that enables the airports to become self-sufficient without imposing higher user-taxes. The expansion of the ICC concept at the airports could greatly assist in the financing of the airports through local revenue generation and the attraction of cargo activity.

The expansion of the ICC concept under the Canadian Airport Authorities could mitigate many of the objections to FTZs identified by Berg (1984). The

boundaries of the airport are secured, which would help guard against the possibility of smuggling or theft. The airports are located in the largest centres across the nation, which would help ensure regional fairness in the policy. The ICC could utilize existing customs personnel who are already located at the airport. This would minimize the costs of the ICC program. Finally, the ICC would help encourage the production, distribution and export of high valued manufactured goods in all parts of the country, without diminishing the opportunities in any particular part.

As global competition increases, the Government of Canada's stance that its existing customs programs obviate the need for FTZs is being challenged. In fairness, the customs administration has demonstrated a cooperative spirit with respect to the Vancouver ICC that helps move the government's claim towards reality. Specifically the reduction of administrative burden is a major step forward. The missing opportunity to make the newly "commercialized" airports internationally competitive, is the ability to undertake manufacturing activities related to final assembly and distribution.

The policies of the government have created a "co-operative" environment in which the manufacturing and distribution sectors of the economy can participate with the CAAs to explore new export strategies. In turn these interests will be seeking further co-operation with government departments, such as Customs, to develop more efficient partnerships between the private and public sectors.

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ENDNOTES

1. The terms "privatization" and "commercialization" tend to be used interchangeably, but there would seem to be a significant difference. Privatization is the sale of publicly owned assets, like CN Rail, to private interests. Commercialization involves the lease of government assets, with an agreed rental payment. In the first case, ownership is transferred with management, while in the second, only managerial control is transferred.

2. Exporters of Processing Services policy exempts holders of Inward Processing numbers from GST.

3. There are specific limitations on activities permitted in a sufferance B warehouse (e.g. only full truck loads are permitted access; no partial truck loads can be cleared at the Vancouver ICC facilities).

EXTERNAL COSTS OF TRUCK AND TRAIN

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1.0 INTRODUCTION

The guiding principle of the 1987 Canadian transportation policy is to "make the best possible use of all available modes of transportation at the lowest total cost."[1] (emphasis added) In the past, we considered only the direct costs of infrastructure and vehicle operations. With the growing concerns about environmental degradation and escalating medical costs, the concept of transportation costs is changing. For the purpose of stimulating discussion, this paper examines external costs of rail and road freight transportation.

2.0 METHODOLOGY

This paper is based on a longer report prepared for the Brotherhood of Maintenance of Way Employees. We gathered background information for this report through materials and contacts in Canada, the U.S., and continental Europe. The information gathered was then analyzed in the context of Canadian conditions.

Because of the location of some intermodal terminals, some intermodal shipments will involve greater shipping distance than the equivalent all-truck routing. In these cases, the external cost of intermodal freight would be somewhat higher than this study estimates. In other cases, the rail distance is shorter than the truck distance, for example Halifax to Montréal. And the impact of pick up and delivery fuel consumption declines for longer trips.

Research for the U.S. Department of Transportation by the Abacus firm found an advantage of rail fuel consumption over truck fuel consumption similar to that found in this study. The U.S. study included fuel used in local rail switching, terminal operations, and truck pick up and delivery.[2]

The comparison between truck and train (intermodal) is for general policy discussion. To know the precise comparison between truck and rail (intermodal) for a particular shipment, you would need to adapt the data to specific routes and vehicles.

The typical 1990 truck vehicles studied are:

- a representative semi-trailer with 39 tonnes gross weight, 24.5 net tonnes payload, and 5 axles.
- A representative B-train double trailer truck with 62.5 tonnes gross weight, 44.2 net tonnes payload, and 8 axles.

The typical 1990 rail vehicles studied are:

- A representative piggyback trailer with 24.5 net tonnes payload
- A representative double stack container with 26.3 net tonnes payload per container
- A box car loaded to 71.7 net tonnes payload
- A bulk commodity hopper car

The environmental section also develops 1995 costs for higher performance loadings and cleaner engines for both truck and rail. We have attempted to derive costs separately for the different types of vehicles. Accident costs, however, could not be segregated between intermodal and bulk rail traffic. Generally, accident costs and traffic interference costs suffer from limitations on data. We are confident, however, that more precise data would not change the relative position of rail and road.

3.0 THE NEED TO CONSIDER EXTERNAL COSTS

Many of the costs of transportation are internal, that is, paid by the users of the transportation system. For example, the cost of buying and maintaining cars and trucks is paid for by vehicle owners. The portion of road or infrastructure costs paid for by user fees is an internal cost, not an external cost.

Many of the costs of transportation in Canada are external to the user, for example: road costs not paid by user fees, accident costs not covered by insurance, pollution costs, noise costs, and traffic congestion costs.

Table 1 illustrates the distinction between internal and external costs. Internal costs are those costs absorbed by the person who causes the effect. External costs are those passed on to other transportation users or to society in general.

Table 1

External Costs

Accidents -
Pollution -
Congestion -
Infrastructure -
Cash Subsidy -
Fuel Taxes and License Fees +
Property Taxes on Rail Corridors +

(- burden on society) (+ contribution to society)

Internal Costs

Vehicle Costs
Own Accident Risk
Accident Costs Covered by Insurance

The mode of transport with higher external costs - trucking - dominates the freight transport market in terms of revenue. Rail, including intermodal, accounts for only 26% of annual freight revenue, truck accounts for 63%, with the balance carried by other modes.[3] modes with the highest external costs - air and trucking - are expected to grow three times faster than the modes with the lowest external costs - marine and rail.[4]

Failure to account for external costs amounts to the equivalent of a "subsidy" from society to the modes of transport that generate the highest external costs. The following inefficiencies result:

» congested roads and airports, and underused rail lines
» investment in roads rather than rails
» higher overall costs for the country

Some would argue that we cannot quantify external costs in transport planning because we do not know exactly what amount they cost. By excluding them, we have quantified them; we have set them at zero. Thus, estimates of external costs, even if rough, are better than no estimates.

The principle of considering external costs has been suggested by the Royal Commission on National Passenger Transportation in its 1992 report Directions. The report, however, did not calculate the external costs of freight modes as this was beyond its terms of reference. Much more progress has been made overseas, both in terms of calculating external costs and, in some cases, to require transporters to pay for them.

Transportation planning in Sweden is done on a socio-economic multi-modal basis. The Government subsidizes 90% of railway infrastructure costs in order to let the railway compete fairly with publicly funded roads.[5]

4.0 HOW TO CALCULATE EXTERNAL COSTS

External costs can be divided into two components: marginal costs that fluctuate with traffic volume; and fixed costs. The European transport planners relate marginal costs to variable traffic charges such as fuel taxes and kilometre taxes (e.g. weight distance tax on trucks). They relate fixed costs to the annual license fee.

In calculating the external costs (e.g. pollution, accidents), there are at least three main methods of cost calculation:[6]

a) Direct Monetary Costs:
Tangible costs of material damage such as hospital costs and costs to restore corroded facilities

b) Indirect Monetary Costs:
Overall economic consequence, including loss of output due to illness and accidents or crop damage

c) Avoidance Costs:
The cost to reduce negative effects to community targets (e.g. the cost to reduce emissions, noise, and accidents to an acceptable level)

Environmental effects on future generations can be incorporated into avoidance cost calculations. Traffic congestion, accidents and noise are considered transient effects because what they generate today will not affect future generations. On the other hand, environmental degradation can affect future generations. The dead lakes of today were caused by pollution in the past as well as the present. The cost of avoiding problems for future generations would be the cost to reduce emissions to the critical load level to achieve a sustainable ecological balance.[7]

In North America, we already calculate and consider external costs when spending money to expand highways. Most highway projects are justified on the basis of arbitrary estimates of the benefits of the new road in reducing accident costs and reducing traffic congestion costs. Bruce Hutchinson estimates that more than 50% of the project savings for highway projects are due to promises of reduced travel times.[8] Travel time savings are responsible for 60-70% of the user benefits projected by Canada's National Highway System proposal.[9]

5.0 ACCIDENTS

Table 2 below compares the accident rate of trucks and trains.

Table 2

Safety of Freight Modes in Canada

Deaths per billion tonne kilometres	
Rail Freight (includes 100 % of grade crossing fatalities)	.48
Rail Freight (excludes grade crossing fatalities)	.224
Rail Freight (grade crossing fatalities shared by truck & rail)	.356
Truck Freight	3.76

Source: Accident statistics and rail output taken from from National Transportation Act Review Commission, volume II. The trucking output contained in the NTA Review Commission report understates truck tonne kilometres by about 40%, which would result in overstating truck accident costs. Truck output is understated because the Statistics Canada survey does not capture private truck fleets with less than 15 trucks at one reporting location. To avoid overstating truck accident costs, we use 125.5 billion truck tonne kms estimated by the Canadian Institute of Guided Ground Transport.[10]

Accident costs are calculated using Transport Canada's rates of $1.5 million per fatality and $10,000 per injury. Table 3 compares our accident cost calculations with the results of European calculations. This illustrates that accident costs are highly sensitive to methods of data gathering and to the different values that different nations have for pain and suffering and lost work. For example, countries with low GDP would have lower accident costs.

Our estimate of the external cost of rail accidents per tonne kilometre is slightly overstated because we have attributed all grade crossing accidents as train accidents rather than shared road-rail responsibility, and because passenger train accidents are included.

Table 3
International Comparison
of Accident costs
Canadian cents/tonne kilometre
Truck vs Rail

	Truck (cents per tonne km)	Rail (cents per tonne km)	Ratio
Our Result	.59	.06	9.8
Ellwanger (Germany)[11]	1.30	.09	14.4
Meier (Switzerland)[12]	2.00	.77	2.6
Kågeson (Germany)[13]	.56	.23	2.4
Ecoplan (Switzerland)[14]	4.52	.17	26.6

Research from Europe estimates the cost of traffic accidents to be in the range of 2-3% of GDP or about 1.25% after deducting insurance premiums.[15] Applying this 2-3% ratio to Canadian GDP would indicate an annual national cost of about $16.7 billion.[16] This compares favourably with the Royal Commission on National Passenger Transportation calculations of Canada's road accident costs at $14 billion annually (including Transport Canada's human value cost of $5 billion).

6.0 POLLUTION COSTS

In calculating pollution charges, we have used $2,960 per tonne of hydrocarbon, $2,960 per tonne of nitrogen, and $44 per tonne of carbon dioxide. These are estimates recommended by Hansson and Markham from a survey of pollution costs developed in European countries. The charge for carbon dioxide is based on the European Economic Community proposal for environment taxes on oil. The charges are similar to those used by Sweden's policy, and by Canada's recent Royal Commission on National Passenger Transportation.[17]

Table 4
Environmental Costs
Rail vs Truck
1990 Vehicles

Vehicle	net Payload tonnes	NOx cents/ tonne km	VOC cents/ tonne km	CO2 cents/ tonne km	Total Cost cents/ tonne km	Load Factor
Semi-Truck	24.5	0.28	0.061	0.38	0.72	.65
B-Train Truck	44.2	0.23	0.050	0.31	0.58	.65
Piggyback	24.5	0.20	0.010	0.15	0.36	.60
Container	26.3	0.16	0.008	0.12	0.29	.60
Box Car	71.7	0.14	0.007	0.11	0.25	.36
Hopper Car	70	0.08	0.004	0.06	0.15	.60
Rail Average		0.13	0.007	0.10	0.23	

1995 Vehicles

Vehicle	net Payload tonnes	NOx cents/ tonne km	VOC cents/ tonne km	CO2 cents/ tonne km	Total Cost	Load Factor
Semi-Truck	31.5	0.16	0.043	0.27	0.48	.65
B-Train Truck	44.2	0.15	0.041	0.25	0.44	.65
Piggyback	31.5	0.12	0.005	0.09	0.22	.60
Container	27.8	0.11	0.004	0.08	0.19	.60
Box Car	88.5	0.11	0.004	0.08	0.19	.36
Hopper Car	70	0.08	0.004	0.06	0.14	.60

Table 4 shows that the environmental cost of truck transportation is 2-3 times that of rail transportation. For example, a semi-trailer truck has an environmental cost of .72 cents/net tonne kilometre. The same truck trailer on a piggyback train has an environmental cost of .36 cents per net tonne kilometre

The ratio of truck versus rail pollution costs will not change much in the future. Bigger payloads will be available for both modes. This table is based on nitrogen emissions of 55 grams\litre of rail diesel compared to 29 grams\litre of truck diesel (emission information adopted by Blevins & Gibson). Over time, we expect nitrogen emissions from rail locomotives will decline as well. Comparison with European information is impractical because European trains are powered by electricity which has lower pollution costs than diesel.

7.0 TRAFFIC INTERFERENCE COSTS

Table 5
Interference Costs
Trucking
(Canadian Currency)

Mingo cents/truck kilometre @19.50/hr 3.11 PCE	Adjusted to $15.68/hr 3.11 PCE	Tractor Trailer adjusted to 2.5 PCE	B-Train adjusted to 3.5 PCE	Tractor Trailer cents/ tonne km	B-Train Truck cents/ tonne km
24.7	19.86	16.0	22.4	.65	.52

To obtain a more accurate estimate of Canadian interference costs, one would have to apply the traffic flow equations to Canadian traffic data. Currently, the average daily traffic volumes for the sections of the National Highway System are unavailable on a national public database.

8.0 NOISE COSTS

We did not attempt to estimate the relative costs of noise for truck and rail (intermodal).

9.0 INFRASTRUCTURE COSTS

Table 6 illustrates roads costs due to big trucks. The cost of trucks on busy freeways would be less, and the cost of trucks on low volume highways would be more.

Table 6
Road Infrastructure Costs Due to Big Trucks

Truck	Gross Weight (Tonnes)	Net Payload (Tonnes)	Road Cost cents/truck kilometre	Road Cost cents/tonne kilometre
Tractor Trailer	39	24.5	15-19	.694
Double Trailer	62	44.2	20-26	.520

The average cost of trucking for road infrastructure is between .52 and .69 cents per tonne kilometre (fuel tax and license revenue will be subtracted in another section of this report). There is no external cost for rail infrastructure which is on a user pay basis (the external cost of grain transport subsidies are identified separately).

In order to calculate road costs for trucks, we adopted calculations by the Royal Commission on National Passenger Transportation. These are the most up-to-date and sophisticated estimates available for Canada. The results of the Royal Commission compare favourably with the results of the U.S. Highway Cost Allocation Study of 1982.

10. CASH SUBSIDIES

We treat cash subsidies paid to trucking and rail companies as an external cost, in other words a financial burden on society at large. These are external costs because users are not paying for them. They are, however, no longer an issue between truck and rail because the recent Federal budget eliminates most freight subsidies.

11.0 FUEL TAX AND LICENSE REVENUES

From our calculation of external costs of transport modes, we subtract the financial contributions of the transportation modes to society through fuel taxes and licence fees.

The railway companies also pay property taxes to society on rail corridors, whereas trucking companies do not pay property taxes on highway corridors. The Railway Association of Canada was unable to segregate property taxes on rail corridors from taxes on other railway property. Thus, we excluded property taxes paid by rail.

In summary, trucking companies pay fuel taxes equivalent to .22 to .29 cents per net tonne kilometre and license fees equivalent to .07 cents per net tonne kilometre. Because of lower fuel consumption per tonne kilometre, rail companies pay, on average, fuel taxes equivalent to .06 cents per net tonne kilometre.

We will subtract fuel tax and licence revenues from our estimates of external costs.

12.0 EXTERNAL BENEFITS

Some people argue that the external benefits of transportation should be subtracted from the external costs. This, they suggest, implies that transportation should be subsidized. In particular, this argument is used to justify subsidies for highway maintenance and construction.

Following are some of the external benefits of roads commonly cited by automobile clubs and road construction firms:

- flexibility of the car
- generates employment and economic development
- logistics benefits such as just-in-time deliveries

Important as these benefits are, they are hardly external benefits. These effects are already internalized in economic decisions by individuals and firms. For example, families pay $7000/year on car ownership and operation in order to enjoy the flexibility of having a car. Similarly, shippers pay higher freight rates to trucking companies than railroad companies because of the logistics benefits of truck transport.

Some argue that subsidies to roads are justified because of the employment and economic benefits. Does this mean we should subsidize computers because they create jobs and improve productivity? Rothengatter argues that the same groundless claims to subsidy could be made by manufacturers of everything from electricity to telephones and dishwashers.[18]

The benefits of the road system flow through to the users through mobility and logistics benefits, but the disbenefits (accidents, pollution, congestion) do not. Pricing for external effects would send a market signal.

13.0 SUMMARY OF RESULTS

Table 7 below illustrates the result of our calculation that the overall average external cost of inter-city trucking in Canada is 2.15 cents per net tonne kilometre. The overall average external cost of rail freight is .51 cents per net tonne kilometre. Note that the recent federal budget eliminates most cash subsidies for freight transport.

Table 7
Summary of External Costs
Train vs Truck
Canadian cents per tonne Kilometre

	Inter City Truck Average	Truck Semi Trailer	Truck B-Train	Rail System Average	Rail Piggyback	Rail Container	Rail Box Car	Rail Hopper Car
Accidents	.40	.40	.40	.06	.06	.06	.06	.06
Pollution	.71	.72	.58	.23	.36	.29	.25	.15
Interference	.64	.65	.52					
Infrastructure	.67	.69	.52					
Cash Subsidy	.09			.28	0	0	0	0
sub total costs	2.51	2.46	2.02	.57	.42	.35	.31	.21
Fuel Taxes	- .29	- .29	- .22	-.06	- .09	- .07	- .04	- .04
License Fees	- .07	- .07	- .07					
sub total revenue	- .36	- .36	- .29	-.06	- .09	- .07	- .04	- .04
Net External Cost	2.15	2.10	1.73	.51	.33	.28	.27	.17

14.0 IMPACTS OF MODAL SHIFT

Table 2 illustrates some examples of external costs that would be saved or increased through modal shift. For example, a 20% shift from road to rail would reduce annual highway costs $93 million, and reduce accident, pollution, and interference costs $366 million for a total saving of $459 million. Conversely, a 20% shift from rail to road would increase annual highway costs $185 million, and increase accident, pollution, and interference costs $730 million for a total increased cost of $915 million. We have excluded MFRA, ARAA, and WGTA subsidies because they apply only to specific commodities in specific regions. Also, they have been eliminated in the recent Federal budget.

Table 8
Financial Impacts of Modal Shift

Shift Truck to Rail	Tonne kms Shifted	Govn't Road Costs Reduced (minus fuel tax)	Accident Savings	Pollution Savings	Interference Savings	Total Savings
	millions annual	$millions annual (.67-.36+.06)	$millions annual (.40-.06)	$millions annual (.71-.23)	$millions annual (0,64)	$millions annual (1,83)
10%	12550	46	43	60	80	230
20%	25100	93	85	120	161	459
30%	37650	139	128	181	241	689
40%	50200	186	171	241	321	919
50%	62750	232	213	301	402	1148
60%	75300	279	256	361	482	1378
70%	87850	325	299	422	562	1608
80%	100400	371	341	482	643	1837
90%	112950	418	384	542	723	2067
100%	125500	464	427	602	803	2297

Shift Rail to Truck	Tonne kms Shifted	Govn't Road Costs Increased	Accident Costs	Pollution Costs	Interference Costs	Total Costs
	millions annual	$million annual (0,37)	$million annual (,40-,06)	$million annual (.48)	$million annual (0,64)	$million annual (1,83)
10%	25000	93	85	120	160	458
20%	50000	185	170	240	320	915
30%	75000	278	255	360	480	1373
40%	100000	370	340	480	640	1830
50%	125000	463	425	600	800	2288
60%	150000	555	510	720	960	2745
70%	175000	648	595	840	1120	3203
80%	200000	740	680	960	1280	3660
90%	225000	833	765	1080	1440	4118
100%	250000	925	850	1200	1600	4575

15. POSSIBLE SOLUTION

Because external costs are not accounted for in transport decisions, the freight market is artificially distorted toward trucking. There are three possible solutions to increase transport efficiency and reduce overall costs:

1. Truck user fees could be charged for the difference between the external costs of trucking and rail. This would be, on average, 1.64 cents per net tonne kilometre (2.15-.51). There would be concerns that if Canada acted alone it would harm the competitiveness of the Canadian economy. Perhaps there could be coordinated action by all three North American governments.

2. Another approach would be to provide public financial support to rail infrastructure. For example, this could be an investment tax credit financed by savings on pollution, accident, and road costs.

3. Public authorities could hire the railroads on contract to haul truck trailers. The cost to government would be financed by reduced accident, pollution, and road costs.

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[14]ECOPLAN, Soziale Kosten von Verkehrsunfällen in der Schweiz, April 1991
[15]Hansson and Markham, 103
[16]Canada's annual GDP in 1990 was $668 billion according to Corpus Almanac Canadian Source Book (Don Mills: Southam, 1993)
[17]though the Royal Commission only charged for hydrocarbon and nitrogen in sensitive areas during summer only
[18]Kågeson, 37

BARRIERS AND OPPORTUNITIES FOR INTER-AGENCY COORDINATION IN THE TRANSPORTATION POLICY FIELD IN CAMEROON

INTRODUCTION

The growing problem of resource scarcity, exacerbated by that of increasing negative trends in the economies of less developed countries (LDCs), suggest that any attempt to make significant additions to extant transport facilities is inherently unrealistic. Thus, transportation planners and policy makers in LDCs must seek innovative strategies that are capable of attaining the goal of guaranteeing access to essential facilities and activity centres such as work, health, and education, at minimal cost both to the individual and the state.

We propose inter-agency coordination (IAC) as a viable strategy for reaching this goal. Although activities addressed to promoting IAC in LDCs date back to the 1960s and early 1970s (Esman and Bruhns, 1966; Eaton, 1972),[1] IAC remains a rarity especially in the transportation policy field in these countries. Ironically, hardly any efforts have been addressed to determining why this is the case. Yet the need to make this determination cannot be overstated. This need is magnified with respect to the public transportation field, which inevitably circumscribes many, sometimes disparate, agencies. The activities of these agencies must be coordinated if the important goal of developing an economically integrated transport system in which the different elements complement each other is ever to be attained.

The present study seeks to analyze the public transportation system of one developing country namely, Cameroon, with a view to surfacing barriers and opportunities for IAC in particular, and coordination in general, therein. A significant number of these barriers and opportunities are likely to be located within the country's administrative machinery. Thus, we begin by briefly examining this machinery in both historical and contemporary perspectives. Next, we discuss the concept of inter-agency coordination (IAC) in general and in the context of transportation in particular. Then, we underscore the need for IAC in the transportation field of a resource-scarce economy such as Cameroon. Following this, we undertake an analysis of the country's transportation system. Finally, prior to concluding the discussion, we uncover opportunities for coordination in the system. Although our focus is on Cameroon, we hope that transportation planners and policy makers in other developing countries will benefit from this study. This is because, IAC problems like most institutional problems, can hardly ever be unique to any single developing country.

BACKGROUND

A logical starting point for undertaking a meaningful discussion of institutional weaknesses in any sector of a developing country's economy is

the country's administrative history. This is because most institutional problems in LDCs can be traced to their historical experiences particularly, colonialism. It is therefore in order that we briefly review Cameroon's political and administrative history.

Political and Administrative History of Cameroon in Brief

The origin of Cameroon as a geo-political entity can be traced to 1472, when the Portuguese explorer, Fernando Po first arrived at River Wouri in Douala, where he found so many shrimps and decided to name the river, *Rio dos Cameroes* (Portuguese for River of Shrimps). In fact, the appellation, Cameroon is derived from this Portuguese phrase. The Germans colonized Cameroon, or what they called *Kamerun*, from 1884 to 1919, when upon losing World War I, they were forced by the United Nations (then, the League of Nations) to relinquish their claims to the territory. On July 10, 1919, the United Nations (UN) mandated four fifths of the territory to the French and one fifth to the British. While the French directly administered the portion of the territory under their trusteeship (French Cameroun), the British administered theirs (British Northern and Southern Cameroons) through Nigeria, then, a next-door colony of theirs. French Cameroun became independent on January 1, 1960 and assumed the name, 'Republic of Cameroon'. In a UN supervised plebiscite of October 1, 1961, Southern Cameroons elected to become independent and re-unify with the Republic of Cameroon.[2]

Thus, Cameroon has been a colony of Germany, France and Britain. Each of these European powers introduced a different system of administration in the country. The Germans for instance, divided the territory into twenty-six administrative districts (Mbuagbaw et al., 1987)[3]. Each district was placed under the administrative jurisdiction of a district commissioner, who was answerable to the governor of the entire territory. The governor was in turn answerable to the chancellor in Berlin.

The British transplanted to Africa a model they first experimented with in India through the British East India Company (Wallis, 1989). The model which came to be known as the 'indirect rule' strategy sought to administer the colonies through existing 'native' authorities and/or institutions. This in effect, was the administrative model the British introduced to Cameroon through Nigeria.

The French were bent on transplanting their own administrative model to the colonies regardless of existing conditions. Thus, every effort was made to tailor the administrative system of French Cameroun to be as much as possible, a replica of the French system. The result was a highly centralized administrative system in Cameroon not significantly different from France's. In fact, Mazrui (1983: 33) has noted that

> by liberal democratic standards, the [French] government continues to exercise a good deal of control over important areas of national life, ranging from education to the control of television.

Based on the above account, Cameroon has been independent for at least three decades. Given this, one would think that the administrative system left in place by the colonial masters has undergone significant

changes. This is not the case. Although it must be noted that the system's development has favored the French model much more than anything else.[4] Thus, as Figure 1 shows, a conspicuous feature of the country's administrative system is centralization.

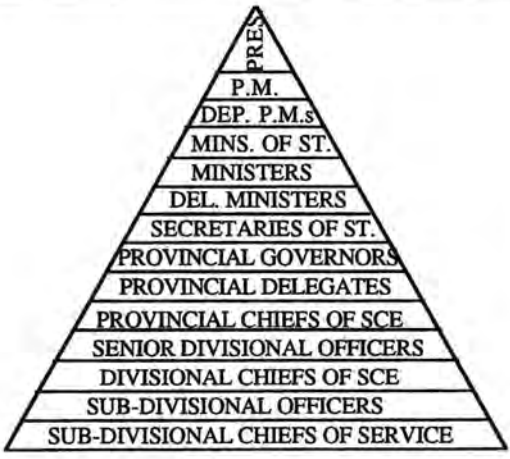


FIGURE 1:
ADMINISTRATIVE MACHINERY OF CAMEROON

THE NEED FOR INTER-AGENCY COORDINATION IN TRANSPORTATION

We deem an understanding of the concept of inter-agency coordination (IAC) a necessary precursor to appreciating its need in any policy field. Thus, we begin this segment by briefly reviewing the concept of IAC.

The Concept of Inter-Agency Coordination

Inter-agency or inter-organizational coordination has been defined differently by different commentators on the subject. According to one, inter-agency coordination can be seen as the process whereby at least two agencies employ existing decision rules to deal collectively with their task environment (Mulford and Rogers, 1982). Another, Davidson (1976: 118) contends that it is '. . . the process by which two or more organizations make decisions together. A more useful definition of the term, inter-agency coordination, for the purpose of the present discussion is offered by Alexander (1993: 31), who states that interorganizational coordination (IOC) is

> . . . a deliberate activity undertaken by an organization or an interorganizational system to concert the decisions and actions of their subunits or constituent organizations.

Inter-agency coordination thus entails the ability to work together in harmony; ensuring that all relevant factors and actors as well as their activities are taken into account. The importance of such harmony in any attempt to improve effectiveness in the transportation field in particular, and any development policy field in general, can hardly be overstated. While Richard Hall's and associates' (1978) unqualified pronouncement that inter-agency 'coordination is almost like magic' may be somewhat hyperbolic, the merits of coordination are easy to appreciate. For service delivery agencies such as those in the transportation field, the merits of inter-agency coordination (IAC) can best be appreciated through the lenses of passengers or other clients of the transportation systems, who are likely to receive better transportation services. In fact the effectiveness theory of IAC holds that when agencies in any given policy field coordinate their efforts, they are likely to be more effective than when they do not. This is, as Njoh (1993: 135) contends, because through coordination hence, interaction, the agencies are able to: a) expand their resource bases; b) avoid conflict, waste and duplication of functions; c) reduce organizational uncertainty; and d) contribute more positively to efforts to deal with "indivisible problems". Recent organizational studies in the United States (see e.g. Molnar and Rogers, 1982; McKinney, 1986) and in developing countries (see e.g. Njoh, 1993; 1990) have demonstrated the tenability of this relationship in practice. Although such studies are yet to be conducted in the transportation field, we contend that the relationship between IAC and effectiveness is likely to also be positive in this field. In fact, the importance of IAC in transportation, especially in a resource-scarce economy such as Cameroon's, can hardly be exaggerated.

The Importance of Inter-agency Coordination in Transportation in Cameroon

An understanding of the institutional composition of Cameroon's transportation policy field will go a good way in enhancing appreciation of the need for IAC in this field. The country's roads, ports, airports, railways, urban transit, and urban streets are respectively under the control and/or administrative jurisdiction of the Ministry of Transport, the National Ports Authority, Civil Aviation Authority, Cameroon Airlines, the National Railway Authority, the National Urban Transportation Authority and the Ministry of Town Planning and Urban Development in Collaboration with the local government councils. In addition, the country's intercity, and in most cases, its intracity transportation vehicles are owned and operated by private individuals. Apart from these actors who are mostly involved in the process of constructing, maintaining and rehabilitating the transportation infrastructure as well as supplying the transportation vehicles, there are other actors such as the police whose role in the field is mainly regulatory, and agencies of the Ministry of Finance, which are responsible for the collection of most fees and taxes related to transportation. Table I contains a summary of the actors and their major roles in the country's transportation

policy field. Although not shown, each ministerial body contains several departments or agencies, each with a slightly different function in the field.

TABLE I:
ACTORS IN THE TRANSPORT FIELD IN CAMEROON

	STATUS			MODE				ROLE IN TRANSP.				
AGENCY/ORG.	PUBLIC	PARA-PUBLIC	PRIVATE	HIWAY & STR	MARITIME	AIR	RAIL	REGULATE	DELIVERY	FINANCING	INFRASTR	EQUIPMENT
Min. of Transp.	X			X	X	X	X			X	X	
Min. of T. Plg/Hsg.	X			X						X	X	
Min. of Finance	X			X	X	X	X	X		X		
Del. Min Public Wks	X			X						X	X	
Local Gov't Council	X			X				X		X	X	
Police	X			X				X				
Gendarmerie	X			X				X				
Nat. Railway Corp.		X					X		X	X	X	X
Nat. Ports Authority		X			X				X	X	X	X
Nat. Civil Aviation		X				X				X	X	
Cameroon Airlines		X				X			X			X
Private Individuals			X						X	X		X

That there are so many agencies and/or institutional actors in a single policy field amplifies the need for IAC. For one thing, coordination can ensure the more effective utilization of the meager resources available to the transportation sector by harmonizing the functioning of the various modes of transportation including, taxicabs, bus, rail, air, water and even intermediate modes of transportation such as walking and cycling. For another thing, coordination can make more accessible to rural and/or hinterland residents, important services such as banking, health, and education, which for reasons related to economies of scale, are concentrated in the country's urban centers. In this case, coordination can take the form of ensuring that local buses work in synchrony with rail services thereby guaranteeing adequate links between urban and intercity passenger services (cf. World Bank, 1975). Coordination can significantly improve the overall effectiveness of the country's transportation system. For any improvements in urban transportation services in the country to succeed, they would have to be carried out in concert with other measures such as traffic engineering and management. Currently, transportation vehicles must share the country's urban streets with pedestrians, hawkers, and sometimes, cattle. The same

streets, which are generally narrow in the first place, are used for parking and loading and off-loading, amongst other activities. Additionally, coordination can guarantee a more efficient and effective spatial development pattern in the country. The relationship between transportation and land use is well-established. In fact, the type of transportation system configuration impacts land development patterns (Ross in Catanese and Snyder, 1989: 310). Thus, synchronizing transportation planning with other urban and regional planning efforts, which will entail coordinating the efforts of government ministerial bodies such as the State Ministry of Town Planning and Housing, the Ministry of Transport, the Ministry of Industrial and Commercial Development, the Ministerial Delegation in charge of Public Works, the State Ministry of Territorial Administration, and the Ministry of Environment and Forests, amongst others, will ensure a more rational location of activities such as employment and basic services. This will in turn provide great opportunities for less transport-intensive hence, less costly and more efficient urban and national physical development patterns.

Some transportation experts have recommended the promotion of highly dense (more compact) small urban areas as a means of ensuring transportation effectiveness and efficiency in developing countries (World Bank, 1975). The rationale for this is that smaller urban areas will require fewer streets and provide greater access since only fewer motorized trips will be necessary. Furthermore, the track or pavement design standards will also be low since the density of the areas will permit only lower speeds. The chances of such a strategy succeeding hinge tightly on the extent to which the efforts of transportation planners and policy makers are coordinated with those of their counterparts in the urban development arena.

Essentially therefore, the importance of IAC in particular and coordination in general in the transportation field of Cameroon is unequivocal. Although this is the case, several factors tend to deter the success of any efforts aimed at promoting coordination amongst the agencies in the country's transportation field and/or different modes within the system. We attempt to uncover the most fundamental of these factors in the next segment.

BARRIERS TO IAC IN THE CAMEROONIAN TRANSPORTATION FIELD

The barriers to inter-agency coordination (IAC) in the Cameroonian transportation policy field relate to the country's colonial history, the nature of her transportation policy administrative machinery, and her urban and national physical development patterns.

Factors Related to the Country's Colonial History

Cameroon, as stated earlier, lays claim to a unique political history. Each of the three European powers that colonized the country employed a different political/administrative model. The Germans introduced a highly centralized bureaucracy. The British adopted an 'indirect rule' strategy. As for the French, they favored the German strategy and in addition, sought to assimilate and integrate the natives. The two principal colonial administrative

models introduced in Cameroon can therefore be summarized as follows: the 'indirect rule' strategy (of the British) and the strategy of 'assimilation and integration' (of the French) coupled with a 'centralized bureaucratic' model (of the Germans and French). In addition, the colonialists developed a transportation network that was meant to do little more than foster their colonial development objectives. We contend that the colonial administrative models and transportation network, which formed the foundation for the country's existing transportation infrastructure, contribute, or have the potential to contribute, in varying fashions to inhibiting coordination in the transportation sector.

The Indirect Rule Strategy. The British employed this in Cameroon, as elsewhere, as an administrative cost-saving strategy. Because the strategy sought to 'rule' through existing 'native' political institutions and/or authorities, it effectively accentuated ethnic consciousness. This accentuation has produced a heightened consciousness and division amongst the country's many ethnic groups.[5] Thus, since agencies within the transportation field (or any other field for that matter), are likely to be headed by individuals hailing from different ethnic groups, ethnic consciousness and inter-ethnic divisions become a basis for lack of inter-agency cooperation in the field. In his analysis of the impact of British colonial policy in Africa as a whole, Mazrui (1983: 29) states that

> British approaches to colonial rule, by being culturally relative and ethnically specific, helped to perpetuate and in some cases create the kind of ethnic consciousness which could seriously mitigate against nation building.

Thus, we contend that in an ethnically heterogeneous society such as Cameroon, which has been subjected to 'indirect rule', two agencies within the transportation policy field may fail to coordinate their activities not because they are unaware of the merits of coordination, but because they are headed by individuals from two different (rival) ethnic groups. This is likely to be the case even when they realize their goals in this field are identical. The case of two liberation organizations in Zimbabwe, which were respectively under the leadership of Joshua Nkomo and Robert Mugabe, and had as a common goal, freeing the country from the White regime of Ian Smith, but refused to coordinate their activities because of the 'legacy of cleavage' between Nkomo's Ndebele ethnic group and Mugabe's Shona ethnic group (Mazrui, 1983), is illustrative.

The Strategy of Assimilation and Integration. The French, who controlled most of the Cameroonian territory from 1919 to 1960, adopted this strategy. The strategy entailed overlaying the indigenous administrative and political institutions with French ones. Furthermore, the French intensified the efforts initiated by the Germans to centralize the country's bureaucracy. While this strategy might have had the effect of encouraging some degree of national integration, it has not been successful in enhancing the chances for inter-agency coordination particularly in the transportation field. To be sure, centralization is antithetical to meaningful IAC. This is because, with power concentrated in the center such as is the case in centralized systems, local and/provincial officials are powerless. Yet, indulging in IAC activities requires some degree of power. Inter-agency

coordination is an activity that requires officials to reach beyond the boundaries of their respective agencies. In Cameroon, this powerlessness on the part of local level officials mitigates against interaction amongst officials from different agencies. Rather, the officials owe their loyalty to their respective superiors within the same organizations or ministerial bodies in the national capital. While in the colonial days a substantial body of administrative directions and instructions with respect to how local agencies may behave emanated from Paris, today, such directives and instructions originate in Yaounde, the country's capital.

The Colonial Transportation Infrastructure. The first known 'modern' transportation lines in Cameroon were built by the Germans. The lines included a railway, the *Nordbahn,* which ran 160 kilometers from Douala to Nkongsamba (1911), a total of 484 kilometers of surface roads mostly in the agriculturally fertile coastal area of the country (McKee et al, 1988), and a seaport at Bonaberi, Douala. The French continued from where the Germans left off. For instance, they extended the railway line begun by the Germans from Douala into Mbalmayo, and later into Yaounde in 1927. In addition, the French built a number of surface roads and improved the Bonaberi seaport. The English, did hardly anything in the area of transportation infrastructure development. In fact, they did very little more than tarred the narrow meandering road from Limbe (formerly, Victoria) to Tiko, Buea, and Kumba. They were also responsible for building the seasonal road from Kumba through Mamfe to Bamenda in the hinterland. Apart from narrow gauge rail lines in the plantations owned and operated by the Cameroons Development Corporation (CDC), the English accomplished nothing in the area of railway building. In the area of Maritime transportation, they established one seaport at Bota in Limbe and another in Tiko.

This colonial infrastructure constitutes the foundation of the country's transportation system. In fact, the indigenous authorities have made very little, if any, deviations from the transportation infrastructure master plan conceived by the colonialists. For instance, the indigenous government continued and completed the rail line between Douala and Ngaoundere, which was originally conceived by the Germans (see Fig. 2). Furthermore, few additions have been made to the transportation infrastructure left behind by the colonialists. In this connection, the portion of the country that was under British control during the colonial era, remains without any railways except the few narrow-gauge plantation lines mentioned earlier. Figure 2 depicts the country's transportation infrastructure.

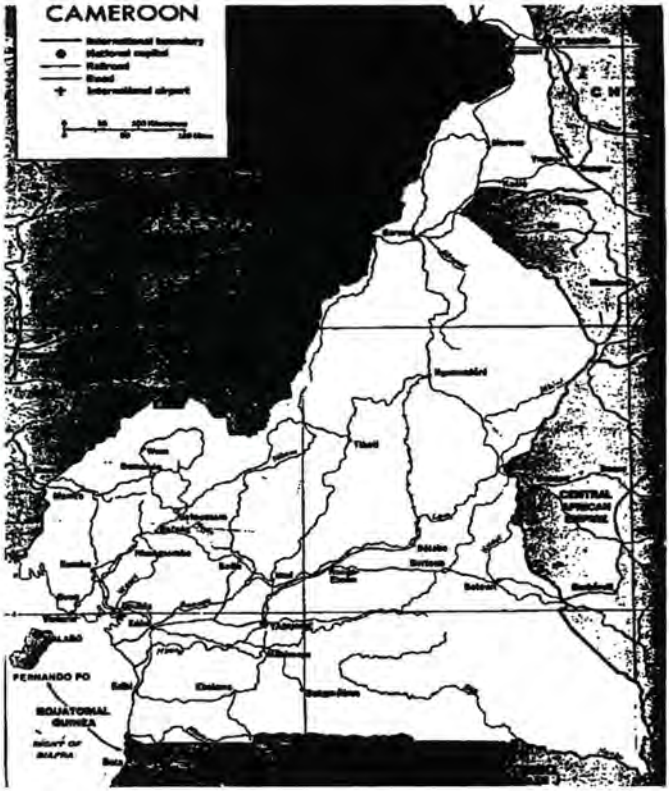


FIGURE 2: CAMEROON'S TRANSPORTATION NETWORK

The foregoing facts have negative implications for coordination in the country's transportation sector. To be sure, the colonial powers never intended to develop a coordinated transportation system in Cameroon. Rather, whatever infrastructure they developed was intended to exploit the country through trade and a productive plantation economy. Thus, as one commentator has observed, the German road building projects were primarily intended to integrate only the economically important coastal areas of the country (McKee et al., 1988). The same can be said of the country's erstwhile colonial masters. Although, the French in addition, had military purposes in mind when they embarked on transportation infrastructure development projects in the country. As Thompson and Adloff (1975: 148) note: 'Military and French colonial policy dictated the linking of the more populous hinterlands to the exporting coastal regions'. Thus, the country's intercity roads were constructed without any attempt to balance capacity in the urban road distribution system. The resultant has, amongst other things,

been a transportation system that is unintegrated and in which the different elements fail to complement each other.

The Nature of the Country's Transportation Policy Administrative Machinery

Cameroon's transportation policy administrative machinery has four fundamental features having implications for inter-agency coordination in the transportation field. These features include: 1) the presence of an excessive number of agencies in any given policy field; 2) overconcentration of power; 3) the inequitable distribution of power amongst the agencies; and 4) lack of continuity.

Excessive number of agencies. As part of the bureaucracy, the number of agencies in the country's transportation sector has grown and proliferated since independence. Certainly the task of transportation policy administration has also grown in complexity since then too. However, this can hardly justify the excessive number of agencies present in the country's transportation field (see Table I). In fact, growth in the number of agencies in the transportation sector as in any other part of the country's bureaucracy, has been mainly for political reasons. The country's political leadership has often used the creation of, albeit, artificial jobs hence, additional agencies in the public sector as a means of dealing with the problem of unemployment prevalent in the country and as a means of political patronage (Njoh, 1992; DeLancey, 1989). To be sure, Cameroon is not alone in this regard. The patronage system, in which jobs in the public sector are offered as rewards for political support, accounts for the unnecessary growth of the bureaucracy in Brazil (especially under President Goulart), Mexico, the Dominican Republic and Chile, to name but a few.

That too many agencies operate in Cameroon's transportation policy field, amounts to a deterrent to inter-agency coordination. This is because with too many agencies, the cost and complexity of IAC become prohibitively high as each agency in the network must not only communicate and interact with the rest of the many other agencies in the network, but also must manage a heavier coordination load. Concomitant with the growth and proliferation of agencies in the country's transportation field has been a tendency towards the fragmentation of transportation services with no specific agency responsible for determining the most rational interconnections and complementary services.

Overconcentration of Power. All the agencies operating in the country's transportation field, as the national bureaucracy itself (see Fig. 1 above), are pyramidally structured such that the apex of the pyramid is located in the national capital. Such a structure is designed to strengthen the executive's authority, and to a lesser extent, the authority of the central elites. Above all, the system is meant to ensure central control over the national territory. Effectively, all but the most trivial of decisions in the transportation field are made at the centre. This is counterproductive to any efforts aimed at promoting inter-agency coordination. This is because, as stated earlier, the decision on the part of one agency to coordinate its activities with another is by no means trivial. As the term implies, inter-

agency coordination means going beyond one's organizational boundary. This cannot happen without clearance from the centre. Thus, regional, provincial or local level officials in the country's transportation field, even when they are interested, are often discouraged from indulging in IAC activities by the fact that they must obtain prior approval from the center.

Inequitable distribution of power amongst agencies/agency heads. As stated earlier, Cameroon's administrative system is a legacy of its colonial past. Thus, one conspicuous feature of the system is its incorporation of the integrated prefectoral model introduced by the French. This model places excessive emphasis on the 'prefecture', that is the agency representing the state's political interest—the 'eyes and ears' of the state (Wallis, 1989). This agency and its head, the prefect (from the French, *prefet,* is accorded powers superior to those of other agencies at its level. Furthermore, some agencies, which operate in the transportation field such as agencies of the Ministry of Town Planning and Housing fall under the jurisdiction of a Deputy Prime Minister. This accords the agency superior status relative to that of an agency such as the Public Works Department that falls under the jurisdiction of a deputy minister or Secretary of State.

These disparities in power amongst the agencies and/or their heads seriously impede IAC in the transportation field. Empirical evidence suggests that no effective collaboration can take place in any inter-organizational network unless the organizations comprising the network possess roughly equal power (Gray, 1985).

Lack of continuity. Functionaries, especially the high-ranking ones, in Cameroon seldom ever enjoy the continuity necessary for effectiveness in any particular post or station. They are often busy being transferred from one station or post to another. In this connection, one commentator has noted that '. . . it is not unusual to find a public official who has been transferred three times in a single year, resulting in an average of four months per station' (Njoh, 1992: 31),. The rationale for these transfers on the part of officials in the center has to do with their concern with the possibility of local and provincial level functionaries becoming familiar enough with any particular locality to galvanize potentially threatening support in that locality. The frequent movement of government officials is not a practice unique to Cameroon. In fact, in Latin American countries, the patronage recruitment system also ensures such movements at the local and provincial levels.

Lack of continuity, such as is brought about by the constant transfer of high-ranking officials at the local and/or provincial levels, is antithetical to inter-agency coordination (IAC) efforts. With such officials constantly moving around, they hardly become familiar with one another. Yet, such personal familiarity and the attending informality amongst especially high-ranking officials and/or agency heads, is a necessary pre-condition for meaningful IAC. This point is aptly made by Rondinelli (1983: 114) when he argues that

> . . . coordination and cooperation in most
> developing nations are achieved not by command
> but through informal, personal networks of interaction.

Therefore, we contend that, by discouraging continuity through the frequent transfer of functionaries, authorities in the center effectively prevent the growth and development of the types of informal networks necessary for viable and productive IAC in the country's development policy field of which transportation is a crucial part.

OPPORTUNITIES FOR IMPROVING COORDINATION

Several opportunities for improving coordination in Cameroon's transportation system exist. The fact that vast portions of the country's territory remain undeveloped means there is immense room to significantly alter and/or shape urban and national physical development patterns to facilitate a more harmonious inter-modal transportation system. The country's road, rail, maritime and air transportation infrastructure is still in its infancy as far as development goes. Therefore, in extending and expanding the existing infrastructure, planners and policy makers will have a chance at establishing viable and necessary linkages amongst the various modes of transportation in the country.

Since 1986, the country has been experiencing a prolonged recession and continuing liquidity crisis. This presents an opportunity for streamlining the transportation sector as part of the recently adopted structural adjustment program (SAP)[6] recommended by the International Monetary Fund (IMF) in collaboration with the World Bank. Fewer agencies will result in among other things, a significant reduction in the cost of inter-agency coordination in the transportation field. Fewer agencies will also present an opportunity for developing

complementarity among especially urban transport services. Numerous agencies render the development of such complementarities difficult (cf. World Bank, 1975).

As part of the IMF/World Bank-led SAP, and as a result of persistent demands for a democratic government on the part of the citizenry, the country's leadership is, albeit, very slowly moving to decentralize the bureaucracy. Hopefully, this will result in the introduction of smaller administrative units which will more readily coordinate their efforts and adapt to changes than the slow-moving large bureaucratic units characteristic of the country's extant transportation sector.

The structural adjustment program has privatization as one of its core elements. This presents yet another opportunity for improving coordination in the transportation field as private suppliers of transportation services, with their profit motives, will be more likely, than their public sector counterparts, to engage in activities such as inter-agency coordination (IAC), that can improve their efficiency and effectiveness. In fact, the notion that inter-agency coordination contributes to both effectiveness and efficiency is, as stated earlier, supported by empirical evidence (see e.g. Molnar and Rogers, 1982; McKinney, 1986; Njoh, 1990; 1992).

Finally, we believe the country's economic situation will compel officials to adopt cost-saving strategies in the administration of public affairs. In this connection agencies may be encouraged to share and/or jointly

utilize resources. To do so will be to promote inter-agency coordination. This is because, inter-agency interaction, which inevitably occurs when agencies engage in resource exchange, is an important precursor to meaningful inter-agency coordination.

CONCLUSION

The transportation problems in Cameroon like those of most developing nations result from administrative ineffectiveness particularly, the tendency on the part of institutional bodies within the transportation field to work in isolation of one another. Stated alternatively, a substantial portion of the country's transportation problems is a function of lack of inter-agency coordination (IAC) in the transportation field. The reasons for this phenomenon are rooted in several sources. This paper has identified the most fundamental of these sources including the country's colonial history, the nature of her transportation policy administrative machinery, and her urban and national physical development patterns. The paper also contends that opportunities do exist for improving the effectiveness of the country's transportation system through inter-agency coordination in particular and coordination in general.

Transportation planners and policy makers in Cameroon will do well to take advantage of these opportunities. As an institution strengthening strategy, coordination holds immense promise for improving the effectiveness of the country's transportation system. This is particularly because the strategy is capable of maximizing the utility of the country's meager resources. Although the analysis has focused on the transportation field in Cameroon, we hope that transportation planners and policy makers in other LDCs will find the discussion and issues raised of some utility.

NOTES

1. The Institution Building Model (Esman and Bruhns, 1966; Eaton, 1972).
2. Northern Cameroons voted to become independent as part of Nigeria.
3. The 26 administrative districts of Cameroon during the German colonial era included (Mbuagbaw et al., 1987): Duala, Victoria, Jaunde, Ossidinge, Dschang, Edea, Kribi, Limie, Jabassi, Ebolowa, Dume, Johann Albrechctshohe, Bare, Jukaduma, Banyo, Ukoko (Muni), Ikelemba (Lower Sanga), Bamenda, Wolo, Ntem, Middle Sanga, Upper Sanga, Logone, Iwindo, Mora, Garua, and Ngaundere.
4. One reason for this is the fact that the French controlled as much as four-fifths of the country. Another reason is the fact that the country has remained very close to France since independence. The country has however, not enjoyed similar relationships with any of its erstwhile colonial masters].
5. The country is comprised of at least 136 major ethnic groups (Azevedo, 1989) By an ethnic group is meant, a large group of people speaking the same language, sharing the same culture and history, and living in a recognizable territory that is sanctioned by tradition.
6. The structural adjustment program (SAP) is designed to rejuvenate the country's economic growth in the medium term. Other objectives of the program include undoing obstacles to growth and development, de-emphasizing government's role in the economy, and redirecting government's energy towards the social well-being of the people and increasing productivity.

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Bonanza or Buzzword - Double Stack Dissected

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What is double stack, so renowned in song and story as the 1990's cutting edge of railroad intermodalism?

It is simply the carrying of one container on top of another, in a train.

But then, what is intermodalism? It is the transfer of units of freight from one mode of transport to another. It began with Trailer on Flat Car, TOFC or piggyback, where railroads moved highway trailers, held onto flat cars with special hitches. See Figure A. Most of the trailers were the railways', but common-carrier truckers were pursued, and are now, more then ever.



Figure A

Next came containerisation, initiated by a US trucker who needed to take his trailers to Puerto Rico, so took them off their wheels, and put their bodies on a ship. This innovation spread over every ocean, and on land to both road and rail. The trailer bodies became "containers", limited then to 8' wide by 40' long, dictated by US highway rulings. On vessels, they could be stacked up in close-fitting cells - their heights made no difference, but started at 8' - and on rail, they fitted onto specially-equipped flat cars, of constantly longer types, ending finally at 89', herein called "conventional.

The first attempt at stacking them two-high appeared in Oakland in the late 70s, and within a few years, first one then a second car builder offered them as standard, the much lowered floor accepting the extreme height, with a correspondingly low centre of gravity. See Figure B. The Pacific ocean container Lines quickly arranged for their imports to move east from the coast on their private trains, from the "water ocean" onto the "iron ocean". There are now about 100 Line-exclusive trains from the coast each week, plus some rail-operated common-user trains, open to all. The Port of Seattle ran their own train at one time.



Figure B

This was called "revolutionary" by an enthusiastic but amateur railway fraternity, and the "salvation of the industry". The professional railroadmen had been looking for something to make their glamourous intermodalism even marginally profitable; maybe they still are. But from some of the encomiums lavished, one might conclude that it is the greatest advance in land transport since the invention of the round wheel.

Revolutionary it is not, nor a quantum leap. Such inventions as the automatic coupler, the Westinghouse automatic air brake and the diesel-electric locomotive were true operating revolutions, likewise the automatic block signal. So also was piggyback a marketing revolution, and the universal use of the computer a management revolution.

The double stack container car, see Figure C, is the triumphant product of clever and innovative car designers, as is the high-cube boxcar, the ultra-high capacity coal car, and the tri-level automobile carrier, all from the striving for lighter cars, heavier loads, and less fuel burned.

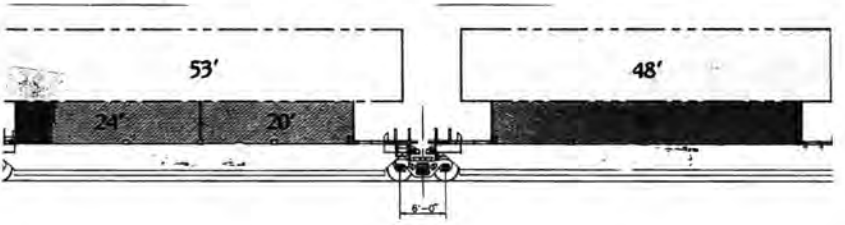


Figure C

One railroad started it, but progressive suppliers developed it. Signal engineers created the hump classification yard, and the roller bearing eliminated the hot box, both of the greatest importance and products of outside ingenuity.

What *is* most definitely a revolution is not the machinery, but the immediate exploitation of the concept by two US-owned Pacific ocean carriers, and not only by taking complete control of eastbound train operation with their own (leased or bought) rolling stock, and contracting with the several railroads to haul these great trains east to Chicago, sometimes further. By buying truck lines to ensure westbound back-haul for their empties, and then adventuring into routes not even connected with seaports, American President Line first, and then SeaLand later (still later bought by CSX, the railway) used their cars to spread into far wider trades than just moving sea containers. They employed conventional cars when necessary to fill their huge demands, and even moved their freight on the highway ; they are known to lease returning boxes to the rails for *their* traffic. All this began with double stack, and makes these carriers true multimodalists. The AP group has 500 cars in service, with capacity for 5,000 containers.

Savings in operating costs The Government of Alberta, in creating Alberta Intermodal Services, had been persuaded that this equipment produced savings of 40%, with no mention of what this was compared to. It must have been that fully-stacked trains save 40% of crew charges compared to conventional trains of similar parameters. A consultant's study predicted 20% savings, including drayage costs, compared to TOFC, which includes the weight of an entire trailer. This saving was mileage-sensitive, of course, and stacking was forecast as making rail competitive with trucks over long distances. What is still required is some way to do this for medium distances, where density is greater. In both examples, capital may not have been part of the calculations, as the steamship Lines were then supplying most of the investment themselves.

When Ports Canada issued "Towards a Canadian Intermodal System - Recommendations for Change" in 1991, the scribe mentioned double stack 26 times, asserting that it was necessary to meet customers' demands (whatever they were) and concluding that significant cost savings could be passed on to shippers (why should they?). He produced savings, e.g. "linehaul" costs, reduced by 31%, without explanation. The railways did not approve this report. Intermodal was said to be 10% of their traffic, 7% of their tonnage, but no profit figures were presented.

UNCTAD, the UN agency reviewing matters maritime, states that stack trains run 625 miles a day, compared to a "normal" run of 180; if true, likely due to few stops with fast trains, hardly attributable to new technology. It reports a saving of $1,000 on a westbound movement out o Chicago, compared to something; this may or may not reflect lower railway operating cost. The Asia Pacific Foundation is convinced that dependable double stack is essential for Vancouver to become a "Gateway". A Member of Parliament for Nova Scotia (when in Opposition) demanded that the Federal Government force CN Rail to match the US west coast railroads in double stack frequency from the Port of Halifax, as if supply would create demand, without explaining why.

This illustrates the light-hearted and uncritical attention devoted to this new transportation mode and its effects on costs and competitiveness.

So is double stack a bonanza, or simply a fashionable buzzword? To borrow from Hans Christian Andersen, is it dressed as a potentate in brilliant new clothes, or does it wear an old T-shirt? How deep is the conventional wisdom?

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Articulation The original cars (hereafter called Mk I) were permanently joined in rakes of five units (platforms, or wells) with the inside three sharing four trucks (or "bogies") and the outside pair riding on one shared and one of their own trucks. See Figure D. Each well had a capacity of two 40' containers. The industry uses the "20' equivalent unit" as the statistical unit of capacity; a 20' box is one teu, a 40' is two, so they can be added. A 40' container is also one feu. These are International Standards (ISO) definitions, and a" slot" on a railcar holds one teu.



Figure D

The deckless or so-called "spine" car, with containers and/or trailers in a single layer, is articulated the same way and is often mated with double stacks in intermodal train consists. See Figure E.



Figure E

Mk I was followed by Mk II, in rakes of two, three or four cells, each with its own pair of trucks, and joined by heavy solid drawbars. While also leasing Mk I, Canadian railways have adopted Mk II for their own stock.

Either form of articulation prevents loose slack action between platforms as speeds rise and fall, thereby limiting lading damage. The rakes have standard couplings at both ends, each with a heavy spring draft gear, so there has to be some slack in a train, but relatively less as it grows longer. One cannot envision an entire train of articulated slack-free cars; it would never get started. 89' cars have their own pair of long-travel draft gears for protection against run-in and run-out. Double stack slack freedom is said to be attractive to owners of fragile freight.

The original shared-truck platforms had another, more measurable advantage over double-truck cars; the lesser weight of six trucks in place of ten. This meant fewer wheel sets and brake shoes to be replaced. At the penalty of longer braking times, fewer air-brake components are required. Fewer pieces means lower first cost.

Maintenance Freight car running repair costs for 89' cars average 7/8 cents per 20' slot-mile; Mk I double stack cars average about 1/3 of a cent, while achieving four times the mileage between wheel changes, most probably due to the shared truck's superior tracking ability on curves. All of which is a most useful cost reduction.

The drawbar-connected Mk II, while slack-free, surrenders much of the weight, and all of the maintenance gains. However, it is clearly less complex to change out a complete truck, and to add - or subtract - a segment as traffic demands. The ability to "uncouple" eliminates the historic handicap of permanently-joined cars: five components held out of service to repair one, first encountered with the early streamlined passenger trains, and soon discontinued.

The shared-truck fleet needs special machinery at divisional repair tracks. It has always been simple to jack up one end of a car and roll out a truck. But when it is shared between two hosts joined by a unique device over the centre pin, (see Figure F), there arises the need for some way to jack up or hoist up two ends of two cars at the same time and some apparatus to extract it. No doubt this can be done efficiently, but it is not as effortless as wheel change has always been for skilled carmen.



Figure F

So while Mk I articulation offers welcome weight and cost reduction, with fewer wheels to look after, it carries this burden of inflexibility. That is overcome by Mk II, but at the price of higher weight and more wheels, leaving the trade-off for management to ponder.

There is a small number of single stand-alone platforms, which can be coupled into any train, save a little weight and are easy to maintain. In fact one type can take four 40' stacked two-high; this is almost as long as the old 89' car and weighs as much, but is supremely productive.

Loads Because the Mk I inner wells rode on two half-trucks, so to speak, their loads had originally to be restricted. 20' boxes were assumed to be loaded relatively more heavily than 40' (certainly true in Canada) so were shut out of these inner wells while 40' boxes were unrestricted. This is why these cars had to be selectively loaded, and were so stencilled. This is cumbersome and costly, so as time went on and designs were modified, these limits disappeared, and two 20' boxes can now go on the bottom of any well; there is no way to carry them on top of a 40', where they cannot be fastened down. Double-truck Mk IIs have never had similar restrictions, but in all cases, the centre of gravity prevents loads being carried on top of empties.

As containers, both domestic and international, grew longer, from 40' to 45', 48' and even to the latest 53', platforms grew longer too. The only limitation has been that a 53' container must go on top. These new lengths are the product of liberalized highway limits, and someday ships' cells may change with them.

In fact by now, US domestic container traffic has greatly outpaced international activity, and stacking is the only way to accommodate it. Nearly all new domestic boxes are 9'6" high, and 6" wider too, while only 10% of international boxes are. So railway tunnel heights are being opened up, especially by eastern US States, in the expectation that stacking will arrive. J B Hunt, the biggest of all US truckers, after starting out on the road, went overnight to TOFC, and is now buying thousands of 9'6" containers (and trailer chassis to put them on). Until tunnel clearances are complete, many double stack loads will have to be reduced to single, as Conrail is forced to do at Syracuse NY.

Meanwhile, the 89' car, intended originally for marine, has been confined to two 40' or four 20' containers on 6x11" bearings, and on some US cars with 5 1/2 x 10" journals, only three heavy 20'. The car cannot carry more than 80' of boxes. It can be unreliable when passing through tight reverse curves; its long overhang at the ends plus two long drawbars create derailment forces. Much domestic intermodal nevertheless remains on these cars as unstacked TOFC.

Tare (empty) weight An empty Mk I platform weighs measurably less than a 4-slot 89' car, and so does Mk II, although in view if its unshared truck sets, not as much less.

The significance of this weight saving appears on Table 1. Just for comparison, the 4-slot spine car is shown; it is a valuable intermodal player, but cannot accept 400 teu, since that would entail a 10,000' train, longer them most passing sidings. 400 teu and even 500 teu are commonplace in the US west coast steamship Line corridors.

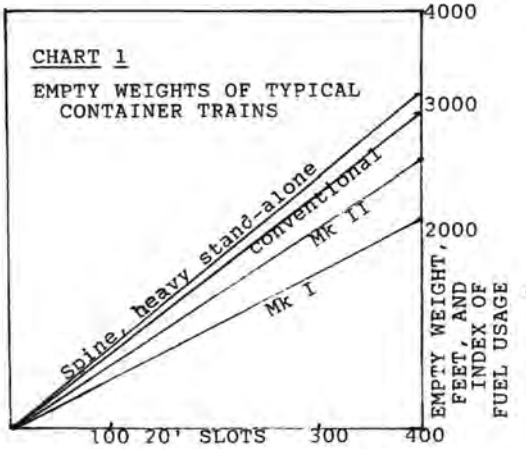
Table 1

EMPTY WEIGHT PER 20' SLOT

	Tons	Weight Difference
Conventional	7	
Mk I double stack	5.5	-20%
Mk II double stack	7	0%
Heavy stand-alone	8	+14%
Spine (only for shorter trains)	8	+14%

Not every container platform or well receives a full load, since traffic constantly varies. A truck-shared car cannot be taken apart to get rid of half-loads, but must stay together, as it must when a platform is empty. This is an operating event that is in the nature of the business, and the half-filled car may well be filled on the return trip. However, 89' cars may not always have to move half-filled; it may be possible to fill one and leave one behind.

Chart 1 shows weight reduction on full 400 teu and half-full 200 teu trains. There is no empty/load improvement with a half-filled articulated car, but the lower tare remains in all cases, full or half-full - or empty, always a possibility. Tare reduction is *relatively* minor in a heavy train, but it is always *absolute*, and will save more fuel as miles are run up. While fuel consumption varies primarily with speed, it varies with tonnage as well, and each slot is about 1 1/2 tons lighter. At one ounce per ton-mile, the saving in fuel is 1,200 gallons per 100,000 20' slot-miles. A third components is air resistance. Single or double stacks present smooth continuous side areas - although not so when mixed in groups - and generate minimum resistance, Although unmeasurable, TOFC has very high air resistance

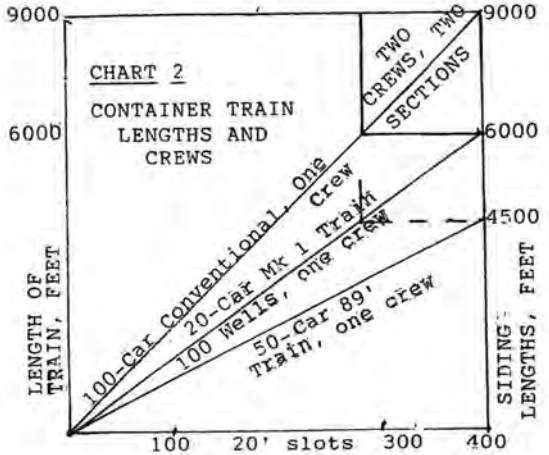


Train-mile and crew costs Double stack cars develop significant savings in train length as against 89' cars with the same loading, since they are much shorter per slot. Table 2 shows car lengths per 20' slot .

Table 2 - AVERAGE PER 20' SLOT

	Feet	Difference
Conventional	23	
Mk I double stack	16	-30%
Mk II double stack	18	-20%

This saving is critical whenever a train has to be longer than sidings on its route. A typical west coast train will be, say, 400 teu (or more likely 200 feu). The 100-car conventional train will be well over 9,000' long, but the same capacity fully-articulated stack train will be 6,000' long. So the 9,000' train must be despatched in two sections when faced with a 6,000' siding, doubling the train-miles and crews to man them. But the stack train can enter the siding, and with one crew. That train has its own siding limitations, of course, and so does any train. Chart 2 provides the train-mile/crew situation and its implications.



There is naturally no way to reduce crews to fewer than one per train, but, depending on siding lengths, double stack is sometimes the only way to make up a train for one crew. In addition to solving problems of heavy traffic, it is also useful in a terminal with short loading tracks, e.g. the Port of New York at Elizabeth. (Despite 75% of its catchment area being within 100 miles, the state of New Jersey is calling for them to be lengthened).These short consists still have to be switched out to make up a train with one crew, but stacking will have cut the loading times in half and the yard areas as well. Longer loading tracks and stack trains make for optimum switching activity.

Train-mile reduction is a constant target. The volumes of ocean containers from the coast are sometimes so enormous as to make a second stack section, but these two crews are replacing three or even four. While crew payments vary, they are a major item of operating cost. Figure G shows a full train of Japanese import boxes.



Figure G

First cost While not an observable per-mile operating expense, the price of a new car must be amortized over many years, or miles, which amount has to be added in for a true cost appraisal.

The conventional car is priced at US$65,000. This could be seen as academic, since it may not often be bought solely for containers. However, all signs are that it will have TOFC duties for a long time yet, as the fleet continues to expand, now at a quarter of total intermodal capacity. One builder has stopped container production but increased trailer output.

So the 89' first cost is about US$16,000 per slot. The current price of a five-well Mk I car is about $190,000, or $9,500 per slot when stacked, but only then. That it is often not stacked does not negate the value of this capacity, even though it is not then realized. The drawbarred car price is not available, but it is certainly somewhat higher, because it is heavier and has more wheels. The new design is clearly more attractive than the old, and its population has doubled in five years, as the 89' fleet grew 40% smaller.

What is more, a five-platform spine car at about $170,000 is priced at $17,000 per slot, slightly higher than its 89' predecessor). A Canadian container-only spine car will cost about Cdn$190,000). This penalty must be set against its lower fuel and maintenance costs, which appear to make it a contender, especially because it can carry trailers mixed with containers. Figure H is the outline of this flexible equipment.

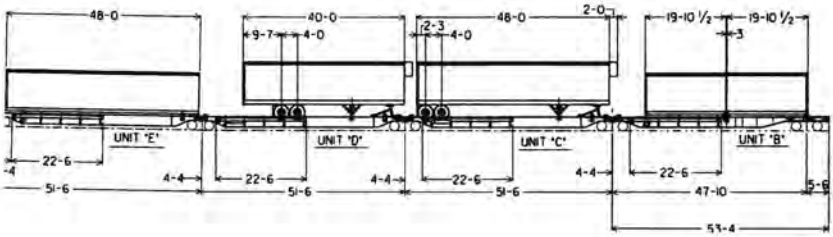


Figure H

If the railway leases in place of buying, a stack car is available for about $60 per day (or $3 per slot) plus about 7 cents a mile, and a spine car for about $40 (or $4 per slot) plus about 2 1/2 cents per mile, including maintenance. Longer and longer runs at higher speeds will pile up mileage charges, but absorb the daily charges. High speed and increased utilization are the only ways to escalate margins. Lease payments are not capitalized as contingent liabilities, and are expensed as paid. But the question of "bought or leased" is unlikely to influence a terminal manager in his choice of which type of car to load; he will have whatever arrived the day before and was made empty, and which must be loaded to keep the business. As it is, he concentrates on weights, blocking cars by destination and for interchange; he may try to load doubles for a particular customer who for some reason asks for it.

But age will inevitably catch up with any car and demand heavy repair, which is when the accountants will advise whether to scrap it or fix it. Steam locomotives were made obsolete so quickly by returns on investment that many were scrapped prematurely. They were victims of a revolution, but there is no such phenomenon affecting old container cars.

Marketing and promotion While the technical features and cost savings of this car design are of primary interest, the marketing and promotion strategies of their railway operators and others are intriguing as well, partly because they appear unquantified and undirected.

A good deal of printed advertising by both Canadian railways, and at least two major container ports, emphasizes the availability of "double stack service". It is unclear who is the target of this effort. At least five Pacific ocean lines explain in the "Pacific Shipper" that their US containers move east by double stack; as if the others use single stack, or are unimpressed by double.

Now Canadian ports offer no rail service of any kind themselves, but continually announce that their inland rail connectors offer "double stack service". This presumably is to entice a prospective container Line to call, but specifies no benefits. Traders cannot be the targets, since they deal neither with railroad nor port, but with forwarders or the Lines directly; it has often been pointed out that they are "port neutral". The Line may negotiate a favourable rate with the railroad, but the shipper will never know. The 1991 Task Force on the future of the Port of Halifax advocated strongly that stacking be "encouraged" without saying how or why. The Province of Nova Scotia then provided CN Rail with some, on terms undisclosed and with results (except for the car builder) unknown. Figure J shows a major Canadian port container loading tracks, with no double stack visible.



Figure J

The railways' offers of this "service" must surely be aimed at domestic clients. The implication is that it is superior, and reaches all destinations. If it is better, as with airlines' business class, then it can command a higher rate; if it does not, a profit is forsaken . Perhaps the superiority lies in a lower price, always attractive. It is unclear

which it is, and the researcher must settle for double stack being better by definition, and that the railway must just be up-to-date. One steamship Line manager said double stack must be better, or they wouldn't be using it, without further amplification.

A shipper may indeed be persuaded to use this service, while more and more intermodal service is being provided by third parties who retail what the railroads sell them wholesale. His freight may be carried on a stack car, but not stacked and lie on the floor. There is no sign of a guarantee, or reimbursement for failure. In fact, his freight may go on a 89' car or a spine car. It depends on what is available that day, and he will never know and has no recourse if he finds out. The Canadian Industrial Traffic League compares the picture to a box of coloured candies: you may get a red one.

Much stack operation does not involve block trains (sometimes called unit trains) of fully-loaded wells. There are many half-stacked wells, and mixed trains of all sorts of other cars, the result of coping with ever-changing patterns of traffic, cars and customers. See Figure K for an intermodal train of three species of cars, for two customers. The rates may be the same for all of the loads. Some railroads criticize this variety of car equipment.



Figure K

It has not been possible to learn anything about specific cost savings from any of the nine railroads approached. All the ideal savings cannot always be realized, unavoidably and understandably. In fact, it may be impracticable for the companies to keep cost figures separately for double stack. Their estimated savings round off below 15%, but it is the revenue from traffic captured from trucks that is much more important, and this may be the only way to carry out that recovery. Andrew Held, in The Northeast Journal of Transportation (January 2, 1995), suggests that States in the late middle of raising tunnel heights are almost missing the boat; while stacking is efficient for long hauls, it lacks the flexibility of lower-height alternatives, and there will be new opportunities for single stack in price-competitive short hauls. Massachusetts may now stop its tunnel-raising program; even with double stack, Boston's fortunes are unlikely to improve.

There is no question that modestly-lower cost is a reward for double stack, even if not broken out in detail. Along with new revenue from new business, it may be enough to affect Canadian roads' bottom lines, although buried in results from their massive bulk movements. Intermodalism has again been acknowledged as a low-margin traffic, where the technology, whatever its benefits, is not as prominent as with western US roads, dominated as they are by ocean carriers' operations.

Figure L shows a double stack container train, with neither crew nor maintenance saving, and a few tons of weight saved. This group of marine containers has been loaded at the end of an inland branch, and will move west. In a few days it will form part of a long full train to the west coast, and so a full participant in the grand mystique of double stack.

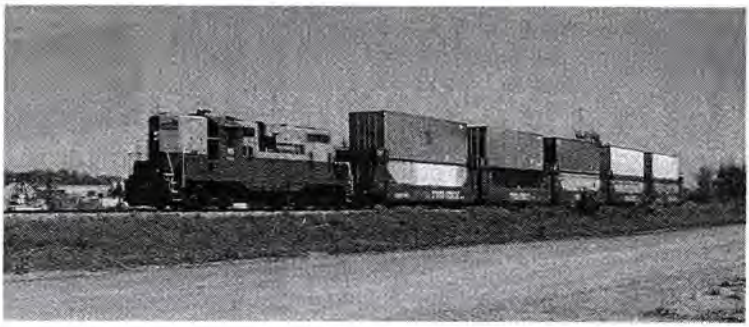


Figure L

So bonanza, double stack is not, it wears no potentate's golden robes. But from time to time it does give off the sound of a good buzzword, and is dressed in clean overalls.

* * *

ERRATUM - Conrail no longer downloads double stacked containers at Syracuse NY.

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CANADIAN TRAFFIC THROUGH WEST COAST CONTAINER PORTS

by

Jake Kosior* and John Heads**

This paper examines the competition for Canadian container traffic through west coast ports. In 1993, 434,000 twenty-foot equivalent units (TEUs) were moved through the Port of Vancouver. However, 173,000 TEUs of Canadian traffic were also moved through U.S. ports, while there was a negligible movement of U.S. traffic through Vancouver. The research for this paper was carried out mainly for Western Economic Diversification Canada,[1] but the authors are solely responsible for any opinions expressed in the paper.

1. DESCRIPTION OF THE PORTS

The marine terminal is the hub of any international trade. Every overseas container must go through a port of exit and a port of entry. The trend of shipping lines to larger ships, and hence ports which can accommodate these vessels, has produced intense competition between port authorities worldwide. The response has been an infusion of capital intensive projects to improve the efficiency of throughput of terminals.

For container movements, Vancouver's main competitors are Seattle and Tacoma, followed by Oakland, Long Beach and Los Angeles. Table 1 is a synopsis of container traffic and infrastructure at the main west coast container ports. The container movements are international traffic only, excluding domestic and empty containers.

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Table 1: Comparison of Major West Coast Container Ports, 1993					
Port	Thousand TEUs	Container berths	Container cranes	Railway links	Average draft (ft)
Vancouver	434	6	8	CN,CP,BN	45
Seattle	768	20	23	UP,BN	40-50
Tacoma	526	12	23	UP,BN	40-50
Oakland	708	22	30	SF,SP,UP	35-42
Long Beach	1,496	22	31	SP,UP	36-50
Los Angeles	1,605	22-30	35	SF,SP,UP	36-50

Source: International container traffic in TEUs from Canada Ports Corporation, 1993 Winter Business Review. Other data from Containerization International Yearbook, 1993; this publication gives much higher figures for container throughputs, but includes domestic and empty containers, together with a double-counting of transshipments. The Canadian railway abbreviations are self-explanatory; the U.S. railroads are Burlington Northern (BN), Santa Fe (SF), Southern Pacific (SP) and Union Pacific (UP).

Vancouver

Vancouver is Canada's only high volume container port on the west coast and had a 1993 throughput of 434,000 TEUs. However, 173,000 TEUs of Canadian west coast traffic were diverted through U.S. ports in 1993, while Vancouver received only small amounts of U.S. containers. Vancouver's TEUs have been growing steadily. From a throughput of about 150,000 TEUs in 1984, handlings rose steadily to a record 441,000 TEUs in 1992, with a small dip in the figure for 1993. This growth reflects increasing traffic, together with the trend to containerize as much freight as possible. Vancouver's two container facilities, Vanterm and Centerm, are already close to capacity. There are also truck and rail access problems.

Like other west coast ports, Vancouver is anticipating a doubling of container traffic by the year 2005 and has begun construction of a new container facility called Deltaport, located at Roberts Bank. Vancouver Port Corporation (VPC) is spending $180 million and Empire Stevedoring, the chosen operator, is contributing $40 million, while CN and CP are providing ancillary rail facilities. Roberts Bank will have a highly efficient terminal with 2 berths and 5 cranes

which can handle 500,000 TEUs annually, slightly more than Vanterm and Centerm combined.

In 1987, Empire Stevedoring spent $16 million revamping its existing crane capacity to raise on-dock productivity equal to any port in North America. To attract new users to the port, and maintain present customers, VPC offers volume based discounts of up to 30% to shipping lines who make Vancouver the first port of call. China Ocean Shipping Company (COSCO) is one of the first to take advantage of the new offer. However, the port must also have other lines as its first caller to demonstrate that Vancouver is a viable first port of call.

Seattle and Tacoma

The ports of Seattle and Tacoma share Puget Sound, 130 miles directly south of Vancouver, and had a total throughput of 1,294,000 TEUs in 1993. Together, they handled 136,000 Canadian inbound/outbound TEUs that year, which accounted for almost 80% of the total Canadian traffic diverted to U.S. ports.[2]

Like Vancouver, Seattle and Tacoma do not have a large population base in relation to the volume of traffic through the ports. Over 80% of import traffic is destined for the U.S. midwest and eastern seaboard. Realizing this, in 1985 Tacoma completed its north and south intermodal railyards directly adjacent to the container berths. Tacoma is one of only six U.S. ports with sufficient vacant land for development. Seattle is not so fortunate, as the port is in a constricted area of the city with limited facilities.

The new Tacoma yards have been a major factor in attracting new customers to the port. Both facilities are located immediately adjacent to the container berths, which reduces drayage costs and time. In addition, the yards are directly across from the main port gates, which further reduces travel time for truck movements. Some of the new traffic at Tacoma has been at the expense of Seattle. In an effort to reduce duplication of effort and destructive competition, Seattle and Tacoma have formed the Puget Sound Corporation. The objective is to increase the total market share of the two ports by co-operative joint planning. They have also created a shared foreign sales corporation to assist small exporters.

Oakland

Oakland is the 20th largest port in the world, but it has one of the shallowest depths at an average of 38 feet. This is about to be rectified by a $120 million dollar dredging project by the U.S. Army Corps of Engineers, as soon as environmental approval is received. Presently, 75% of ships that enter the channel scrape bottom, causing concern amongst shipping lines as larger vessels enter service, and the shallow depths often force ships to wait for high tide to enter port. The dredging project is crucial for the port's long range plans to develop six new container berths and a joint intermodal facility with the three railroads serving the port. These projects are expected to cost $420 million and $80 million, respectively.

The programs are aimed to make Oakland more competitive with its two California neighbours, Long Beach and Los Angeles. Oakland has two advantages over southern California - shorter sailing time from southeast Asia, and faster intermodal turnaround time during peak shipping seasons. Shippers can shave a day off the Singapore-Chicago route through Oakland by bypassing congested southern California.

In terms of container traffic, Oakland had a 1993 throughput of 708,000 TEUs. Approximately 13,000 TEUs of this total consisted of diverted Canadian traffic.

Long Beach and Los Angeles

The ports of Long Beach and Los Angeles share the same harbour of San Pedro Bay. In 1993, Long Beach and Los Angeles recorded throughputs of 1,496,000 and 1,605,000 TEUs. Together, they rank as the world's fourth largest gateway, behind Hong Kong, Singapore, and Rotterdam. Container handlings in Long Beach and Los Angeles together were 6% higher in 1993 than in 1992. This was the highest increase recorded in the west coast ports, reflecting the proximity of LA/Long Beach to the rapidly growing areas of southeast Asia.

Long Beach and Los Angeles have several expansion projects planned or under construction. San Pedro Bay ranges in depth from 36 to 50 feet, which restricts some ships to ride the high tide. This has caused concern for shippers who have been frustrated when vessels leave half full. Los Angeles recently began a $149 million dredging project. The program includes three miles of channel which will be dredged to 63 feet for bulk carriers and 45 feet for container ships. This project will also create 5,000 feet of berth space at three new container terminals and a new intermodal transfer facility as the port prepares for an anticipated fourfold increase in container traffic by the year 2000.

Long Beach has recently purchased 725 acres of land to accommodate a projected doubling of container volume by 2005 and is considering an off-site intermodal sorting facility linked to the berths by EDI. Dockside cranes would unload a ship direct to a shuttle train, which would transfer the containers to the sorting facility. Another train would come in behind with pre-sorted containers for the vessel's return leg. The objective is to remove the container storage and sorting function from expensive dockside lands to cheaper land located outside the city. In addition, trucking and train movements would avoid downtown congestion.

LA/Long Beach have recently established the Alameda Corridor Transportation Authority to consolidate the operations of three freight railroads into one high-speed, high-capacity corridor between the two ports. Among other advantages, this link would allow for transfer and rapid shuttle movements of containers between ships calling at the two ports. This is a major project with a total cost estimated at $1.8 billion. The objectives include the diversion of traffic from other U.S. Pacific ports - Seattle, Tacoma, and Oakland as the major competitors, and by implication, Vancouver. Currently, 9% of diverted Canadian import/export containerized traffic or 16,000 TEUs flow through southern California.

To summarize this discussion, Vancouver moved 434,000 TEUs of traffic in 1993 and a negligible amount of this was traffic destined for the U.S. The movement of Canadian traffic through U.S. ports amounted to 173,000 TEUs - 136,000 TEUs through Seattle and Tacoma, 16,000 TEUs through Los Angeles and Long Beach, 13,000 TEUs through Oakland, and the balance of 8,000 TEUs through Portland and other ports. Although the two Vancouver container terminals are presently near capacity, when Deltaport becomes operative in 1996, Vancouver will be able to accommodate all the Canadian traffic and still have capacity to spare. Similarly, the capacity at the U.S. container ports along the west coast is considerably in excess of anticipated demand over the next few years. The competition will be severe. A few of the competitive factors are now addressed in general rather than definitive terms.

(a) *Productivity* is an ambiguous concept when applied to ports, yet some statistics can be used. On the basis of calculations from Table 1, the Vancouver performance on TEUs worked per crane is impressive at 54,300 per annum. This is better than for the two southern California ports and far better than for the other U.S. west coast ports. However, when land use is examined, Vancouver does not fare as favourably. Vancouver handles only 2,400 TEUs per acre of the container terminal and this is less impressive than for the U.S. ports. Container train service within the Port of Vancouver is less streamlined

than in many U.S. ports. Vancouver's container trains must compete with coal, grain and other bulk commodities for the same trackage. However, this problem will be much alleviated with the opening of Deltaport.

(b) *Labour relations* have been very good in U.S. container ports and there has been no strike since 1972. Vancouver has a less impressive reputation. Until the late 1980s, the controversial container stuffing/destuffing clause was operative in Vancouver labour contracts. This required that any marine container destined to the Vancouver area for local consumption or destuffing to domestic trailers or containers was to be done by members of the ILWU and this considerably increased container handling charges in the port. In February 1994, there was a major work stoppage at Vancouver. Although this was the first major strike in eight years, as of March 1995, there is further disruption in the port caused by a walk-out of some 500 longshoremen. Unless shippers see a more harmonious management/labour atmosphere in Vancouver, container traffic will continue to be at risk to shipments through U.S. ports. It must be hoped that the British Columbia Maritime Employers Association (BCMEA) and the unions will have more success in their work to improve the perception of labour relations in the international market place.[3]

(c) *Labour costs* are considerably less at Vancouver than at comparable U.S. ports. On estimates provided by the Port of Vancouver, the base rate per hour for longshoremen in mid-1994 was $22.71/hour in Vancouver. The comparable rate in Seattle, converted to Canadian dollars at the rate of C$1.34=US$1, was $30.40. Labour benefits are a much heavier burden in the U.S., as many of these benefits are met from general taxation in Canada. Adding in payroll assessment, taxes and insurance to the base rate, the Vancouver advantage becomes much more pronounced. It has been alleged that a large proportion of longshore work in Vancouver is performed at overtime rates. However, it is pointed out by BCMEA that this is mainly at the choice of shipowners, that Vancouver overtime rates are probably the lowest in North America, and that Vancouver longshoremen do not have the guaranteed work week that applies on the U.S. west coast.

(d) *Port taxes* present a heavier burden to Vancouver than to most U.S. ports. Although both Canadian and U.S. port authorities are generally exempt from income and capital taxes at the federal and provincial/state levels, the Port of Vancouver has to pay dividends and special contributions to the Government of Canada. Vancouver has to pay municipal charges in lieu of taxes, while many U.S. ports are exempt from such payments and the ports in Washington and Oregon are even allowed to assess taxes on property owners in adjacent port districts.[4]

2. CONTAINER TRAIN SERVICES

The railways in both Canada and the U.S. have established daily scheduled service to and from west coast ports with guaranteed departure and arrival times. This is accomplished by giving intermodal trains priority yard and line scheduling. The trains often have dedicated power and cars that are not broken up to serve other trains. Since the trains leave either an intermodal yard or port, they avoid yard humping and lengthy train assembly procedures. The railways are also achieving economies of density by using "hub and spoke" operations. Large intermodal terminals located in major urban centres, particularly in the U.S., attract shippers within a given radius and allow volume discounts.

The legislation of the early 1980s provided a liberalized environment in the U.S. for shipping lines and railroads to enter into intermodal service agreements. Specifically, intermodal development was encouraged by the provisions that authorized shipping lines (and/or conferences) to set intermodal rates, the formal recognition of service contracts between carriers and shippers, and the setting of time/volume rates for filed regular tariffs and service contracts.

Regulatory restrictions on intermodal transport were never as severe in Canada as in the U.S. before the deregulation of the early 1980s. However, it was only with the passing of the *National Transportation Act, 1987*, that shippers and carriers were allowed to enter into confidential contracts. *The Motor Vehicle Transport Act, 1987* also relaxed entry regulations in trucking and this has fostered the development of intermodal transport. In terms of freedom from regulatory control, Canada and the U.S. are competing on a level playing field. However, intermodal volumes are much heavier on U.S. railroads than on Canadian railways.

In August 1992, CN North America signed two commercial agreements with the Burlington Northern (BN) and the Ferrocarriles Nacionales de Mexico (FNM). The agreements permit the railways to price over each other's lines, allowing shippers to deal with only the original carrier, and the shipments to move under a single through rate and shipping document. CN also initiated an agreement with American President Lines (APL) in late 1992, in which CN provides container service from Chicago to Toronto, Montreal, and the Maritimes, while APL gives CN access on its established stack train service to Mexico City from Chicago via Laredo, Texas. In addition, the APL agreement gives CN access to APL's stack trains from California ports to Chicago over the Union Pacific network.

CN is also investing to upgrade its east-west network within Canada to remove constraints to the free flow of intermodal trains. CN has already invested $10 million to increase overhead tunnel and bridge clearance to accommodate double-stack 9'6" high containers in its western corridors from Vancouver. In 1995, the new $155 million dollar tunnel underneath the St. Clair river will be completed that will allow double-stack 9'6" containers, auto carriers, and TOFC to pass unhindered.

CP Rail System has likewise moved rapidly to reposition itself in a continental market and to take advantage of new intermodal opportunities. CP has completed a $15 million tunnel clearance program in the Rocky Mountains for the provision of high cube 9'6" double-stack service from Vancouver to Chicago. CP acquired the Delaware & Hudson in the U.S. eastern seaboard, and full control of the Soo Line in the U.S. midwest. The D&H railway gives CP direct access to New York and Newark for a Toronto-Buffalo-New York double-stack corridor, while the Soo Line connects with CP Rail's western Canadian network and provides a Vancouver-New York corridor through Minneapolis and Chicago. At the same time, CP has a direct network of north-south routes as far as Kansas City and Louisville, Kentucky.

CP has also entered into strategic agreements to increase its North American presence. CP has entered into an agreement with Guilford Transportation for access to the Port of Boston providing Chicago-Boston and Toronto-Boston links. Conrail and CP currently operate a joint double-stack service between Toronto/Montreal and the Port of New York. The State of Pennslyvania, Conrail (which is headquartered in Philadelphia) and CP have signed an agreement for state funding to improve clearances on Conrail's links to the Port of Philadelphia. CP also has working relationships with the Santa Fe and Southern Pacific for access to import/export traffic from southern California ports.

CN and CP have positioned themselves to be service competitive with U.S. railroads and offer daily intermodal train service to and from the west coast. CN has entered into service agreements with Evergreen, American President Lines (APL), and Orient Overseas Container Lines (OOCL). CP Rail's ocean partners include Nippon Yusen Kaisha (NYK), Mitsui OSK Lines (MOL), Neptune Orient Lines (NOL), China Ocean Shipping Company (COSCO), and Hapag-Lloyd. CP and CN offer weekly dedicated non-stop train service for their main partners. In the case of MOL over CP lines, the train is used as an auto parts pipeline destined for southern Ontario plants. The main U.S. western railroads - BN, SF, SP and UP - all offer their customers similar services.

APL has its own fleet of dedicated double stack railcars. It currently has arrangements with several U.S. railroads, the largest being UP. APL will configure a stack train at a port, and have the rail partner hook up its motive power. APL runs daily stack trains in the Los Angeles-Kansas City-Chicago-New York corridor. However, with all the double-stack equipment the railways have invested in during the past ten years, APL is questioning its continued ownership of railcars.

However, Canadian railways compete against the U.S. rail system with two main disadvantages. Firstly, the productivity of Canadian railways is substantially lower than that of U.S. railroads, with lower traffic density an important explanation of this gap. Secondly, taxation regimes between the United States and Canada place CN and CP at a cost disadvantage, equivalent to between 5% and 6% of railway operating revenues.[5]

3. SERVICE TIMES FOR CONTAINER TRAFFIC

Canadian container traffic diverted through U.S. west coast ports was 173,000 TEUs in 1993, consisting of 104,000 TEUs of import traffic and 69,000 TEUs of export traffic. Transpacific trade rose 6% in 1993, which indicates that the new Canadian traffic went through U.S. ports instead of Vancouver, where container handling was slightly less than in 1992.

Asia was the origin/destination for 89% of all Canadian container traffic diverted through U.S. ports in 1993. Traffic details are given in Table 2.

Table 2: Canadian West Coast Containerized Traffic at U.S. Ports by Origin and Destination - TEUs, 1993

REGION	Import Origins	Export Destinations	Totals
Asia	92,205	61,990	154,195
West Europe	6,777	2,292	9,069
Oceania	3,959	3,834	7,793
Others	884	1,164	2,048
TOTAL	103,825	69,280	173,105

Source: Canada Ports Corporation, Business Review, Winter 1993, p. 13.

The fastest growing segments of the Asian market are in the southeast with annual growth rates ranging from 6% to 21%. Malaysia, Thailand, and Indonesia are emerging economies and China is the most recent entry on the Pacific Rim scene. Singapore and Hong Kong continually battle for supremacy as the major container port in the southeast. Singapore enjoys political stability while there is some uncertainty as to the future of Hong Kong, which is to be turned over to Beijing in 1997. Taiwan has also become an important assembly and distribution point.

In contrast, Japan and Korea, with their autos, consumer electronics, and a host of other manufactured items are more developed exporters. But with the stagnating economies of North America and Europe, Japan has suffered. The result has been a shift in the call patterns of European and Japanese ocean carriers. Several carriers have terminated the Pacific northwest ports in favour of LA/Long Beach or Oakland, with double stack train service to the eastern markets.

On the U.S. west coast, the traffic increases for the southwest ports have surpassed the northwest ports of Seattle and Tacoma. This reflects the growth of the southern Pacific Rim as opposed to Japan and Korea in the developed north. Also, the total volume of traffic at LA/Long Beach makes these ports a "must call" for every ocean carrier operating on the trans-Pacific, resulting in a high frequency of liner service. Smaller regional carriers serving Malaysia, Thailand, Indonesia, and the Philippines do not call at the Pacific northwest ports, including Vancouver. Therefore, any shipper trading with these nations must either go overland from southern California or use a feeder marine service to the Pacific northwest ports. In either case, these movements can be considered "captive" traffic to southern California ports and this is the fastest growing traffic.

The discussion now goes on to consider the elapsed time on the major container routes between Asia, represented by Tokyo and Hong Kong, and Toronto and Chicago. These are shown in Table 3. Full details of the rail routings were given in the original research report,[6] but these are omitted to save space.

Vancouver, Seattle/Tacoma and Oakland have similar sailing times for *direct* point to point calls which average 12 days to Tokyo and 13 days to Hong Kong. On *direct* sailings, LA/Long Beach are at a disadvantage by 453 miles, reflecting the inland curve of the south California coast, and this adds an extra 2 days sailing time. All railways serving the west coast ports offer comparable service to Chicago at 3 days, and Toronto at 5 days. The actual travel time to Toronto is little more than an extra day from Chicago but, by the time the train

arrives, containers are offered for 5th morning delivery at 0700 hours. CP could provide a 3 day service to Chicago from Vancouver, but does not have the volume to make this worthwhile.

Table 3: Long Haul Routes: Tokyo/Hong Kong to Toronto/Chicago						
(fob: terminal)						
	Sailing Time		Rail Time		Total Time to Toronto/Chicago	
	From Tokyo	From Hong Kong	To Toronto	To Chicago	From Tokyo	From Hong Kong
Vancouver	12 days	13 days	5 days	3-4 days	17 days/15 days	18 days/16 days
Seattle/Tacoma	12 days	13 days	5 days	3 days	17 days/15 days	18 days/16 days
Oakland	12 days	13 days	5 days	3 days	17 days/15 days	18 days/16 days
LA/Long Beach	14 days	15 days	5 days	3-4 days	19 days/17 days	20 days/18 days

For *direct* sailings, Vancouver is fully competitive with Seattle/Tacoma and Oakland in serving Toronto and almost as competitive in serving Chicago on traffic from Tokyo and Hong Kong. Vancouver is more competitive than the southern California ports. This statement relates only to *direct* sailings. However, if a ship called at LA/Long Beach first and then went direct to Vancouver, the extra sail time is 4 days. By the time the ship arrived at Vancouver, the container could be unloaded at LA/Long Beach and almost on the consignee's dock at Toronto. For ships using a Seattle/Tacoma-Vancouver rotation, there is an extra day to Vancouver from Seattle/Tacoma. By the time the vessel docks at Vancouver, the train is at the Montana border. Logistically, it is imperative that Vancouver should encourage ocean carriers to make it a first call; the port authority is very aware of this and is trying to persuade carriers to act accordingly.

The surge in imports/exports in the Pacific southwest, coupled with limited growth of traffic in the northwest (dominated by Japan), poses some severe consequences for Canadian transportation. Unless more direct trade can be obtained for Vancouver, Canadian shippers and receivers will have to rely increasingly on U.S. ports and U.S. railroads or on marine feeder service via LA/Long Beach.

4. CONTAINER FREIGHT RATES

The next factor to be considered on the competitiveness of container transport systems is rates. To a shipper, what matters is total elapsed time and total cost. Service levels, tracing accuracy, damage claims and billing expediency all play an influential role, but it has not been possible to examine these factors within the present study.

On import traffic, the long haul routes are the most important. Trade sources indicate that 70% of Vancouver TEU imports go to eastern Canada. The situation on export traffic through Vancouver is more difficult to document. There is an appreciable movement of domestic traffic in international containers from eastern Canada to western Canada and subsequent reloading of the containers, primarily in Alberta and B.C., with export traffic proceeding overseas. The long haul movement within Canada is therefore less predominant on the export traffic.

Table 4 deals with import/export traffic rates between Toronto and Tokyo/Hong Kong. On the basis of the freight volume commitments made to carriers, lower rates are negotiated by freight forwarders and individual shippers who can offer large amounts of traffic. An attempt was made to obtain realistic rates for a shipper willing to make a commitment to a freight forwarder of one 20 ft. and a 40 ft. container per week over a year. The import commodity was consumer electronics, typical of finished goods from Asia, and the export load was dressed lumber, typical of primary goods from Canada. On each traffic lane, at least three freight forwarder rate quotes were obtained.[7] The quotes were averaged and stated as a percent of the published rate for the lane. While this approach would not produce the lowest rates that could be negotiated, it was an improvement on relying purely on published tariffs. Rates quoted were generally identical for Tokyo and Hong Kong and the two figures shown in each cell of the table are for 20 ft and 40 ft containers, respectively.

The combined freight forwarder rate for rail and water together to Tokyo/Hong Kong is appreciably higher from Toronto via Vancouver than through any of the U.S. ports. Rates quoted by freight forwarders were discounted more from the published tariff rates on the movements through Seattle/Tacoma than on the movement through Vancouver. The rates on import traffic from Tokyo/Hong Kong to Toronto were also lower via the U.S. ports than via Vancouver, but the difference was much less marked than on export traffic. It is hardly surprising that a large amount of long-haul Canadian container traffic to and from the Pacific coast is diverted through U.S. ports and U.S. railroads.

Table 4: Export and Import Rates: Toronto and Tokyo/Hong Kong, mid-1994				
Export Rates from Toronto to Tokyo/Hong Kong (US funds)				
	Freight Forwarders	Percent to Tariff	Freight Forwarders	Percent to Tariff
Vancouver	3,383/4,134	96/79	3,145/4,524	99/97
Seattle/Tacoma	3,060/3,478	85/77	3,024/3,701	94/95
Oakland	2,992/3,412	NA/88	2,701/3,225	NA/100
LA/Long Beach	3,029/3,364	NA/89	2,990/3,120	NA/100
Import Rates to Toronto from Tokyo/Hong Kong (U.S. funds)				
Vancouver	2,320/3,010	73/62	2,240/2,972	79/87
Seattle/Tacoma	2,235/2,818	69/69	2,162/2,720	77/76
Oakland	NA/2,805	NA/74	NA/2,730	NA/89
LA/Long Beach	NA/2,805	NA/75	NA/2,730	NA/88

5. SUMMARY

1. In 1993, Vancouver had a container throughput of 434,000 TEUs. However, an additional 173,000 TEUs of Canadian west coast traffic were diverted through U.S. ports in 1993, while Vancouver received only very small amounts of U.S. containers. Seattle/Tacoma accounted for almost 80% of this diverted Canadian traffic, with 9% through LA/Long Beach, 7% through Oakland and the balance through Portland and other minor ports. This diversion of traffic to U.S. routes was confined to container traffic up to 1994. Apart from a small shipment of potash through Longview, WA, the bulk traffic was all transported by Canadian railways and Canadian ports.

2. The container trades are moving towards larger ships and the industry is being increasingly affected by mergers, consortia and strategic alliances. These developments are improving efficiency and benefitting shippers. However, the downside is likely to be a reduction in the number of ports of call paid by the major container shipping lines. Los Angeles and Long Beach together rank as the world's fourth largest gateway and the

leading container port of North and South America. From the LA/Long Beach gateway, double-stack container trains can reach all points in North America from Toronto to Mexico City. With a world trend towards mega container ports, there is an obvious competitive threat to ports such as Vancouver.

3. Vancouver's two container facilities, Vanterm and Centerm, are close to capacity, but construction has commenced on the new Deltaport container facility at Roberts Bank. This will more than double Vancouver's container capacity when it comes into operation in 1996. Vancouver has suffered from a reputation for work stoppages, while labour relations have been much better in U.S. ports. Labour rates at Vancouver are substantially less than at Seattle and the low value of the Canadian dollar increases Vancouver's competitiveness.

4. Canadian and U.S. railroads all offer daily intermodal train service from the west coast. CN and CP each normally operate one train a day; this is less than the major U.S. railroads, but obviously the Canadian railways are limited by the volume of container traffic in Vancouver vis-a-vis U.S. ports. Railways in both countries have been very active in implementing alliances with other carriers to facilitate movement of both marine and domestic containers. However, the Canadian railways compete under two major disadvantages in comparison with U.S. railroads - lower productivity and higher taxation.

5. Canadian traffic diverted to U.S. ports is, of course, predominantly traffic with Asia. The major diversion at present is through Seattle/Tacoma. It is easier for Vancouver to compete for this traffic, predominantly from Japan and Korea in the developed north of Asia, than for traffic from southern Asian countries. However, the major industrial growth in Asia is now in the south and LA/Long Beach is a major competitor for this traffic. Vancouver is not well-situated to take advantage of traffic from the major growth areas of Asia, while increased concentration of container traffic in large ports may already be depriving Vancouver of minor trades, such as that with western Europe.

6. On *direct* long-haul water and rail routes, for example between Tokyo/Hong Kong and Toronto/Chicago, Vancouver is competitive in terms of service times with Seattle/Tacoma and Oakland and rather better than LA/Long Beach. However, this competitiveness can disappear on import traffic when Vancouver is the last port of call. For example, if a ship calls first at Long Beach and then goes to Vancouver, the extra

voyage time is four days. By the time the ship arrives at Vancouver, the container could be unloaded at Long Beach, shipped by rail and virtually on the consignee's dock at Toronto. The Port of Vancouver is trying to increase Vancouver's role as a first port of call.

7. On the basis of rates quoted by freight forwarders, it is roughly US$80 cheaper to bring a 20 ft. container from Tokyo or Hong Kong to Toronto through Seattle/Tacoma than through Vancouver. The difference is more than double for 40 ft. containers. On export containers, the Vancouver disadvantage on movements from Toronto to Tokyo/Hong Kong is even more marked at US$120 to $320 for a 20 ft. container and US$650 to $800 for a 40 ft. container. Routes through Oakland and LA/Long Beach are also less costly than via Vancouver. This is the problem with which Vancouver is faced and it is hardly surprising to find that Canada experiences diversion of west coast container traffic to U.S. routes.

ENDNOTES

1. John Heads et al., The International Competitiveness of Western Canadian Transportation, Report prepared by University of Manitoba Transport Institute for Western Economic Diversification Canada, Winnipeg, November 1994. Chapter 10 of this report dealt with container traffic; some of the detailed references in this chapter have not been specifically documented in the present paper. The principal author of the container chapter was Jake Kosior, assisted by John Heads.

2. Canada Ports Corporation, Business Review, Winter 1993, p. 12.

3. Correspondence with the research team.

4. For a fuller discussion of this, see The International Competitiveness of Western Canadian Transportation, op. cit., pp. 3-28 to 3-31.

5. ibid., pp. 3-8 to 3-10 and 3-24 to 3-27.

6. ibid., p. 10-40.

7. Obtaining ocean rates from freight forwarders proved to be a lesson both in patience and interpreting rates structures. All the forwarders approached (except one) had a real desire to assist the study, but this took time due to the frenzied nature of the shipping business. In years past, one or two quotes from ocean carriers were obtained by forwarders and the load was booked with the most convenient partner. In today's deregulated market several quotes must be obtained.

AN ESSENTIAL MARKET RESEARCH AND PRODUCTIVITY TOOL FOR THE TRANSPORTATION INDUSTRY

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INTRODUCTION

The Canadian transportation system is a complex network of transportation routes and modes competing for commodities flowing between various domestic and international supply and demand centres. The type, amount and direction of the commodities moving through this network are influenced by a multitude of interdependent economical, technological, political and institutional factors at domestic and global levels. In a rapidly changing competitive transportation environment, comprehensive and efficient freight traffic data and forecasts are vital for strategic planning and development in the transportation industry. Analysis of the present and future behaviour of commodity flows require the examination and interpretation of large amount of information before any sound decision can be made. The complexity of the transportation system, the unavailability of comprehensive logically organized and harmonized information on commodity flows at reasonable cost make this task difficult. A solution to this problem is to develop and use knowledgeable computerized systems that provide comprehensive information on commodity flows at optimum costs.

This paper will examine the Commodity Flow Information System (COMFIS), the latter was developed by the Author and reflects his vision of the tool needed to respond to the problem. Major factors which prompted the development of this system will be reviewed. The system concept and approach will be examined prior to describing its structure, components, outputs, applications and its impact on productivity in the transportation industry. Versions of COMFIS are presently installed and used by several organizations.

THE PROBLEM

Many factors necessitate the development and use of a tool such as COMFIS. It would have been relevant to review them in more details since the experience gained in encountering these problems might save a lot of efforts and money for many organizations - this topic may be the subject of another paper. However, for the purpose of this paper, the most important factors that prompted the development of a market research and productivity tool such as COMFIS can be summarized as follows:

The World political, economical and technological situations are changing and with it the World trade pattern. These global dynamic events have affected the Transportation industry and required it to modernize its activities in order to remain competitive. To cope with these new global realities, governments and private organizations involved in the transportation industry, are attempting to use more efficiently their transportation managers and professionals by exposing them to the latest affordable technological know how in the transportation business.

To remain competitive in today's complex, sophisticated and dynamic global trade system, organizations are gradually discovering the need to access and use comprehensive up-to-date information on commodity flows in order to undertake market research, traffic analysis and forecasting - activities that are vital to the assessment and improvement of their competitive position. An understanding of present and potential future commodity flow through alternative transportation routes and modes can make the difference between the success or failure of a transportation business.

Although these activities are vital for a successful business, they still are not necessary widespread or even exist in organizations involved in transportation industry. Rather they are sometimes adopted by selective and large public and private organizations. There are many reasons for this situation, most importantly is the cost of developing and maintaining these activities. The latter requires experienced and skilled professionals with a multi-disciplinary knowledge in transportation economics, market research, industrial complex analysis, system analysis and planning, port planning, engineering and traffic forecasting.

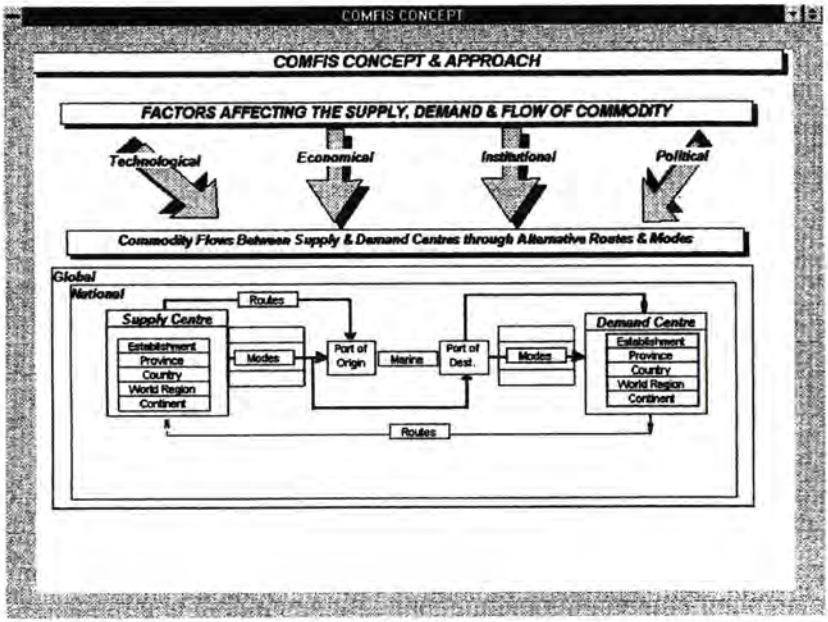
In order to perform effectively, these professionals must have access to a wide range of information which can only be found in some specialized libraries. They usually need to subscribe to domestic and international business and financial journals, magazines, reports, data bases, on-line services, etc. Furthermore, in order to be efficient, these professionals must also be equipped with software applications and computers related to the multi-disciplinary aspect of their function. Therefore, they are required to be at ease with the use of these tools and continually aware of their evolution. In developed countries the human resources aspects of this function is becoming very costly and sometimes difficult to justify. In developing country, although the human resources aspects are much less costly than in developed countries, the training, skills, information and supporting tools could be the problem.

Another reason for the restrained widespread of this function in many organizations can be the loss of confidence in a given information supplied by their professionals and or the decision maker may find that information never seems to be available on time for decisions. The unavailability of comprehensive, cost-effective, logically organized and harmonized information on commodity flows at one source makes the task of these professionals very difficult, time consuming and frustrating, particularly since the decision maker may not appreciate their situation.

Presently, several medium and small sized transportation businesses rely mostly on government for free information and studies related to the global economy, trade, market research, traffic analysis and forecasting of the transportation aspects of their businesses. However, as a result of the urgent need to reduce its financial debts and increase productivity, the Canadian government is embarking in policy of restructuring (downsizing) or privatizing many of its public organizations. Consequently, these free services could be seriously reduced and may even be completely eliminated. Subsequently, this can create a gap in a vital information service sector that will need to be filled if the transportation industry is to remain competitive in this new information era. These factors among others have prompted the development and implementation of COMFIS - a cost-effective computerized system that provides comprehensive information on commodity flows within a global and dynamic perspective. A system in which harmonized information on the supply and demand, trade, shipments and markets of commodities can be obtained quickly and efficiently.

CONCEPT AND APPROACH

The system discussed in this paper reflects the growing needs for the uses of computerized information for traffic analysis and forecasting as well as the evolution in software and hardware technologies.



The system's global approach is based on the concept that elements of a transportation system and factors that influence them are interrelated. By visualizing this relationship in a computerized information system, the identification, analysis and estimation of the present and future type, amount and direction of commodities flowing through a transportation network become efficient (Please see the above Figure).

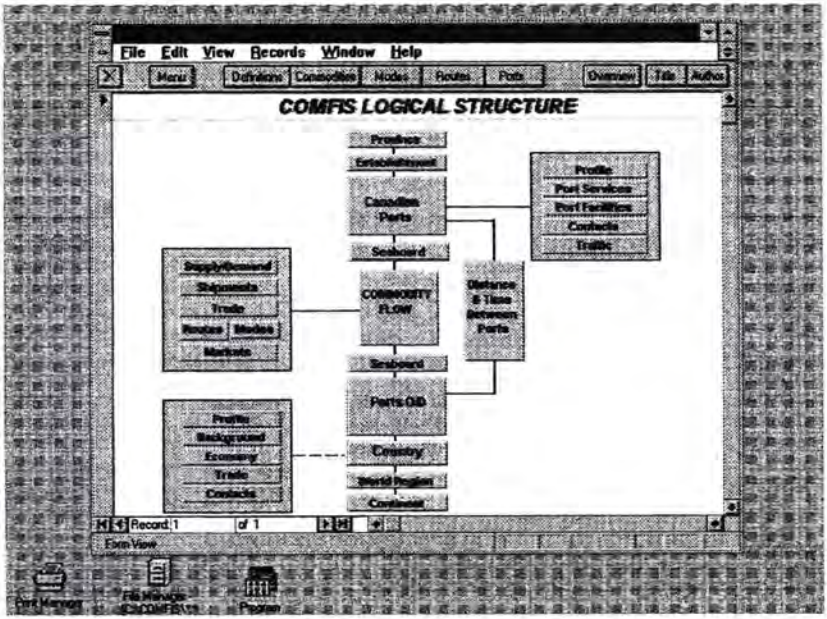
Simply put, COMFIS visualizes the World transportation system as a multitude of transportation networks comprising transportation nodes and alternative routes and modes that are competing for commodities flowing between various domestic and international supply and demand centres. The amount and direction of commodities flowing through this network are

influenced by several interrelated economic, technological, political and institutional factors at domestic and global levels. By assessing the impact of these factors, the process of analysing and forecasting commodity flows and traffic through alternative modes and routes is greatly enhanced and its credibility increased.

Accuracy of information, the ease of access and cost-effectiveness are the major objectives of this system. By operating on cost-effective micro-computers and a user-friendly environment, the information within the system is easily accessed and obtained with optimum maintenance, resources and costs, which makes it an ideal tool for budget conscious organizations seeking efficiency in a modern competitive transportation industry.

OVERVIEW AND STRUCTURE

COMFIS is based on a modular expandable core technology allowing additional modules that reflect present and future requirements. It consists of several integrated modules and sub-modules. COMFIS' modules are composed of objects that represent major transportation elements and variables related to commodities flowing between the centres of production and consumption. The system simulates the flow of commodities by logically organizing the objects (elements and variables) according to their sequential relationship in the commodity flow process. Moreover, a module can include one or more sub-modules and objects can be grouped into an object group.



The figure in the previous page shows COMFIS' logical structure and the relationship between its various objects. Accordingly, the commodity flow is a process which is represented by several object groups, each of which is composed of several objects (transportation elements and variables) as follows:

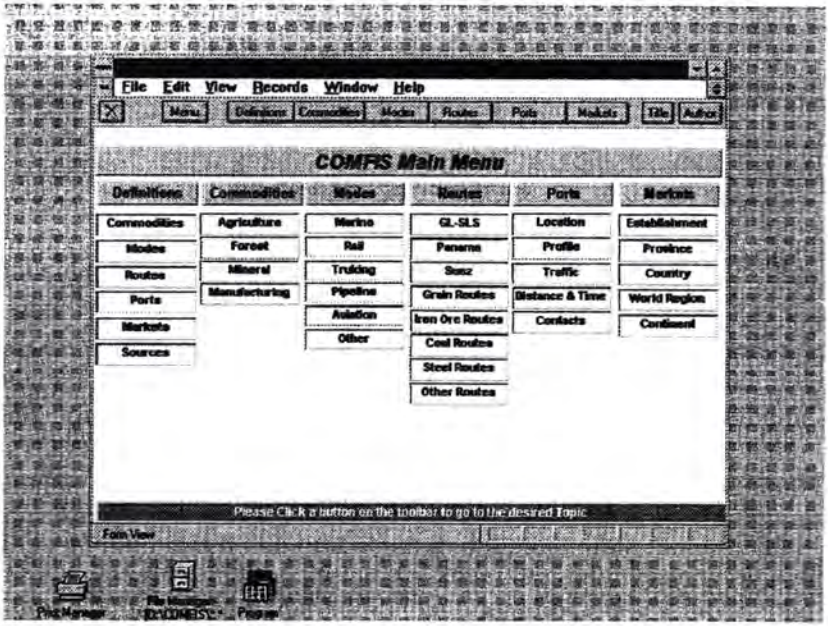
- Supply/Demand
  - Production
  - Consumption
  - Shipments
    - Domestic Shipments

      Loading and Unloading by Alternative Routes/Modes and by Ports, Seaboard Outlets and Markets (Establishments, Provinces) of origin and destination
    - Trade/ International Shipments

      Loading (Exports) and Unloading (Imports) by alternative Routes/Modes and by Ports, Seaboard Outlets and Markets (Provinces/States, Countries, World Regions and Continents) of origin and destination.

SYSTEM FEATURES AND CHARACTERISTICS

The system presented in this paper is composed of six (6) major modules based on the modular structural design described earlier. The figure below shows the Main Menu with its modules and sub-modules.



COMFIS' modules, sub-modules and objects (elements and variables) can be classified as follows:

- Definitions Module
  Definitions, classification of objects/groups (elements and variables) and sources of information used in COMFIS

- Commodities Module
  - Agriculture Products
  - Forest Products
  - Mining Products
  - Manufacturing Products

- Modes Module
  - Marine
  - Rail
  - Trucking
  - Pipeline
  - Aviation
  - Other

- Routes Module
  - Great Lakes-St. Lawrence Seaway (GL-SLS)
  - Panama Canal
  - Suez Canal
  - Grain Routes
  - Iron Ore Routes
  - Coal Routes
  - Steel Routes
  - Other Routes

- Ports Module
  - Location
  - Profile
  - Port Traffic
  - Distance and Time between Ports
  - Contacts

- Markets Module
  - Establishment
  - Province/State
  - Country
  - World Region
  - Continent

To be characterized as efficient and user's friendly the system satisfies the following criteria:

- Accuracy of information and ease of access are two of the major objectives of the system. Information is gathered from several reliable Canadian, U.S. and International Organizations.

- The system is multi-user and network-ready operating under Microsoft Windows™ environment.

- The scope and type of information provided make the system vital for many applications including: market research, traffic analysis, competitiveness studies, commodity flow analysis, traffic forecast, system planning, organization, presentation and education.

- Period and time series of information will vary depending on the topic and should represent the most recent available information. Periodical updates of information and added modules protect user's investment while maintaining consistency.

- The system is an intuitive and straightforward tool that provides the power of a comprehensive information system in everyday data management tasks. With a few clicks of a mouse on button based toolbar menus the user is able to easily work through increasing levels of details to obtain the desired information.

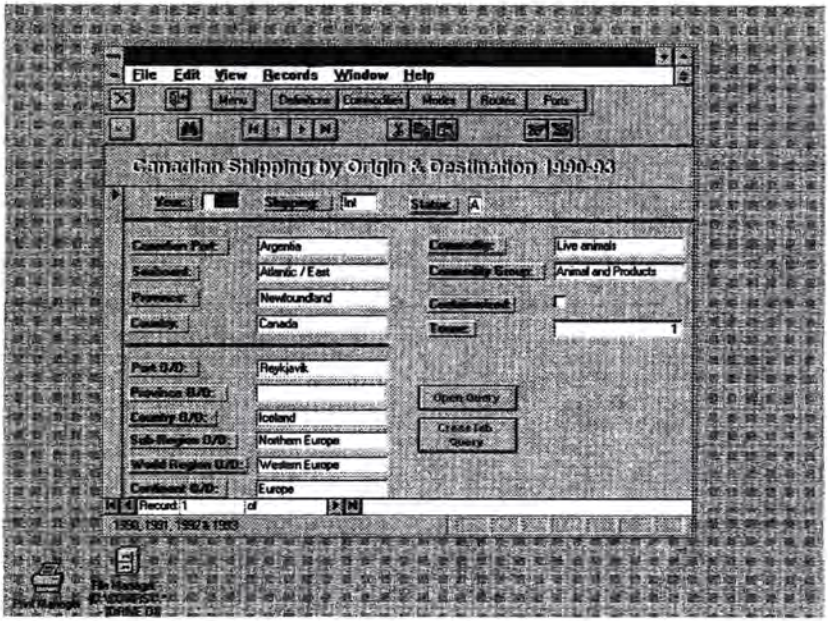
- The system can easily communicate with other applications by having the capability to automatically transfer its query output to a spreadsheet or a word processing file.

OUTPUT

Following is an example that demonstrates the type and scope of information that can be obtained from COMFIS. Assuming we want to start by getting information about the most important commodity X shipped between Canada and/or the U.S. and Country C. (Please see Figure on the next page).

- What is the most important commodity X shipped between Canada/U.S. & Country C in quantitative terms (tonnes)?
- What is the shipments status of commodity X (loaded or unloaded)?
- What is the shipments type of commodity X (containerized or non-containerized)?
- If the shipment of commodity X is for exports then from which Canadian/U.S. port(s), seaboard outlet(s) & province(s)/state(s) is it shipped to Country C?
- Which port(s) in Country C receives (unloading) commodity X from Canada/U.S. & on which seaboard outlet(s) is it located?
- What is the distance(s) (in nautical mile & in km) & vessel time(s) (in days) between the Canadian/U.S. port(s) of loading of commodity X & the port(s) of unloading in Country C?
- What is the rank of Country C, in quantitative & percentage terms relative to other Country(s) that receives commodity X & from which Canadian/U.S. port(s), seaboard outlet(s), & province(s)/state(s) commodity X is shipped to other countries?
- Where is Country C located? Which seaboard outlet(s)? Which world region? Which sub-region & which continent?
- Show the profile (area, population, economy, background) of Country C.
- What is the rank of commodity X, in quantitative & percentage terms, compared to other commodities shipped domestically & internationally from Canada/U.S.?

- What is, in quantitative & percentage terms, the total Canadian/U.S. shipments of commodity X by province/state, seaboard outlet, route & port?
- What is the market(s), in quantitative & percentage terms, for commodity X by continent, world region, country, province, seaboard outlet & port?
- What is the total Canadian/U.S. production, consumption, exports, imports, stocks & prices of commodity X during the last 5 years?
- What is the total world production, consumption, trade & prices of commodity X during the last 5 years?



CONCLUSION

In a rapidly changing competitive transportation environment, comprehensive and efficient freight traffic data and forecasts are vital for strategic planning and development in the transportation industry. To remain competitive in today's complex, sophisticated and dynamic global trade system, an understanding of present and potential future commodity flow through alternative transportation routes and modes can make the difference between the success or failure of a transportation business.

The complexity of the transportation system, the unavailability of comprehensive, logically organized and harmonized information on commodity flows at reasonable cost, make this task difficult. A solution to this problem is to develop and use innovative and knowledgeable computerized systems that provide comprehensive information on commodity flows at optimum costs.

A market research and productivity tool should be dynamic, evolving with time in order to reflect the needs and requirements of the transportation industry. Technically, these systems are expected to become more efficient in terms of performance and cost-effectiveness by taking advantages of the continual development in software and hardware technologies. The impact of information systems such as COMFIS on the transportation industry is considerable. The scope and type of information that can be provided, its wide applications, the ease of use and access to information at optimum maintenance and costs, make it an ideal tool for budget conscious managers and professionals seeking efficiency in a modern competitive transportation industry.

DEFINITIONS OF TERMS USED IN THIS PAPER

- Commodity Flow

  Commodity flow is the process related to commodity movements through alternative modes and routes between the centres of production and consumption. In COMFIS the commodity flow process is represented by several object groups each of which is composed of objects that represent the transportation elements and variables.

- Traffic Analysis and Forecasting

  Traffic analysis and Forecasting is a function, as defined in this paper, encompassing the following stages and activities that are vital to a sound Policy and Business Decision Making.

  - Inventory Development
    - Gathering of data and information
    - Harmonizing information and data from various sources
    - Organizing data and information into logical structure
  - Developing knowledge Data Base Information System
  - Analysis
    - Market research
    - Regional Analysis
      - Industrial Complex Analysis
      - Cost-Benefit Analysis
      - System Analysis
    - Route Modal Choice Analysis
  - Forecasting
    - Macro-Economics
    - Commodity Supply and Demand
    - Commodity Flow Forecasts
    - Traffic Forecasts
    - Impact and Sensitivity Analysis
  - Policy and Business Decision Making

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- *U.S. Dept. of Mines*
- *U.S. Dept. of Transportation*
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- *World Bank*
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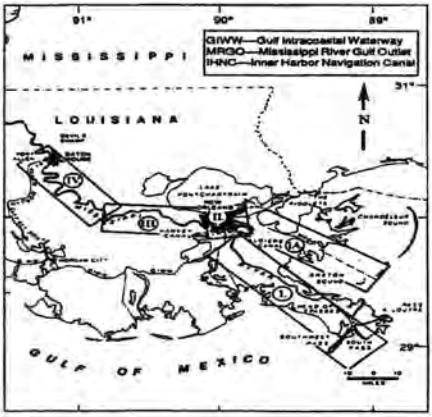
Vessel Accident Modeling: A Comparison of Neural Networks, Discriminant Analysis and Logistic Regression

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1.0 Introduction

Several studies (Center for Wetlands Resources, 1981; Perrow, 1984; U.S. Coast Guard, 1973) have reported that the Port of New Orleans and the lower Mississippi River (see Figure 1) are 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 (1988) and based on historic casualty records for the Port of New Orleans, the average cost of each vessel accident was estimated at $545,000.

Figure 1. New Orleans Vessel Traffic Service Operating Sectors



Accidents are, by definition, unplanned and unforeseen occurrences. Their causes are often circumstantial, with chance serving as a catalyst (Perrow, 1984). But accidents are not necessarily improbable occurrences. Indeed, circumstances may provide any degree of likelihood that they will

occur (Kwik, 1986). 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 and procedures for plying the lower Mississippi River than it does in the area of short term cause and effect inferences.

As applied in this research, neural network analysis assumes that human learning can be emulated by a network of massively interconnected but very simple processing units. The theoretical foundation for the algorithm of the current neural network models is based on Hebb's (1949) theory of learning in which connections between pairs of neurons are more strongly reinforced when the neurons are concurrently active.

Although neural network models are being developed in a wide variety of disciplines, there have been no published reports or field research investigating their potential use in predicting vessel accidents. In this study, a neural network is employed to predict the type of vessel accident that might occur along a major waterway - the lower Mississippi River from above Baton Rouge to the Gulf of Mexico.

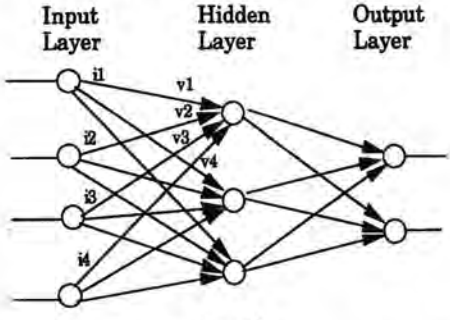
2.0 Background on Neural Networks

A brief description of the neural network model and the back-propogation algorithm is presented here. More detail may be found in Hertz et al. (1991) and Wasserman (1989).

2.1 Neural Network Architecture

A neural network is composed of a set of artificial neurons (nodes) grouped in a number of layers. The first layer and the last layer within a neural network are called input and output layers, respectively. The inner layers are known as hidden layers. The output of each neuron in a given layer (except the output layer) is fed as an input to every artificial neuron of the next layer. The input to the input layer is not the output of any layer. Figure 2 shows a three-layer neural network.

Figure 2. A Three-Layer Neural Network



Node N_i in layer L_n has four properties. These properties are: 1) an *input vector*, $I_i = [i_1, \ldots, i_k]$; 2) an *output*, a_i; 3) an *activation function*, f; and, 4) a *training rate*, μ_i. The input vector mimics the signals received by the neuron N_i from all the neurons (k neurons) in the previous layer. To each element of the input vector, a weight is associated which collectively makes a *weight vector*, $Vi = [v_1, \ldots, v_k]$. The weight vector mimics the strengths of synoptic connections between the neuron N_i and the other neurons. The inner product of $I_i \cdot V_i = s = \Sigma i_j v_j$ (for $j = 1, \ldots, k$) represents the total weighted inputs (signals) received by node N_i. The activation function f determines the level of excitation for the node N_i. The activation is the same for all the nodes of a neural network. The output a_i equals $f(I_i \cdot V_i)$. When the activation functions is a sigmoid function, then:

$$a_i = f(s) = \frac{1}{1 + e^{-s}} \qquad [1]$$

The training rate is a coefficient ($0 < \mu_i < 1$) that will be used in training of the node N_i. It may be the same for all the nodes within a neural network.

For the nodes $N_1, \ldots, I_j$ in layer L_n, the weight vectors of $V_1, \ldots, V_j$ related to input vectors of $I_1, \ldots, I_j$ make a matrix of J columns and K rows, W_n. The output for the layer L_n is a vector $A_n = [a_1, \ldots, a_j]$; and it is calculated as follows:

$$A_n = f(I_n \cdot W_n) \qquad [2]$$

Since all the nodes in the layer L_n have the same input vectors, then $I_n = I_i$ (although the input vectors for all the nodes of layer L_n are the same but their associated weight vectors are not). If the neural network is composed of $L_1, \ldots, L_m$ layers, then the output for each layer is calculated according to Wasserman (1989). The output of layer L_i is fed as input to the next layer, L_{i+1}. This process continues until the final output vector is produced. The process of taking an input and sending it through all the layers of a neural network to generate the final output vector is referred to as a *forward pass*.

2.2 Neural Network Training

Using a training paradigm, a neural network may be trained to generate the desired output vector for each individual input vector of a training dataset. The training paradigm of interest is the *backpropogation* algorithm. For a given input vector, it generates the output vector by a forward pass. Then, the difference between the output vector and the desired output vector is backpropogated through the neural network (from the output layer to the input layer) to modify the weight matrices for the entire neural network. This process is referred to as a *reverse pass*.

In the reverse pass, the training of the neural network takes place. Training the network means that all the weights in the weight matrices will be modified based on the Δ rule (Grossberg, 1974). For example, the weight v_j associated with input i_j for the node N_j in the output layer is changing to a new weight v'_j as follows:

$$v'_j = v_j + \Delta_j \quad [3]$$

The value of Δ_j is calculated using

$$\Delta_j = \mu_j \delta_j i_j \quad [4]$$

where:

1) μ_j is the training rate for the node N_j; and,
2) δ_j is calculated as

$$\delta_j = \frac{\partial f(s_j)}{\partial s_j} (t_j - a_j) = a_j(1 - a_j)(t_j - a_j) \quad [5]$$

in which

f is the activation function,
s is the sum of the weighted input,
a_j is the output,
t_j is the desired output for node N_j, and
i_j is an input to the node N_j and the weight associated to this input will be modified.

When δ_j is less than or equal to a *tolerance level*, then node N_j has learned the input pattern. The weight matrices related to the input vectors of the nodes in the hidden layers are also modified according to equations [3] and [4]. Since a desired output is not known for a given node in an inner layer, then δ for the node is calculated differently as follows.

Let M_k be a node in an inner layer (the layer immediately before the output layer). Let the output of M_k be a_{mk} which is fed as input to all the h nodes of the output layer. Let the weights associated with these h inputs, make the weight vector of $G = [g_1, \ldots, g_h]$. Let the δs calculated for the h nodes of the output layer make the vector $D = [\delta_1, \ldots, \delta_h]$. The inner product of G and D is:

$$G \cdot D = \alpha = \sum_{i=1}^{h} g_i \delta_i \quad [6]$$

and

$$\delta_{mk} = a_{mk}(1-a_{mk})\alpha \quad [7]$$

As shown above, the δs for the nodes in inner layer L_j are calculated based on the δs for the nodes in layer L_{j+1}.

After a neural network is trained, it is tested against the records of a testing dataset which have not been previously encountered by the network. For these records, the desired output is known. The output generated for each record of this testing dataset is checked against the desired output for that record. If there is a match, then it is concluded that the trained neural network could recognize (i.e., classify) the record correctly.

3.0 Applications of Artificial Intelligence in Transportation

Artificial intelligence techniques are suitable for application to specific transportation problems that are amenable to treatment on the basis of rules and relationships (Taylor, 1990). Further, these problems may be considered on the basis of incomplete or even conflicting information. It would appear that transportation is an area where AI techniques would be very applicable. In particular, there should be many possibilities for using AI in the planning and operation of transportation systems to enhance decision making.

There are several reviews of potential applications of AI to transportation planning and engineering, including Takallou (1985), Bonsall and Kirby (1986), Ritchie and Harris (1987) and Szwed (1988). A notable feature of these reviews is the relatively few operational AI applications reported, especially in the areas of planning and operations. The reviews conclude that AI developments in transportation have centered on the more traditional areas of highway and traffic engineering (i.e., engineering design) rather than the broader, possibly multidisciplinary areas of planning and system management and control. This is despite the conclusions of some reviewers (e.g., Bonsall and Kirby, 1986; Ritchie and Harris, 1987) that these areas are suitable candidates for AI development.

This research to evaluate the performance of a neural network in predicting vessel accidents on the lower Mississippi River represents an initial application of an AI technique to marine safety. As suggested by the aforementioned studies, there has been little application of AI techniques such as neural networks to the area of navigation systems planning and control. If a neural network can successfully predict vessel casualties on the lower Mississippi River, AI techniques can play an important role in the safe navigation of inland waterways.

4.0 Neural Networks Versus Traditional Techniques

4.1 Common Origins of Neural Networks and Correlational Methods

Neural networks and traditional methods have a common origin in Galton's (1888/1989) co-relations, Pearson's (1896) coefficient of correlation, and Gauss' (1809) least squares. Both are correlational techniques and both

aim to reduce mean square error. Further, discriminant analysis, a correlation technique developed by Fisher (1936), is a commonly used method of analysis in which differences between two or more groups of objects are examined with respect to several variables simultaneously. Neural networks also use discriminant functions for classification; and both compute the probability of group membership by applying Bayes' Theorem of probabilities and conditional probabilities.

4.2 Differences in Assumptions and Operations

Although the basic assumptions underlying regression and discriminant modeling can also apply to neural network analysis, neural networks do not assume *a priori* any specific type of relationship. That is, the theory of neural networks, derived from cognitive psychology, is based on adaptive learning through which the network *finds* the relationship. The robustness of neural networks is attested to by their capability for pattern recognition as well as for detecting linear, curvilinear, and other relationships.

The output of neural networks exemplify the uniqueness of a procedure that requires an entirely different way of thinking about data. The output in regression models is the linear sum of the weighted responses, whereas in neural networks *multiple* linear combinations are processed in parallel. That is, in neural networks the activation to each neuron is a separate linear combination. Thus, the neural network allows complex relationships to be accommodated. Rakes (1991) noted that a neural network is capable of discovering data relationships, whereas regression or other model building requires knowledge of the nature of the underlying relationship.

There are also differences between neural network testing and regression cross-validation sample sizes. The neural network literature prescribes a sample equivalent to ten percent of the training sample. In prediction research, however, there are several rules of thumb including splitting the sample into equivalent groups (Snee, 1977). Testing the neural network is analogous to cross-validation in prediction research.

There are differences between neural networks and regression/ discriminant models in the effects and treatment of missing data. Rakes (1991) noted that neural networks perform well with missing or incomplete data, a task that is most difficult for other correlational techniques. Zahedi (1991) stated that neural networks have the added advantage of performing successfully where other methods often fail - to recognize and match complicated, vague, or incomplete patterns.

4.3 Neural Networks and the Discriminant Model

Discriminant analysis and neural networks can be compared on six steps: 1) identify required output; 2) identify inputs or determinants;

3) develop a specific functional model; 4) estimate or train the model to known observations; 5) evaluate the statistical significance of the model's parameters; and, 6) validate the model against data not used during training. The researcher using a neural network omits stages three and five; however, the researcher using discriminant analysis proceeds through all of these stages.

In summary, while neural networks, discriminant analysis and logistic regression are all correlational techniques with several similarities, there are also distinguishing characteristics between neural networks and the noted statistical models which are frequently used for classification problems.

5.0 Marine Casualty Dataset

In this research process, the choice of variables to be used with the three types of pattern recognition (i.e., neural networks, discriminant analysis and logistic regression) is a most critical step. 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. 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 consulted to determine the most critical variables to use in this comparative analysis.

The variables for this comparative analysis were identified as the result of lengthy interviews 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 New Orleans Vessel Traffic Service); 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 (U.S. Coast Guard, 1985). 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 dataset was arranged so as to be consistent with the operational sectors (see Figure 1) of the lower Mississippi River as delineated by NOLA-VTS, the primary data source. The dataset is comprised of 279 cases

of vessel accident data occurring between 1979 and 1987 on the lower Mississippi River. Each record in this dataset is composed of eight fields. The content of each field is categorical data. For example, the weather field was coded to represent the month in which the accident happened, while the utilization field was coded to represent the level of system usage on the day of the accident.

There are 234 records in the training set and 45 records in the testing set, respectively. Each accident record consists of the following attributes: 1) accident type; 2) participation - whether or not the vessel(s) involved in an accident were participating in the vessel tracking; 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.

5.1 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.

5.2 Participation

This variable indicates whether or not a vessel, which was involved in an accident, was participating in the vessel tracking service. This represents communication between vessel and NOLA-VTS's control center and the exchange of pertinent information to aid navigation efforts.

5.3 River Stage

The stage of the river (height above sea level measured in feet) is a very critical element of vessel safety, because river staged 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.

5.4 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.

5.5 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.

5.6 Location

Indicator variables provide the area of the lower Mississippi River where the accident happened. Four areas, each with a different physical geography, were employed. (Refer to Figure 1 for definition of sectors.)

5.7 Weather

Meteorological conditions that are hazardous to navigation in the study area are those which produce strong winds, heavy rainfall, and fog. Indicator variables (Gilbert, 1968) were constructed to model these seasonal weather patterns which affect navigational safety on the lower Mississippi River (i.e., Dec-Mar, Apr-May, Oct-Nov, Jun-Sep).

5.8 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.

6.0 The Development of Training and Testing Sets

To select a testing set for the vessel accident analysis with a neural network, ten percent of the records for each respective accident type were set aside. Specifically, for each casualty category, every tenth record was selected as the testing set and yielded 45 records. This sampling for construction of the testing set was conducted only after conflicting records were removed from the dataset.

The training set was constructed by first determining which accident outcome (i.e., collision, ramming, or grounding) had the lowest frequency among the remaining records. This outcome frequency was 78 records. Therefore, the training set had 78 cases of collisions, 78 cases of rammings and 78 cases of grounding outcomes - a total of 234 records. The equal number of records (or cases) for each vessel accident type ensures that the neural network, discriminant model and logistic regression are not trained or developed in favor of one type of accident case. If this bias had not been removed, the neural network would have probably been trained in favor of groundings, which were most numerous.

7.0 Classification of Vessel Accidents

7.1 Classification by Neural Networks

A neural network with three layers was developed. It was trained with the backpropagation paradigm (Lawrence, 1992; Hertz, et al., 1991). Learning rate was 0.9 and the system was trained for 100 percent of the training set in 730 epochs. The number of nodes for input, hidden and output layers was six, five and four, respectively.

The number of nodes for the input layer is the same as the number of variables. The number of nodes in the hidden layers was decided using a trial and error process. The first three nodes in the output layer will be fired for collisions, rammings and groundings. The fourth node is fired by those input that are non-classifiable.

Table 1 provides the classification results from the neural network model of vessel accidents - collisions, rammings and groundings. The overall correct classification rate was 80 percent. Individual category or group classification rates (i.e., percent correctly classified) by the neural network were 67 percent for collisions, 77 percent for rammings and 90 percent for groundings. (This can be read diagonally down Table 1.)

Table 1. Classification of Testing Set by Neural Network

		Predicted Group Membership			
Actual Group	Cases	Group 1	Group 2	Group 3	NC*
Collision (#1)	12	8	1	1	2
		67%	8%	8%	17%
Ramming (#2)	13	0	10	1	2
		0%	77%	8%	15%
Grounding (#3)	20	1	0	18	1
		5%	0%	90%	5%
Column Totals	45	8/9	10/11	18/20	5
		89%	91%	90%	

*NC (Non-Classified): The neural network was not able to classify these cases.

Percent of "grouped" cases correctly classified is 80 percent (36 of 45 cases) if non-classified (NC) cases are treated as incorrectly classified by the neural network. Percent of "grouped" cases correctly classified is 90 percent (36 of 40 cases) if non-classified cases are excluded from the calculation.

There were some accident cases that the neural network was not able to classify. (These are noted in Table 1.) Such cases were considered as incorrectly classified records in the calculation of percent correctly classified vessel accidents. As stated above, the percent of "grouped" cases correctly classified is 80 percent (36 of 45 cases) if non-classified (NC) cases are treated as incorrectly classified by the neural network. But the percent of "grouped" cases correctly classified is 90 percent (36 of 40 cases) if non-classified cases are excluded from the calculation.

7.2 Classification by Discriminant Functions

To test the predictive capability of the neural network, its results were compared to those from a discriminant model, an alternative statistical model for categorization and pattern recognition. The comparison was conducted by analyzing the 234 records in the training set with the discriminant procedure in SPSS and predicting group membership for the 45 cases in the testing set. A two function model (Gilbert, 1968; Hair, et al., 1992; Klecka, 1980) was estimated by the discriminant algorithm using the training set as input data. The testing set was then categorized using the discriminant model.

Table 2 shows that the multiple discriminant model was able to provide only 53 percent correct classification of the testing set - a markedly poor performance in comparison to the neural network. The discriminant analysis correctly classified 25 percent of the collision cases, 62 and 65 percent respectively for ramming and groundings. (These statistics can be read diagonally down Table 2.)

Table 2. Classification of Testing Set by Discriminant Analysis

		Predicted Group Membership		
Actual Group	Cases	Group 1	Group 2	Group 3
Collision (#1)	12	3	5	4
		25%	42%	33%
Ramming (#2)	13	2	8	3
		15%	62%	23%
Grounding (#3)	20	5	2	13
		25%	10%	65%
Column Totals	45	3/10	8/15	13/20
		30%	53%	65%

Percent of "grouped" cases correctly classified: 53%

7.3 Classification by Logistic Regression

To further compare the predictive capability of the neural network, its results were compared to those from logistic regression (Mendenhall and Sincich, 1989; Neter et al., 1983). The comparison was conducted by analyzing the 234 records in the training set with the discriminant procedure in SAS and predicting group membership for the 45 cases in the testing set.

Table 3. Classification of Testing Set by Logistic Regression

		Predicted Group Membership		
Actual Group	Cases	Group 1	Group 2	Group 3
Collision (#1)	12	4	3	5
		33%	25%	42%
Ramming (#2)	13	1	8	4
		8%	62%	31%
Grounding (#3)	20	4	3	13
		20%	15%	65%
Column Totals	45	4/9	8/14	13/22
		44%	57%	59%

Percent of "grouped" cases correctly classified: 56%

Table 3 shows that the logistic regression approach was able to provide only 56 percent correct classification of the testing set - another poor performance in comparison to the neural network. This model correctly classified only 33 percent of the collision cases, 61 and 65 percent respectively for ramming and groundings (read diagonally down Table 3).

8.0 Summary and Conclusions

A neural network in this research has demonstrated its usefulness and accuracy in predicting the type of vessel accidents that would occur under different combinations of navigating conditions on the lower Mississippi River. Furthermore, the performance of the neural network has shown its superiority (refer to Table 3) over the statistical procedures of discriminant analysis and logistic regression. The neural network correctly predicted 80 percent of "grouped" accident cases, while the multiple discriminant procedure and logistic regression correctly classified 53 percent and 56 percent, respectively. (The neural network correctly classified 90 percent of the records, excluding the cases where network did not venture a prediction.)

Table 4. Summary of Accident Predictions

Technique	Cases	Predicted Group Membership			
		Collisions	Rammings	Groundings	Totals
Neural Network[1]	45	8	10	18	36
		67%	77%	90%	80%
Discriminant[2]	45	3	8	13	24
		25%	62%	65%	53%
Regression[3]	20	4	8	13	25
		33%	62%	65%	56%

1. Three-Layer Neural Network, 2. Multiple Discriminant Analysis, 3. Logistic Regression

From inspection of the column values in Table 4, the neural network model provides the most predictive accuracy of the three models for each type of vessel accident. Table values represent the number of correctly classified records of the testing dataset and their relative percentages. The neural network correctly predicted 67 percent of collisions. Second best was the logistic regression with only 33 percent correct classification of collisions. The AI application correctly classified 77 percent of ramming cases. The statistical models were tied at 62 percent in this category of marine casualty. The neural network obtained 80 percent accuracy in predicting groundings. The regression and discriminant approach could muster only 56 percent and 53 percent accuracy, respectively.

Accidents serve as an operational measure of marine safety, and specifically the safety of vessels, crews and cargoes. The ability to accurately predict the type of vessel accident with the categorical input variables of time, location, weather, river stage, and traffic could significantly reduce marine casualties by alerting port authorities and navigation groups (i.e., U.S. Coast Guard and U.S. Army Corps of Engineers) as to the likelihood of a specific kind of casualty. Action could be then taken to quickly respond to any predicted casualty on the lower Mississippi River. Preventive measures can also be taken, given the advanced notice of an accident likelihood provided by the neural network.

Only the NOLA-VTS had voluntary participation of vessels. It provided a valuable opportunity for field study. However, since other vessel traffic services in the United States (for example, Houston and San Francisco) require vessel participation in their respective tracking areas, these results from NOLA-VTS have somewhat limited applicability to vessel traffic services with required participation. The NOLA-VTS findings could be extrapolated to Houston or San Francisco ports if their respective vessel traffic services were not mandatory.

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Exploratory Multivariate Analysis of Traffic Collision Data

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Abstract: ***In 1990 the City of Calgary Police Services commissioned a study into the activities of their Traffic Section. In the report which resulted from this study there was a recommendation to make better use of the data which was already being collected. The existing database was criticized for not being fully exploited in terms of its potential use for policy formation. Police officers were criticized for issuing speeding citations at locations and at times when accidents were not occurring. Part of that database included vehicle collision reports. The present research describes how a subset of information was extracted from the collision report database. These data were subjected to principal components analysis in order to reduce the data to a smaller set of factors. An extensive literature search covering North American, European and Australian sources, among others , revealed that no systematic study has successfully determined the relationship between speeding and the probability of accidents. That there is a direct relationship between these two variables is one of the fundamental assumptions behind the deployment of photo radar and thus it was deemed necessary to explore this relationship in some detail.***

I. Introduction

The relationship between speed and traffic accidents can be split into two main areas of research. The first area, *severity*, depends on fundamental laws of physics and has been explored in detail. It relies on the premise that during a collision kinetic energy is released and transferred and that the resulting energy is directly proportional to the velocity and mass of the objects involved. The above underpins all research carried out that results in safer designs of automobiles and the creation of safety devices such as seat belts and airbags.

The second area is that of speed being a contributive factor to the actual event we call a collision. This *causative* relationship has also been the subject of much research but has resulted in considerable controversy (Haight; 1980:54).

> *"In contrast, ... the term "cause" is a source of major confusion... we have abandoned the word cause and use the phrase "contributing factor"... to mean any feature of the system, the variation of the system, the variation of which will alter the risk of an accident."*

We will follow this convention and use the term contributing factor.

The present research focuses on the behavior known as 'speeding', defined as travelling faster than the posted speed limit, as a contributing factor to traffic collisions. Information was gathered from the Alberta Collision Report Forms that

resulting in $1,000.00 worth of damage or greater. The multivariate technique of principal components analysis was applied to this information as a data reduction technique.

II. Background

Descriptive statistics are maintained throughout many countries that detail the tremendous cost to society brought about through the agency of traffic accidents. This information has brought about growing concern over this phenomenon resulting in a research that attempts to understand the many contributing factors to collisions. Many researchers have concluded that the nature of this problem is extremely complex and difficult to understand. Not only is there a bewildering array of techniques, approaches, choice of variables, and conclusions, but that little research has been conducted within the urban environment makes this a particularly difficult problem.

A. Social Cost of Traffic Collisions

The carnage on our streets has been with us now for many years. The tragic consequences of collisions have provided the impetus for research into this problem. It is probable that every Canadian has had his or her life touched by the grievous outcome of a traffic accident, either through personal injury, or the death of or injury to a loved one or close friend. While individual risk is seen as slight, aggregated statistics state that worldwide over 10 million accidents occur each year resulting in 1/4 million fatalities (Sabay & Taylor; 1979:4). The singular effect to our young people further adds to the poignancy of these events (Sabay & Taylor; 1979:2, Rosman & Knuiman; 1994:215). The Alberta Traffic Collision Statistics for 1990 states that: "16 - 19 year olds were more likely to be involved in a casualty collision than any other age group." While there appear to be certain explanations for this age distribution, it is still impossible to ignore the impact to society when those with so much to offer are tragically affected so early in life. The same statistics indicate that 409 people were killed in the province of Alberta and 18,604 suffered injuries as a result of traffic collisions within the province during 1990.

While the above appears to be sufficient reason to commit resources to the study and alleviation of this problem, collisions have many other costs associated with them. Loss of time at work for all those that suffer severe injury, insurance costs resulting in higher premiums to all, litigious costs that tie up our courts and affect insurance as well, increased cost to our health care system; all these may be added to the human suffering presented earlier to illustrate the dire need for intervention.

When speeding is introduced as a contributing factor other social costs may be introduced as well, such as increased fuel consumption and higher rates of pollution (Connolly & Abers; 1993:57).

B. The Relationship Between Speeding and Accident Occurrence

With the universal imposition of speed limits and the concerted effort by police departments the world over to enforce said limits, one could not be blamed for believing that operating a motor vehicle above the posted speed limit are a major, singular contributing factor to collision occurrence. The following quotations certainly support this perception:

"*It is well documented that increased speed increases accident risk.*"
(Ostvik & Elvik; 1991:56)

"*Increases in traffic speeds have been shown to give rise to increased accident occurrence.*" (OECD; 1981:iii)

The Alberta Traffic Collision Statistics for 1990 also states that travelling at an unsafe speed is contributory to casualty collisions. Empirical evidence also backs up these positive statements concerning accident causation and speeding behavior. The oil crises of the mid-seventies provided a watershed of information due to it resulting in a national reduction in interstate highway speed limits in the United States. Before and after studies have shown that the reduction in accidents was greater than the reduction in overall traffic thus suggesting a direct relationship (Nilsson; 1981:3).

Further studies attempt to establish this linkage directly and develop models that predict the decrease in fatalities and injuries based on reduction in overall speeds traveled (Rooijers & De Bruin; 1990:51). Rothengatter makes this sweeping statement in the same vein:

"*Depending on situation, type of road, country and levels of police enforcement, between* 20 *and* 80% *of the drivers exceeded the indicated limits. It has been estimated that an estimated* 30 - 50% *reduction in traffic casualty accidents could be achieved if speed limits could be realistically enforced.*" (1990:60)

The final link in this chain appears to be have been forged. Speeding contributes to accidents, increased enforcement reduces speeds, and reduction in speeds reduces collisions. Unfortunately the above argument is too simplistic and must be analyzed further.

C. Complexity

It must be remembered that the majority of studies on the relationship between speed and accident occurrence have been carried out in relation to the rural highway setting. The majority of fatal collisions occur on highways 68% compared to 32% in the city. However, this situation reverses when examining injury accidents, 73% urban and 27% rural, and collisions resulting in property damage only, 82% urban and 18% rural (Alberta Traffic and Collision Statistics: 1990). This concentration on rural highways makes it difficult to draw conclusions from the same results and apply to the urban milieu.

"*Traffic and accident patterns on urban roads are very different from*

those on the interurban network and therefore need a different approach. Some of the characteristics are: - a dense network of roads, including intersections and parking lots requiring a spatial approach; - areas of differing characteristics (Business district, shopping, residential, industrial, parks, and open spaces); - different types of accidents, pedestrian, intersection, etc.; - problems of congestion and peak hours; a lack of detailed information on traffic volumes."

(Hakkert, Yelinek, & Efrat; 1990:100-101)

In addition to the above complexity, the researcher is faced with the problem of not being able to control many factors. Changes are occurring all the time that make comparison from one year to the next problematic. The change in car design is one such change that occurs continually. Automobiles are faster, handle better, are built more strongly and more safely incorporating many new safety devices. Laws are also constantly changing. All models that wish to represent reality must somehow compensate for these ongoing variations that are beyond the control of the researcher. Perhaps Spicer put it best when he stated "The effect of speed is again very complex and must be studied in relation to all other site factors" (1973:4).

The researcher must deal with the real world and is not allowed the luxury of laboratory conditions. Quite often proxy information must be used due to the difficulty in taking accurate measurements that are compounded by the congestion of urban traffic. These constraints result in a variety of techniques and methods used in studies making it difficult to compare results. While recognizing these complications in an introduction to the 1981 Proceedings of the International Symposium on the effects of Speed Limits on Traffic Accidents and Fuel Consumption, the OECD extols researchers stating: "Nevertheless, it is useful to extract as many conclusions as possible from the data collected" (p. iv).

Often these studies that focus on enforcement and whether intervention results in lower speeds and therefore fewer collisions, ignore the urban realm resulting in an overall lack of information (Connolly and Abers; 1993:57, Hakkert & Yelinek; 1990:98, OECD; 1974:142).

It is not surprising to find a number of criticisms referring to work done in this area. A large degree of the criticism has to do with the descriptive nature of the studies that appear to be without any definite conclusions. (OECD; 1972:115). Data sets must be examined rigorously with an understanding of this complexity as well as the very randomness of the events. The data collected is often not gathered with the intent of being used for analysis. Police reports are designed for legal reasons and are not designed to facilitate quantitative analysis. They also have a tendency to concentrate on information at or after the accident with little information regarding events and conditions preceding the collision (Treat, Jones & Joscelyn; 1980:65). Without due regard to these factors, it is easy to understand the following critique:

"A casual observer might be forgiven for believing that in no other field

> *of applied scientific work are simple methodological rules ignored so widely as in road safety work. Hypotheses are rarely clearly stated, data limitations are ignored, and very many - and not just politicians or the publicists - commit the fallacy of 'post hoc, ergo propter hoc'.*"
>
> (Hearne; 1981:84)

III Data

Most of the data utilized in this report was graciously supplied by the City of Calgary Police Services, Traffic Division. A selected group of variables was extracted from the files containing all information collected in the Alberta Collision Report forms. This selection included all vehicular collisions, for which a form was completed, that occurred in the City of Calgary during the year 1993 (any collision resulting in $1,000.00 or more are required by law to be reported to the police). There was a total of 27,190 collisions of which 38 were fatalities and 2,148 were injuries. Two variables, road classification and posted speed limits, were obtained manually through the agency of comparing the collision location to an appropriate map containing the necessary information.

This material was entered into the Quattro-Pro (Borland Intl.) spreadsheet program where it underwent a series of editing procedures so that it would be presentable for analysis. Once this was completed, two data sets where created. The first set contained all accidents where the officer deemed at least one vehicle to be travelling at an unsafe speed. The second set is a subset of the first, this being accomplished by holding the three fields that relate to road and weather conditions constant with all conditions favorable. The rationale for this is to eliminate the subjectivity of the attending officer's judgment. Unsafe speed does not require the offender to travel faster than the posted speed limit, merely too fast for the present road conditions. By ensuring that the road conditions were good, we can safely assume that all represented by this second data set were in fact travelling in excess of the posted speed limit. This reduced the data set to 1,181 cases in total, 7 of which were fatalities and 254 being injuries, organized into 8 variables.

The variables in the data set ranged from nominal to ratio. This proved problematic as principal components analysis requires correlation coefficients for analysis. This was further compounded by the fact that the data was mostly categorical. As mentioned earlier, this is where it becomes apparent that this data was not collected with analysis as the prime motive. A way was needed to transform this data into a state that could be utilized for multivariate analysis or else the analysis would be severely restricted.

IV. Binary Data

While preparing the data for analysis it became apparent that attempting to place categories into components would prove useless for interpretation. For example, if there was a correlation between 'Speed Limit' (which would include

all values in that category) and 'Severity' (which would include all values in that category) all we would be made aware of is that there is some form of association between these two categories. As there must be a speed limit and the accident must have occurred on a road, or at least have begun there, we are no wiser for our efforts. We can not state what speed limit nor do we know whether the participants were injured, killed or not injured. It was decided to make each categorical value an individual variable and then it would be possible to compare particular units of data, such as speed limit and injury, directly to each other.

The first step in making this possible is to convert the data into a binary matrix. This was achieved by creating a column for each value and then transforming the information into 1s and 0s. The 1 would be interpreted as the presence of that variable, while the 0 would indicate the absence of that variable. Some form of association would be required between variables to be able to utilize this information in principal components analysis. The crosstabs procedure in SPSSX (SPSS Inc.) produces chi-square and Cramer's V statistics, the latter being a measure of strength of association between variables, but this value had limitations. Cramer's V ranges in value from 0 to +1, thus it does not indicate the direction of relationship and does not closely correspond to correlations that are traditionally used in principal components analysis.

Tinkler has devised a coefficient of association (Ca) for binary data (197131). It associates matched, or coincident, pairs and unmatched pairs and takes on the form:

$$\mathbf{Ca = 2\,(r/n - 1/2) \text{ or } 2r/n - 1}$$

where r = number of coincident pairs

n = total number of pairs

The range of values resulting from this equation is -1 to +1. We now have a measurement similar to correlations that when calculated between all the pairs of variables may be assembled as an input matrix for principal components analysis. The difficulty of interpreting analysis derived directly from a binary matrix is avoided by using this measure of association (Tinkler; 1971:31).

This coefficient is nevertheless based on binary data, and while having advantageous properties, must also be interpreted with its' limitations in mind. Tinkler discusses both these features in the following statement:

> "*Multiplying the index by* 100 *gives the exact percentage amount of correspondence or lack of it above or below that expected under Ho and in this way Ca is more analogous to the square of the normal correlation coefficients which indicates the amount of covariance. A very crude estimate of a correlation coefficient is therefore obtained by taking the square root of Ca.* (1971:34)

All coefficients being derived according to the above formula, the input matrix was constructed with 1's placed in the diagonal as required for principal components analysis. It was during this process that a particular problem was revealed. Certain values from the same category were matching up with each

other in the matrix, e.g., row O by column N. Thus the variable 'intersection' located in a row would fall under the column heading of 'mid block', for example. It is not possible for these to coincide so it was decided that in these special cases the value of -1 would be inserted to represent a pure negative relationship. Having completed this the input matrix was finalized and ready for use in principal components analysis.

V. Principal Components Analysis

As discussed earlier, the relationship between speeding behavior and traffic collisions is a complex one. The data set is large and the variables may be interrelated in an elaborate fashion. Compounding this problem is the fact that the researcher must work with whatever data is available, police collision reports as in this study, instead of being able to collect data that may better fit the methodology. It is too expensive and often impossible to collect pertinent data that is suited to *a priori* hypotheses, but this is the nature of traffic safety studies. Therefore, in the preliminary stages of investigation, the multivariate technique of principal components analysis may be extremely beneficial.

A. Background

When face with a bewildering array of information without the benefit of a well-formulated hypothesis, the technique of principal components analysis can offer insights into the nature of the data. This is accomplished by the two main features of this procedure: (1) its data reduction capability, and (2) its ability to organize the data into components that often expose underlying structure within the data (Nie et al; 1975:469, Tabachnik & Fidell; 1989:598). The data is reduced by grouping variables into components that are considered to summarize the patterns amongst the variables, and as the amount of significant components is less than the original quantity of variables a parsimonious answer is presented (Tabachnik & Fidell; 1989:598). To come to an understanding of the individual components the researcher may discover new concepts thus the exploratory nature of this approach is revealed (Nie et al; 1975:469).

When principal components analysis is employed for exploratory purposes it is extremely robust with few constraints upon the data. Decisions regarding number of factors to be derived, extraction and rotation technique, theoretical and practical limitations are relaxed in exploratory applications of the technique so as to allow the researcher to be able to explore the data freely (Tabachnik & Fidell; 1989:601). As for more fundamental data screening, that too may be relaxed, as illustrated below, proving this to be a most robust technique (Tabachnik & Fidell 1989:603).

No previous assumptions regarding relationships in the data are required, so we allow the data to recombine into components freely in order to reveal previously hidden patterns amongst the variables. Each component is a linear combination of variables arranged in descending order of explanation. The first

component is the 'best' combination of variables and explains the most variation in the data set. The second component is the linear combination that explains the most residual variance after the effects of the first component have been removed from the data set. The second component is orthogonal to the first. This process of extracting components continues with one component being extracted for each variable (Nie et al 1975:470).

Now this last statement may sound bewildering, if we extract as many components as there are variables then we have not reduced the data at all. What in fact occurs is a very rapid drop off in variance observed by each component. The researcher then must decide where to cut-off the lesser valued components, retaining the significant ones.

B. Results

Several methods are available for determining how many components should be retained in the solution; eigenvalue size, percent of variance and scree plots are the most common tools for decision. In the 'Initial Statistic' table, each component, or factor, is listed with its eigenvalue, percent of variance and cumulative percent of variance. As an eigenvalue of 1 theoretically means that the particular factor holds no more explanation of variance than a single variable, the decision to cut-off is above this point (Tabachnik & Fidell; 1989:634). This is also the default cut-off point used by the SPSSX program that was utilized for this research. Table 1 lists the information for all factors with eigenvalues above 1.

Table 1 INITIAL STATISTICS:

FACTOR	EIGENVALUES	PCT OF VAR	CUM PCT
1	13.29931	33.2	33.2
2	5.74727	14.4	47.6
3	4.15070	10.4	58.0
4	2.58382	6.5	64.5
5	1.69585	4.2	68.7
6	1.64935	4.1	72.8
7	1.27386	3.2	76.0
8	1.10267	2.8	78.8

A general guideline is that the number of components with an eigenvalue larger than 1 should fall within the range determined by dividing the number of variables by three, for the upper limit, and five, for the lower limit (Tabachnik & Fidell; 1989:635). The eight considered here fall within that range.

Another way of selecting factors involves plotting their eigenvalues in a 'scree plot' drawing a straight line diagonally through the first group of components and rejecting all the lower components that will deviate from this line. When this test is applied to the scree plot in diagram 1 on the following page, we find that only the first four components would be suitable for inclusion in the final solution.

Finally, the researcher must look for the aforementioned patterns within each component to decide its importance and utility for interpretation. This can be done by examining how the individual variables correlate to the components in the 'loadings matrix'. Several characteristics aid in interpreting the variables and components: marker variables, complex variables, strength of association and number of variables within each component.

Marker variables are those that correlate highly to one component and to no other. They assist in defining the nature of that component. Generally values higher than 0.3 are accepted as adequate for loading correlations. Complex variables are the opposite of marker variables in that they correlate to more than one factor. They may cause further confusion in that they have a tendency to group together in factors that do not necessarily have anything to do with the underlying pattern in the data (Tabachnik & Fidell; 1989:602).

Components with only one or two variables are suspect and should be avoided. If it is believed that there is homogeneity within the data, lower scores may be accepted. Once variables are chosen for inclusion within a component the researcher attempts to name the component in such a way as to include the information of the variables within it.

One last aid to interpretation is that of rotating the factor matrix. These methods fall into two broad categories. Orthogonal rotation attempts to alter the correlations to maximize the difference between components. Several methods are available and the Varimax method was used in this paper. This helps the researcher to interpret the loadings matrix by maximizing the higher variable correlations and minimizing the lower variable correlations. It performs this without altering the original mathematical solution. Oblique rotation allows for interrelationships to exist between the variables. It is often chosen if there is suspected homogeneity within the variables, but it often does not always improve interpretability.

The rotated Factor Matrix is presented in table 2. The table is arranged for easy interpretation by the following convention. The underlined correlation is the highest value for that variable, the variable name is underlined if it is considered to be a marker or it italicized if it is considered a complex variable. Underlined factor labels in regular type are those considered significant while those in italics will be removed from further analysis. Factors 6, 7 and 8 have few variables and most of them are complex and while Factor 5 does capture eight variables, they are all complex. Table 4 shows the remaining factors, or components, with their appropriate variables and the percent of variance explainedtogether with their suggested names.

C. Interpretation

The first component is labelled 'Stimulus Overload' due to the presence of traffic control devices indicating intersections or interchanges. Potentially dangerous maneuvers such as lane changes and merging as well as having a

greater range in the speed of traffic due to vehicles accelerating as they enter the traffic stream or decelerating as they leave it. This component is explored further by re-examining some of the original data as it is the most important component, explaining over one third of the variance.

Table 3 Factor Matrix

Variable	Fac.1	Fac.2	Fac.3	Fac.4	Fac.5	Fac.6	Fac.7	Fac. 8
Fatality	.273	.309	.362	.368	.450	.188	.165	.213
Injury	.208	.238	.292	.273	.408	.132	.174	.207
P. Damage	-.356	-.380	-.409	-.383	-.431	-.119	-.128	-.233
Pass. Car	-.396	.155	-.433	-.421	-.470	-.068	-.123	-.252
Pick Up	-.053	.863	.018	.013	.030	.079	.086	-.030
Mini Van	.003	.884	.084	.087	.106	.126	.092	.004
Truck >	.048	.767	-.075	.061	.056	-.226	-.503	.142
Truck	.006	.885	.088	.091	.109	.123	.097	.010
Motorcycle	.002	.882	.081	.086	.105	.140	.082	.007
E. Vehicle	.007	.885	.088	.091	.110	.127	.093	.011
Daylight	-.219	-.225	-.178	-.261	-.208	-.600	.160	-.077
Sunglare	.304	.341	.396	.384	.468	.111	.167	.232
Darkness	.042	.056	.048	.153	.198	.720	-.050	.046
*No TCD**	.439	-.344	-.363	-.286	-.349	.174	-.206	-.275
Sig. Lights	.841	-.099	-.062	-.087	-.040	.135	.060	.032
Stop Sign	.893	-.002	.033	.056	.094	.074	-.007	.031
Yield Sign	.899	.016	.054	.076	.117	.073	.021	.034
Merge Sign	.899	.023	.058	.081	.119	.091	.023	.034
Ped. X'ing	.899	.015	.053	.077	.116	.081	.004	.041
Lane Device	.899	.021	.058	.082	.121	.092	.016	.037
RR X'ing	.868	.069	.051	.050	.044	.194	.189	-.062
Normal	-.238	-.390	-.248	.297	-.205	-.657	-.123	-.036
Been Drinking	-.011	.023	.187	.809	.122	.117	-.187	.065
Impaired Al.	.059	.065	.118	.837	.186	.079	.055	.068
Impaired Drug	.092	.124	.178	.830	.224	.013	.123	.079
Asleep	.046	.190	.170	.772	.116	.152	.373	-.063
Intersection	-.270	-.429	-.315	-.367	.026	-.561	-.129	-.035
Exact	.057	.016	.082	.135	.802	.290	-.164	-.007
Mid Block	.164	.190	.251	.219	.750	.074	.159	.109
Unclassified	.146	.225	.255	.207	.710	.133	.271	.040
Residential	.107	.158	.187	.104	.196	-.029	.650	.398
Collector	-.036	-.083	.006	-.006	.011	-.021	.017	.865
Major Street	.131	.134	.201	.240	.295	.364	.097	.529
Freeway	.195	.198	.264	.276	.354	.291	.112	.503
30 Kph	.011	.125	.831	.172	.088	.216	.173	-.044
50 Kph	-.203	-.339	.319	-.239	-.163	.164	-.723	.056
60 Kph	.018	.033	.848	.083	.106	.047	-.099	.121
70 Kph	.032	.059	.864	.111	.140	.055	-.011	.038
80 Kph	.035	.046	.855	.101	.146	.062	-.046	.049
100 Kph	.031	.053	.845	.179	.152	.067	.022	.028

(TCD stands for Traffic Control Device.)*

Factor two involves all vehicles other than passenger cars. Without further study it would be difficult to interpret this factor, although it may be the result of

yet they may be involved in a disproportionately high amount of accidents. It is advisable to remember that this data set represents accidents that involve speeding on good road conditions, therefore most likely exceeding the speed limit.

Factor three is easier to interpret and even though the 30 Kph speed limit is within this factor, it can be viewed as an anomaly. It represents a special case that is sparsely represented in the data set and stands for a special geographic location. Most of these areas involve school zones or playground zones causing traffic to slow down, congestion can occur through compression and collisions may result. The higher speed limits show that when one travels beyond this, the likelihood of collision increases indicating less room for error at higher speeds.

The last factor shows that if one is engaged in speeding while impaired, the risk of being involved in a collision has increased. This bears out the campaign against driving while impaired and supports police efforts to reduce this behavior.

Four different areas for further study have been presented as a result of principal component analysis thus indicating the utility of this popular technique. It would be possible to perform this analysis over, using the first results as a guide for examining and removing variables that make interpretation difficult. All complex variables should be reconsidered. As we intend to add another year of data, it would be prudent to use this as a guide for data screening.

Table 3 Remaining Factors

Factor 1	**Factor 2**	**Factor 3**	**Factor 4**
Stimulus Overload	**Vehicle Other Than Passenger Car**	**High Posted Speed Limit**	**Driver Impaired**
33.2% variance	14.4% variance	10.4% variance	6.5% variance
No TCD	Pick Up/Van <4500Kg	30 Kph	Had Been Drinking
Traffic/Signal Lights	Mini Van/MPV	60 Kph	Impaired by Alcohol
Stop Sign	Truck >4500 Kg	70 Kph	Impaired by Drugs
Yield Sign	Truck Tractor	80 Kph	Fatigued/Asleep
Merge Sign	Motorcycle/Scooter	100 Kph	
Pedestrian X'ing	Emergency Vehicle		
Lane Control Device			
RR Crossing			

VI. Discussion

As discussed above, some variables do not associate as would be expected. The variable intersection, for example, should correspond closely to the variables in component one as all traffic control devices would be located at intersections, except for the RR Crossing signs and Lane Control Devices. This association did not occur was surprising and was deemed to merit closer inspection. The variable Passenger Cars was also interesting in that it was a complex variable and did not

load specifically in any one area. Perhaps this is due to the great variety of accidents that these vehicles are involved in.

A. Future Research

As this data was prepared using the crosstabs procedure it became apparent that the technique of logical regression might prove useful for future research. It would provide a model that would be predictive in nature and would use the variables 'fatality', 'injury' and 'property damage' as dependenvariables. A multivariate model could be built using variables targeted by the principal component analysis.

To go back to the issue of intersections and their apparent lack of association with variables that should be similar, research into the original data set helped clear up this problem. Simple comparisons of frequency counts between certain variables and 'intersection' helped in understanding this phenomenon. Three graphs were prepared, the first two indicating the preponderance of collisions at these sights and the higher ratio of fatal and injury collisions occurring here. The first graph, figure 1, shows the amount and severity of collisions by address location in the data set used for this analysis, which is to say where speeding was a factor on good road conditions and favorable weather conditions. Figure 2 compares all collisions in 1993 to the subset shown in figure 1. These two graphs have shown the need to address the problem of high collision occurrence at these locations relative to other locations. Figure 3, details the lack of correlation between the variable 'intersection' and the variables relating to presence of traffic control devices. As can be deduced, approximately 50% of the intersections do not have any traffic control devices whatsoever. This appears to be a problem in the data set and may signal a lack of consistency in completing the form by the reporting officer. More analysis may reveal a different solution to this problem. As most fatalities occurred at these locations the original data was scanned for fatalities only. In the data set for unsafe speed regardless of road or weather conditions, eleven fatalities were found of which only one was not at an intersection, and yet this one had a signal light present! Three other signal lights were found, one with a 50 Kph speed limit and two with a 70 Kph speed limit. The other locations had the following distribution of speed limits; two 100 Kph, four 80 Kph, and one 60 Kph. The higher frequency of faster speed limits indicates that these locations are interchanges which lack the traffic signals of intersections. The frequency of merge signs, for instance, is much lower than the frequency of interchange locations. A little further analysis should unravel this problem and make clear just what this relationship is. Graphing a comparison of posted speed limits to traffic control devices would be beneficial as would extracting all cases that appear as 'none present' in figure 3.

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Figure #1

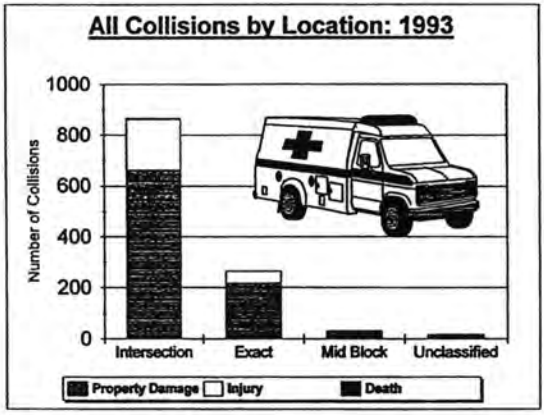


Figure #2

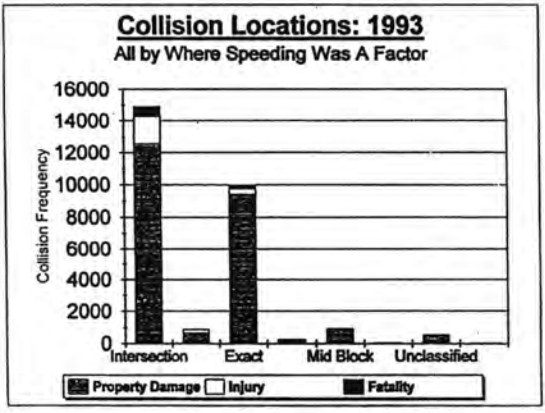
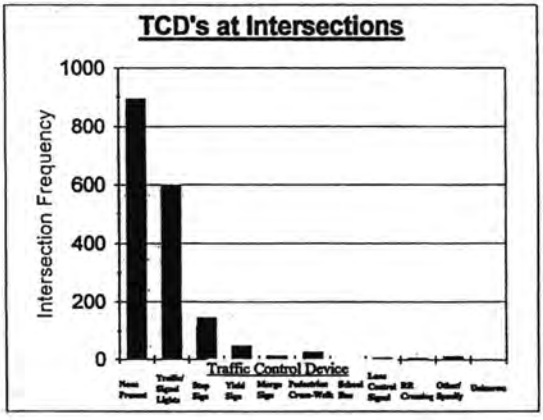


Figure #3



B. Conclusions

The utility in exploratory analysis has been exemplified by this work which shows how the researcher organizes and screens data for future research. The organizing power of this technique has created several dimensions in the data, each one suitable for future exploration and analysis. Problem areas such as complex variables indicate areas for detailed analysis. Some of these problems are due to the nature of the original data set. As explained in the introduction, the Alberta Collision Report Form was not designed with analysis in mind. Some fields had to be ignored as either inappropriate, redundant or, as in some cases, having internal inconsistencies made certain fields suspect as to their validity. Other fields, such as the intersection variable, might be understood in greater detail if explored in more detail. In that way, more information might be teased out of the data.

Yes, the conclusion is 'back to the drawing board', but one goes back armed with a deeper understanding of underlying processes and may also be able to formulate *a priori* hypotheses about certain relationships. What was a large bewildering array of complex data is now a smaller, organized array of data grouped into specific areas for future research.

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Logistics Policies for an Inbound Material Collection System

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Introduction

With the trend towards greater synergy between suppliers and industrial customers, most manufacturing enterprises are organized as *networks* of manufacturing and distribution sites that purchase raw materials, transform those materials into intermediate and finished products, and distribute the finished goods to customers. Management of such networks (also referred to as "supply chains") has recently emerged as a major topic in logistics management (Lee and Billington, 1993). Improving the efficiency of these systems requires striking a balance between the various logistical functions; in particular, inventory control and transportation planning need to be closely coordinated.

This work concerns the management of one segment of a supply chain by such an integrated approach: decisions for both inventory and transportation functions are made simultaneously to achieve near-optimality of the whole system. The specific situation considered is that of a central warehouse (where all stocks are kept) and several geographically dispersed suppliers. The central warehouse replenishes its stock by dispatching vehicles to collect the goods from those vendors, on routes which begin at the warehouse and end there. Our objectives are to, first, find a replenishment strategy (inventory control rules and routing patterns) that enables the warehouse to meet its demand at minimum long-run total cost per unit time and second, determine the cost saving under the integrated policy relative to those that minimize transportation or inventory costs only.

We remark that Blumenfeld et al.(1987) ascribe to General Motors a similarly structured supply network. In recent years, the GM network consisted of approximately 2,500 suppliers worldwide, 130 GM parts plants and 30 assembly plants. Final assembly of a typical General Motors vehicle requires that roughly 13,000 parts (varying in size and value) be fabricated

and assembled. These auto parts, either purchased from outside vendors or produced by the GM parts plants, are transported to and stored at central warehouses for supply to the assembly plants. Reduction of logistics costs (inventory and transportation) in the network is thus very important to GM and other auto manufacturers. In a different context, similar issues are also addressed by an integrated wholesaler/retailer in the supply of grocery products. Our goal in this article is thus to find effective policies for inventory replenishment and transportation route design in such networks. The cost saving under the integrated policy will be determined by comparing its total cost with those under the "non-integrated" policies, i.e. policies that minimizes either inventory or transportation cost only. We note in passing that the "parts" in the GM example are referred to as "items" in the present paper.

Related Work

Although there is substantial literature on both inventory control and transportation management respectively, considerably less is available on the combined problem. Initial studies in this area began in the mid-1980s. Federgruen and Zipkin(1984) integrate the allocation and routing problems within the same model by treating a single-period, single-item problem with random demands at the retailers. No ordering cost is considered. Yano and Gerchak(1989) address a direct shipment situation. They assume transportation cost per vehicle per shipment as fixed. In their single-period model, only one vendor supplies multiple items to a particular point. This greatly simplifies the transportation problem and avoids route design.

Anily and Federgruen(1990) consider a single-item, deterministic model where the objective is to minimize average transportation and inventory costs over an infinite horizon. They use a policy where a retailer can be assigned to different routes simultaneously, each route satisfying a fraction of the total demand. Anily and Federgruen(1993) extend this work to a two-echelon distribution problem where the central warehouse keeps system stocks instead of being a mere transshipment point. Gallego and Simchi-Levi(1990) present a lower bound on long-run average cost over all inventory-routing strategies for such systems. They compare the effectiveness of direct shipping with the lower bound. This is later revised by Hall(1992).

For the case of deterministic demands for several products at multiple retailers, Viswanathan and Mathur (1994) consider both inventory decisions and vehicle routes from a warehouse. They obtain a stationary nested joint

replenishment policy for the situation when replenishment intervals are power-of-two multiples of a base planning period.

Bell et al.(1983), Dror and Ball(1987) and Chien et al.(1989) consider the inventory-routing problem, a particular type of resource allocation problem which contains the following features: a single period model, a unique resource to allocate, deterministic customer-dependent daily demand, and replenishment decisions where stockout is not allowed. This problem, like ours, requires decisions on the period in which each customer is replenished. However, Dror and Ball(1987) have shown how to calculate each customer's delivery sizes, so that issues concerning inventory *policy* are not considered. One may therefore say that the inventory-routing problem is an extension of the vehicle routing problem with emphasis on transportation management.

Our research differs from previous work in one or more of the following ways: we address a multiple-items, several suppliers and stochastic demand over a time horizon. We integrate the inventory policy and transportation decisions into one mathematical model. Some restrictions imposed in the preceding references are relaxed with the inventory and transportation costs more realistically captured.

Problem Description

This is an inbound material-collection problem. The specific system considered consists of a central warehouse and several geographically dispersed suppliers. Items are demanded from the central warehouse and supplied by vendors, each of which specializes in producing one or more items. All stocks are stored at the central warehouse. When the central warehouse decides to replenish some of its stock, it will dispatch vehicles to collect them from suppliers. Hence, vehicles are dispatched from it and return there. The line-haul is empty while the back-haul is loaded. There is a constant lead time for each replenishment. Operationally, each supplier is responsible for getting items ready for pick-up. It is assumed that no shortage or delay occurs for any collection. Since the model is treated from the viewpoint of the manufacturer, charges to a supplier from holding stock are not considered.

A manager of such a system has to make two decisions: first, when to replenish an item and at what quantities; second, the transportation route to use for each trip. The objective is to find integrated inventory and

transportation policies so that the warehouse may satisfy demand at a minimum long-run average cost per unit time.

The total system cost consists of the transportation and inventory costs. For each collection, transportation cost includes a joint dispatch cost, stopover cost at each supplier, and a variable cost proportional to the travel distance. Sufficient vehicle capacity is assumed for each dispatch (subsequent research will consider vehicle capacity constraints). On the inventory side, the ordering cost structure consists of a joint cost for placing an order (embedded in the dispatch cost), and in addition, an item-dependent minor cost for including any specific item in that replenishment. Inventory holding cost at the central warehouse is incurred at a constant rate per unit time. Total backlogging is assumed at the warehouse, with a cost proportional to the total number of units short.

Since the structure of the optimal solution is unknown, our work restricts attention to a class of inventory policies proposed by Atkins and Iyogun(1987) and finds an optimum within the selected class, namely a modification of the periodic review (R_i,T_i) policy. In the usual form of an (R_i,T_i) policy, item i is replenished up to R_i every T_i periods. However, in the *modified* periodic inventory policy (MP), each T_i is an integer multiple of a base period T. T corresponds to the order cycle of a set of items, the so called "base items", that are re-stocked most frequently. In our model, we will choose the base period T by optimization.

Because the review intervals T_i may differ, a varying number of items will be jointly ordered in each period. The items replenished in a given period j consist of the base items, plus all items i for which jT is an integer multiple of T_i. Corresponding to the items replenished in period j, suppliers of these items will be visited by a truck following the optimal route design based on the solution of a Travelling Salesman Problem.

The multi-item joint replenishment process under the MP policy is a regenerative process. The length of each regeneration cycle, is the least common multiple of all the T_i. Since the expected behaviour in each cycle is the same, the long-run cost per unit time is equal to the mean cost over one cycle. Hence, the objective function of this inbound material collection problem is to minimize the expected total cost in a regeneration cycle.

For formulation of the mathematical model, see Qu, Bookbinder and Iyogun(1994).

Solution Method

A decomposition method is developed in that paper to solve the problem heuristically. The mathematical formulation of total cost C indicates that the problem is difficult to solve directly using existing methods. C is neither separable by item, nor by period. As the first step of the decomposition method, the joint costs from the cost function C are excluded so that the remaining costs become additive in items. Decomposition of total cost by item can thus be achieved by fixing travel and stopover costs, and then allocating it, together with joint dispatch cost, to each item in every period. The result is a conventional inventory master problem, decomposable by item. The fixed transportation costs in each period can be obtained through solving an independent transportation subproblem, separable by period. Solutions to the decomposed inventory and vehicle routing models can be found without great difficulty.

The cost from the above heuristic method constitutes an upper bound to the optimal solution. Since the minimum cost for problem (P) is unknown, a lower bound is found by Qu, Bookbinder and Iyogun (1994) to test the effectiveness of the heuristic. Denote C and LB as the costs from the heuristic method and the lower bound, respectively. The C/LB ratio demonstrates the effectiveness of the heuristic method. It is obvious that the closer C/LB is to 1, the more effective the heuristic method is. The optimal solutions occurs when C/LB equals 1.

Numerical Example

Table 1 Geographical Layout (Distances in Miles)

	Warehouse	Supplier 1	Supplier 2	Supplier 3
Warehouse	-	11	9	7
Supplier 1	11	-	5	8
Supplier 2	9	5	-	10
Supplier 3	7	8	10	-

In the numerical example, the model consists of one central warehouse, three suppliers and four items, with supplier 3 producing both items 3 and 4. For the geographical layout and input data, see Tables 1-3.

That input was generated from information in Example 5.2 of Hadley and Whitin(1963).

Table 2 Input Data

	Item 1	Item 2	Item 3	Item 4
demand rate (units/year)	600	900	1200	1000
diffusion coefficient (units^2/year)	800	600	700	500
leadtime(years)	0.02	0.02	0.02	0.02
holding cost ($/unit/year)	5.6	21	42	15
penalty cost ($/unit)	28	35	40	30
minor ordering cost ($/order)	25	14	20	30

Two additional constants: unit travel cost =0.50 $/mile and dispatch cost = $100 per dispatch.

Table 3 Items Produced by Suppliers

	Supplier 1	Supplier 2	Supplier 3
Item 1	yes	no	no
Item 2	no	yes	no
Item 3	no	no	yes
Item 4	no	no	yes
stop-over cost ($/stop)	40	50	60

The Integrated Inventory-Transportation Policy

As mentioned before, the C/LB ratios in Table 4 demonstrate the effectiveness of the heuristic method under various values of the dispatch cost. We observe that all the C/LB ratios are below 114% and they improve as the dispatch cost increases. That indicates our heuristic method performs well overall, and especially when the dispatch cost is large.

Table 4 The Integrated Inventory-Transportation Policy

dispatch cost	100	300	500	700
total cost (C)	9021.2	11242.7	12993.3	14455.8
lower bound (LB)	7883.1	10262.6	12105.7	13672.1
C/LB(%)	114.4	109.6	107.3	105.2

Service Level

It is important to check the service levels attained under the modified periodic inventory policy. We employ the two most commonly used measures: $\mathcal{P}_1$ the probability of no stockout in a replenishment cycle; $\mathcal{P}_2$, the fill rate, the fraction of demand satisfied routinely from shelf (without backlog). Formulae for $\mathcal{P}_1$ and $\mathcal{P}_2$ are adapted from Schneider(1981).

Table 5 Service Levels Attained (%)

dispatch cost	service level	Item 1	Item 2	Item 3	Item 4
100	$\mathcal{P}_1$	95.44	95.44	92.02	99.20
	$\mathcal{P}_2$	99.81	99.79	99.68	99.86
300	$\mathcal{P}_1$	95.76	93.64	88.87	94.70
	$\mathcal{P}_2$	99.82	99.75	99.60	99.83

Results listed in Table 5 indicate high values of both service measures, particularly for fill rate $\mathcal{P}_2$. We also notice that when joint dispatch cost increases, $\mathcal{P}_1$ decreases due to longer replenishment cycle while $\mathcal{P}_2$ remains the same. $\mathcal{P}_1$, because it is more sensitive to changes in the dispatch cost, is a better measure for monitoring this system to insure satisfactory customer service.

Cost Savings under the Integrated Inventory-transportation Policy

We compare the total cost under the integrated policy with two other policies, each of which minimizes transportation or inventory cost respectively.

Policy 1 minimizes the transportation costs (dispatch, stopover and travel costs) without considering its impact on the inventory costs. Minimum transportation cost is achieved when all the suppliers are visited on the same trip. This implies that replenishment cycles of all items are the same T. Since the model reduces to that in which all the items are replenished in the same cycle, all the suppliers are visited every time there is a replenishment. The optimal route and transportation cost are therefore easy to calculate.

Policy 2 focuses on reducing the inventory costs (minor ordering, holding and backlogging costs) only. Since major ordering cost is considered as part of the dispatch cost, no joint cost is considered in this inventory problem. Minimum inventory cost can be achieved when we relax the constraint that each T_i has to be an integer multiple of the base period T. That is, every T_i periods, item i is replenished to R_i regardless of the status of other items. An order is placed and vehicles are dispatched to collect that item from the suppliers. No joint replenishment or shipment consolidation is considered.

Table 6 Cost Comparison between Integrated and Non-integrated Policies

dispatch cost	Difference 1 (%)	Difference 2(%)
0	3.4	8.9
50	2.5	22.5
100	2.4	31.8
200	1.6	42.7
400	0.5	52.9
600	0.0	58.3

Difference 1 (%) represents cost difference between Policy 1 and the integrated policy in percentage, with its value computed as (Cost of Policy 1/Cost of Integrated policy - 1)*100%. Similarly, Difference 2 represents the

cost difference between Policy 2 and the integrated policy. Difference 2 (%) equals to (Cost of Policy 2/Cost of Integrated policy - 1)*100%.

Tables 6 lists the cost differences between the integrated policy and Policies 1 and 2, respectively. We notice that, for all levels of the dispatch cost, the total cost is lowest for the integrated policy. Policy 2 is most costly, and the Policy 1 is in between. It is obvious that by using the integrated policy to manage this inbound material collection system, cost savings can be achieved.

Conclusion

This work addresses a multi-item inbound material collection problem. The integrated system we consider incorporates more realistic features on inventory control and transportation management. Our model provides a clear description of how these two issues interact, and how to achieve a near-optimal inventory policy and vehicle routing schedule simultaneously by using a heuristic decomposition method. Numerical tests indicated that the decomposition method performed satisfactorily in find the solutions. The integrated inventory-transportation policy obtained provided high service levels to the central manufacturer and yield significant cost savings for this inbound material collection system.

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Terminal Management for Less than Truckload Carriers

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I. Introduction

The importance of highway freight transportation in modern societies has grown consistently in recent years. Year after year, national statistics show that the volume of highway freight transportation is on the increase more than the one associated with transportation by either rail, water, or air. This increase is easily justified by the flexibility and the speed of the trucking industry.

An important proportion of freight shipments handled by independent trucking firms are partial loads. Firms which are mainly involved in the transportation of partial loads are refered to as "less-than-truckload carriers" (LTL). According to Statistics Canada, partial loads accounted for an average 85% of the number of shipments, 50% of shipment revenues, and 15% of the weight of goods shipped. In a previous study, d'Avignon[1990a] estimated, using certain well-accepted hypotheses in the industry (eg. the assumption that 30% of all costs can be attributed to handling at the terminal), that for the independent trucking industry in Québec the total handling costs are approximately $200 million for a market of $1,500 million. One could speculate that these costs are conservative and increase each year.

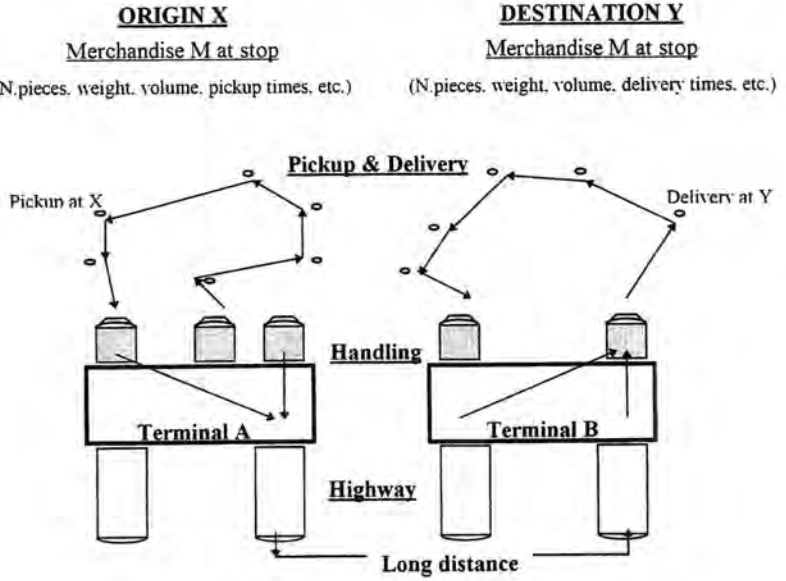
Consequently, a thorough analysis of freight terminal operations is justified. This analysis will permit the identification of factors influencing terminal productivity and should help its management.

In this first section, before elaborating on physical and productivity considerations, we propose to characterize the general context in which terminal activities take place. In the second section, we present the model of terminal activities in order to come up with a terminal time formula for every shipment. In Section 3, we present the validation of our model at five terminal and we discuss the validity of our approach as well as the interpretation of its implementation. Finally, a conclusion points to the main findings and further developments.

I.1. General Context

In LTL operations, one may identify three sectors of activity: pickup and delivery, terminal handling, and the long haul between the origin and destination terminals. Figure 1 below illustrates these three activities.

Figure 1. The Three Sectors of LTL Operations.



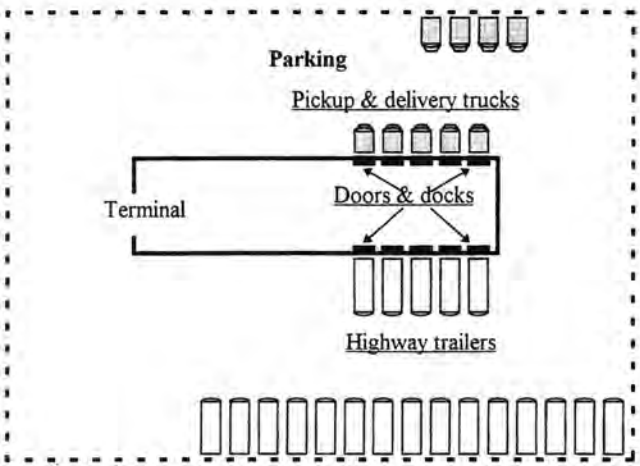
Increasing efficiency encourages trucking firms to consolidate pickup/delivery activities, to organize the handling process by effecting transfers of freight between local trucks and long-distance trailers at the terminal. With such an activity in sector organization, it is possible to model the transportation of shipment M from an origin X to a destination Y: i) pickup operations; ii) handling operations at the terminal of origin; iii) long-distance activities; iv) handling operations at the terminal of destination; and v) delivery operations. Even though interactions among the activity sectors would ultimately need to be modeled, the present research considers only the terminal handling activity.

I.2. Physical and Time Considerations

The site of a typical modern design freight terminal is essentially made up of interior and exterior areas. The exterior includes parking areas for the trucks and traffic aisles around the building. The building normally has a rectangular form. It includes a series of doors which are built into each of the two long parallel sides. Considerations such as the height of trucks and trailers, as well as certain operating procedures, encourage the use of separate loading docks to serve local and long-distance vehicles. Thus, in general, the local pickup/delivery trucks are served on one side and long-distance trailers are served on the other side. In addition, other characteristics can be useful in describing the loading docks and possibly to which trucks they are assigned.

Depending upon the specific operations of each firm, temporary storage areas can be found in the middle of the terminal interior. Figure 2 below illustrates the physical layout of a freight terminal.

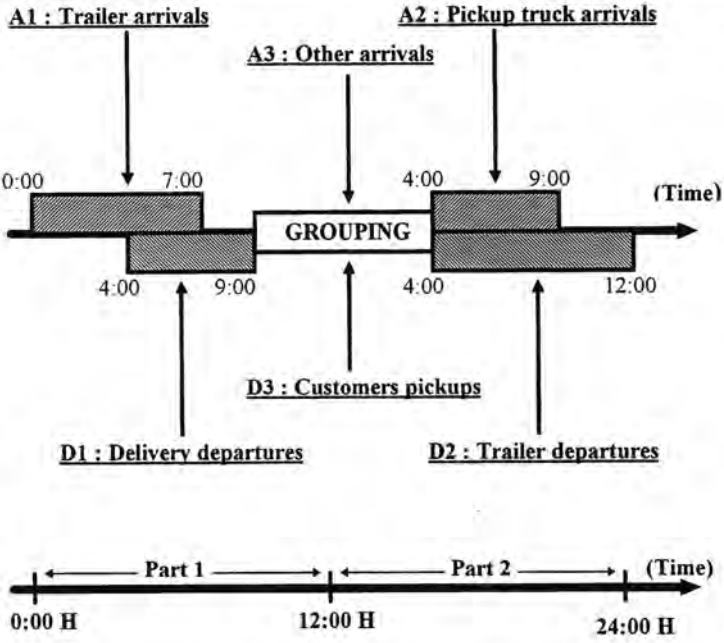
Figure 2. The Physical Layout of a Freight Terminal.



For the development of a model of operations, it is useful to define the terminal freight handling activity (D'Avignon[1990b]). Considering the three sectors of activities as well as the physical layout described above, one may define the *terminal freight handling process* as the result of the interaction of loading and unloading processes within a certain time period.

The time period can vary from one firm to another, depending upon the logistics adopted and the firm's degree of specialization within the trucking industry. Consequently, when consolidation plays an important role, the time period under consideration becomes longer. In most North American trucking firms, a time period of 24 hours is considered typical. In any case, the most important aspect of the above definition corresponds to the loading and unloading processes. Identification of the origins and destinations of the freight may be used to characterize the processes of loading and unloading. Freight arriving to be unloaded is usually conveyed by means of either: trailers arriving from other terminals (A1); pickup/delivery trucks arriving from areas in the vicinity of the terminal (A2); outbound goods arriving at the terminal by shippers themselves (A3). Likewise, departing freight usually has one of the following destinations: pickup/delivery trucks departing for areas in the vicinity of the terminal (D1); trailers departing for other terminals (D2); outbound transfers effected by shippers themselves (D3). Figure 3 below illustrates the interaction of the loading and unloading processes. Here, it is assumed that a 24-hour time period can be subdivided into a day period (part 1) and a night period (part 2).

Figure 3. The Daily Handling Process.



I.3. Measuring Productivity

The productivity measure presently used for terminal operations is global, computed from aggregate data. That is, considering a period of transshipment operation, say a day, we add up the total number of pounds handled during that day and divide it by the number of persons-hours needed to do the work. This is an average which does not properly reflect the particularity of individual shipments nor the productivity associated with the unloading/loading of a specific trailer. Moreover, these measures are difficult to interpret when it comes to the improvement of handling procedures.

Consider, for instance, a productivity measure of 4,000 pounds per person-hour at a particular terminal. If an "easy" shipment of 2,000 pounds has to be handled, can we safely say that it would cost half an hour of handling resource with one person? And, if one has to handle a trailer of 28,000 pounds of merchandise, should we always forecast 7 people during one hour. Moreover, such a measure does not indicate how we can improve the productivity at that terminal. Therefore, we propose to introduce a new approach in measuring productivity by looking at the particular operations involved when handling shipments.

II. Modelling Terminal Operations

II.1 The Basic Model

The literature reports very few studies focusing on terminal operations. Peck[1983], for example, analysed a minimization problem of the overall handling effort. Our objective is rather to look at the measurement of the handling time to be associated to each shipment. Therefore, our approach is to look at the basic operations needed in order to handle individual shipments. These basic operations are as follows: preparing freight when necessary, moving freight over the dock and doing the complementary tasks. These operations were identified and analyzed in the terminal operations model introduced in Thériault[1991] and experimented in D'Avignon & Thériault[1992].

Preparing freight means taking the parcels that are not on moving equipment and placing them on moving equipment in order to be able to move the freight easily. This would include the reverse work: taking the parcels that are on moving equipment and placing them at a specific place on the dock or in a vehicle. There are three principal pieces of moving equipment: two-wheeled hand truck, platform truck and pallet.

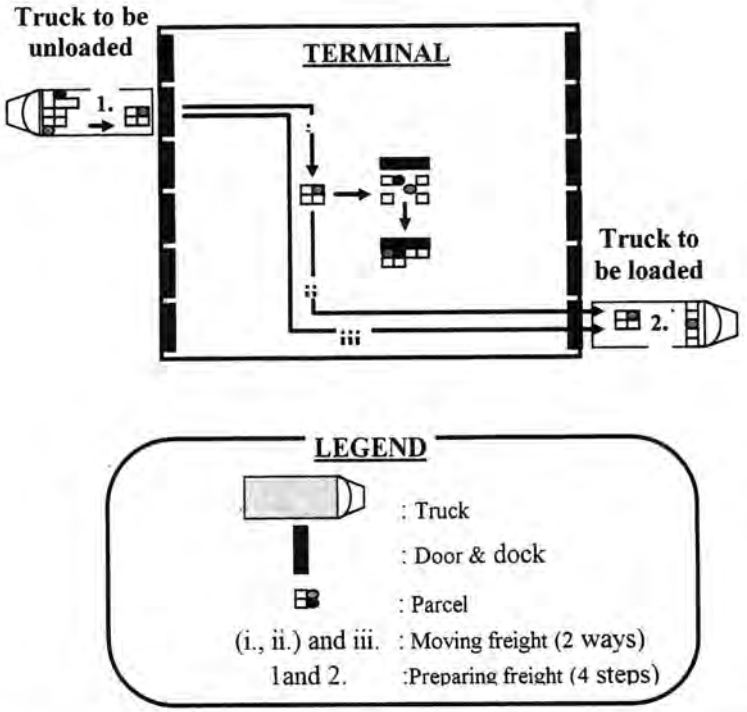
Moving freight means: transporting the freight on the dock, manually or with lift-truck; this operation is possible by using a vehicle. There are four principal

vehicles: platform truck, two-wheeled hand truck, "gigger" and lift-truck. Each vehicle is characterized by speed, force, volume, height lifting. However, the first three vehicles are usually used in manual handling (coded M) whereas the lift-truck is used in mechanical handling (coded L).

Complementary tasks are the many little jobs that complete the handling of parcels. Time required by these complementary tasks are considered "non-productive" tasks. For example: supervising the handling process; making bills of lading in order on the work table; once handling is over, signing bills of lading; in the terminal, finding the parcels to handle; sweeping up; answering clients and many other tasks.

The first two operations are presented in figure 4 where we see that they are directly linked to particular shipments. The third operation refers to administrative work in relation to the handling of shipments in general.

Figure 4. The First Two Operations of Handling Shipments.



Therefore, our approach in determining terminal time for a particular shipment would involve the observation of appropriate data for each of the three operations of the above basic model and using them in the calibration of the following formula:

Terminal time for a shipment = [(Preparation time for a shipment) + (Moving time for a shipment)] * Index,

where the parameter **Index** is a multiplicative factor which accounts for the complementary tasks. Needless to say that the appropriate data to be collected are specific to each terminal and must be related to shipment as well as to the handling process of the terminal: weight, volume, number of pieces or pallets, preparation time, moving distance, number of movements, moving time, distribution of productive and "non-productive" time and storage percentage.

II.2. The Calibration of the Model

To calibrate the model to the handling process of a particular terminal, one must distinguish between two types of imput: a first set of imput which characterizes the way the terminal operates and a second set which characterizes the freight to be handled. We will refer to the first set of imputs as the *parameters* of the model and to the second set of parameters as the *variables*.

By collecting appropriate data from the handling process at a particular terminal one would be able to fix the values of the parameters. We then have a calibrated model for that particular terminal. Later on, using the characteristics of a given shipment, one sets the values of the variables used in the model of that particular terminal to derive the terminal time of the given shipment. Hence, one can formally state the general formula in figure 5.

In d'Avignon & Thériault[1995], the reader will find an operational guide to calibrate the model according to the handling process of a particular terminal. It presents a three-part procedure. In the first, we give some indications about how to collect appropriate data by observing the handling process. In the second n part, guidlines for statistical analysis are available under the form of an Excel file. In the third part, we indicate how to modify the computer system of the trucking company in order to assess terminal time to every shipment which goes through the terminal.

Figure 5. General Formula for the Terminal Time of Shipment S.

TT(S) = Terminal Time for shipment S measured in seconds;

$$TT(S) = \begin{cases} \{N.pallets(S) * \mathbf{ZZ}\} * \mathbf{Index} & \textit{IF "L" Handling} \\ \{[\mathbf{P.p.t.(S)} * Y] + [(Volume \div \mathbf{VM}) * \mathbf{ZZ}]\} * Index & \textit{IF "M" Handling} \end{cases}$$

where,

ZZ = Average time for moving freight;
= 2 * **Z1** * **Z3** + **Z2** * (1 - **Z3**).

Terminal parameters

P.p.t.(S) = Partial preparation time for shipment measured in seconds;
= (N.pieces) * X1 + (Weight) * X2 + (Volume) * X3

VM = Average volume (ft^3);of freight placed on one piece of moving equipement;

Y = Time proportion of freight having to be prepared more than once + 1;

Z1 = Average time for moving freight with temporary storage (sec.);

Z2 = Average time for moving freight without temporary storage (sec.);

Z3 = Proportion of freight which is in temporary storage;

Index = The multiplicative factor accounting for complementary tasks;

X1, **X2** and **X3** are either zero or the appropriate regression coefficients.

Shipment variables

N.pieces = Number of pieces handled manually within shipment S;

Weight = Weight of shipment S (pounds);

Volume = Volume of shipment S (ft^3);

N.pallets = Number of pallets supporting the freight of shipment S.

Now, let us discuss briefly each component of the previous general formula.

Partial preparation time for a shipment

In this analysis, we consider three characteristics for each shipment: the number of pieces, the volume and its weight. In this case, we have to remember that not all shipments require preparation. The preparation is necessary only when parcels are not already on pallets. Therefore, using statistical analysis, we want to find values for the parameters X1, X2 and X3 in the following relationship:

$$P.p.t.(S) = \{ [(Nb.pieces) * X1] + [(Weight) * X2] + [(Volume) * X3]\},$$

with the understanding that whenever a characteristic is not present in the above relation, the corresponding parameter takes the value zero.

The parameter Y

This parameter takes into account the proportion of the time freight had to be prepared more than once. In fact, the parameter Y incorporates the handling process of a specific terminal. For example, within a terminal, if we place unloading freight on 100 pallets of which 40 retain the freight during loading, then dockmen would have to handle twice the freight of 60 pallets. Thus, for this terminal: $Y = (100+60)/100 = 1.6$. It means that 60% of the freight has to be prepared twice. In general, the parameter Y is estimated from the terminal operations for all shipments handled over a long period.

Moving time for a shipment

The moving time for a shipment had to be obtained. We started from the following point of view: moving time for a shipment should be related to the movement time from the unloading door to the loading door multiplied by the number of movements necessary for the shipment. Thus, in order to obtain moving time, we had to calculate the average time for each time-movement, taking into account temporary storage.

Moreover, we had to find the number of movements to be done for each shipment. For the mechanical movements, we only have to know the number of pallets or the number of large pieces for each shipment. Hence, this number of pallets or large pieces is the number of movements. For manual movements, it is more complicated. In fact, it has been observed that the number of movements changes from one person to another. For example, a shipment of 400 pounds, having 6 pieces, could be moved with one movement when a dockman uses a

platform-truck or with six movements when a dockman uses a two-wheeled-handle-truck. Therefore, to avoid this difficulty, we estimated the number of manual movements based on the shipment volume. With a platform-truck, we consider that dockmen can move 45 cubic feet at a particular terminal. Thus, the number of manual movements is equal to the shipment volume divided by 45. The result is rounded up to the nearest integer. For example, a shipment of 110 ft^3 would need 3 movements. In general, we denote by VM the average volume of freight placed on a moving equipment.

Index

The previous parameters are directly related to a particular shipment, therefore they form the "productive" part of the terminal operations. To take into account time spent during which dockmen do not prepare or move a particular shipment, one uses a multiplicative factor, noted the **index**. It is related to "non-productive" time as far as a particular shipment is concerned. For example, if dockmen prepare and move shipments for 15 minutes per hour, the productive time is 25% and the "non-productive" time is 75%. This productive time (15 minutes) should be multiplied by an index in order to obtain the total time worked [productive time(15 minutes) * index = total time(60 minutes)]. For this example, the index is found to be 4 (60 minutes/15 minutes). In order to distribute coffee-breaks, we multiply the index by 16/15 [8 paid-hours/(8 paid-hours - 30 paid-minutes for coffee-breaks) = 16/15] . Therefore, for this example, the final value of the index is 4.27, whicht is 4 multiplied by 16/15.

III. Validation

The terminal time formula described above was validated at five terminals in three companies. Remember that parameters are specific to a terminal. Moreover, our approach in the determination of terminal time for a shipment is such that it is sufficient to consider only two classes of handling procedures - manual and mechanical. As we can see in figure 6 parameters and even the structure of the general formula vary from one terminal to another.

As an example, consider a shipment S (1011 lbs , 2 pallets, mechanical handling) handled at terminal **T1** with handling time formula in figure 6:

With the terminal time formula:	TT(S) = 8.54 minutes.
From observations:	TT(S) = 8.00 minutes.
Using general productivity measures for **T1**: (with 9,088 lbs/hr for mechanical handling)	TT(S) = 6.67 minutes.

Figure 6. Specific Terminal Time Formula for Shipment S.

Terminal T1

$$TT(E)=\begin{cases}[125 * (N.pallets)] * 2.05 & IF\text{ "L" Handling;}\\ \left\langle\left\{[3.6*(N.pieces)+.191*(Weight)]*1.7\right\}+\left\{(Volume/45ft^3)*125\right\}\right\rangle*2.05 & IF\text{ "M" Handling.}\end{cases}$$

Terminal T2

$$TT(E)=\begin{cases}[122.3 * (N.pallets)*3.9] & IF\text{ "L" Handling;}\\ \left\langle\left\{[(3.29*N.pieces)+(0.15*Weight)]*1.9\right\}+\left\{(Volume/45ft^3)*122.3\right\}\right\rangle*3.9 & IF\text{ "M" Handling.}\end{cases}$$

Terminal T3

$$TT(E)=\begin{cases}[122.7(N.pallets)] * 2.6 & IF\text{ "L" Handling;}\\ \left\langle\left\{[(7.5*N.pieces)+(0.083*Weight)]*1.5\right\}+\left\{(Volume/45ft^3)*122.7\right\}\right\rangle*2.6 & IF\text{ "M" Handling.}\end{cases}$$

Terminal T4

$$TT(E)=\begin{cases}[105.15 * (N.pallets)] * 2.23 & IF\text{ "L" Handling;}\\ \left\langle\left\{[(5.76*N.pieces)]*1.92\right\}+\left\{(Volume/18ft^3)*105.15\right\}\right\rangle*2.23 & IF\text{ "M" Handling.}\end{cases}$$

Terminal T5

$$TT(E)=\begin{cases}(131.53 (N.pallets) * 2.43 & IF\text{ "L" Handling;}\\ \left\langle\left\{[(5.95*N.pieces)]*1.77\right\}+\left\{(Volume/64ft^3)*131.53\right\}\right\rangle*2.43 & IF\text{ "M" Handling.}\end{cases}$$

For the purpose of this paper, the terminal time formula is analyzed for 200 shipments from twenty trailers at terminals **T1** and **T3**. Twelve shipments and ten trailers were chosen at random and comparisons were made with respect to the assignment of terminal times. In figures 5 to 8, we present the three different terminal times. As you see, there are large differences which should raise questions for the design of a costing system as well as for the management of terminals.

Figure 7. Terminal Times to handle shipments at terminal **T1**.

SHIPMENTS	REAL TIME (minutes)	TIME FROM FIRM (minutes)	TIME FROM FORMULA (minutes)
1	33.6	40.42	18.15
2	8.2	9.88	3.93
3	41.0	116.49	41.48
4	11.0	40.77	17.2
5	11.0	9.39	11.79
6	5.1	3.84	3.93
7	5.2	2.91	4.583
8	5.0	1.45	4.25
9	30.0	29.92	35.36
10	7.2	5.41	5.09
11	15.6	13.21	9.08
12	49.4	56.62	67.09
•	•	•	•
•	•	•	•
•	•	•	•
All shipments	**4812**	**4812**	**4810**

Figure 8. Terminal Times to handle trailers at terminal **T1**.

TRAILERS	REAL TIME (minutes)	TIME FROM FIRM (minutes)	TIME FROM FORMULA (minutes)
1	46.1	86.42	54.39
2	35.2	87.53	53.36
3	94.0	279.49	135.13
4	35.8	44.26	38.46
5	77.2	87.86	73.59
6	65.3	100.22	64.13
7	73.7	145.40	85.11
8	78.0	55.02	80.37
9	50.0	181.49	52.2
10	91.1	61.98	92.54
•	•	•	•
•	•	•	•
•	•	•	•
All trailers	**4812**	**4812**	**4810**

Figure 9. Terminal Times to handle shipments at terminal **T3**.

SHIPMENTS	REAL TIME (minutes)	TIME FROM FIRM (minutes)	TIME FROM FORMULA (minutes)
1	7.54	10.57	6.2
2	11.00	1.08	5.3
3	4.25	5.01	5.3
4	3.90	11.02	6.2
5	19.20	72.46	24.9
6	11.57	18.12	8.9
7	63.09	11.39	42.5
8	8.84	5.55	10.6
9	6.09	18.12	8.9
10	11.09	16.53	10.6
11	8.62	12.23	7.2
12	25.48	4.98	22.0
•	•	•	•
•	•	•	•
•	•	•	•
All shipments	**4620**	**4620**	**4617**

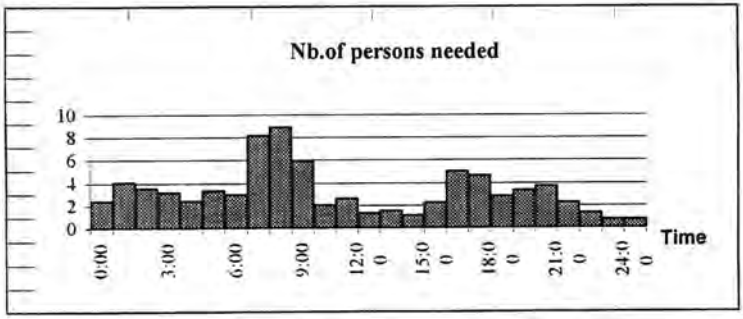
Figure 10. Terminal Times to handle trailers at terminal **T3**.

TRAILERS	REAL TIME (minutes)	TIME FROM FIRM (minutes)	TIME FROM FORMULA (minutes)
1	139.62	201.12	113.31
2	136.19	363.00	101.02
3	53.95	127.70	69.12
4	161.77	202.26	158.76
5	170.17	112.93	159.51
6	91.78	36.17	101.02
7	182.35	128.52	140.66
8	399.75	108.31	647.49
9	173.20	140.76	191.41
10	177.41	257.82	220.34
•	•		•
•	•	•	•
•	•	•	•
All trailers	**4620**	**4620**	**4617**

From the above figures, it can be said that the methodology developed provides for better results than the present methodology used by firms to assess terminal time. Thus, it is possible with the above formula to calculate the terminal time necessary to handle a shipment, and this with a higher precision... than the methodology presently used within trucking companies.

Using the above terminal time formula together with the arrival and departure times of each truck, it is possible to derive the work-load necessary to realize the handling process over a 24-hour period. In figure 9, we present the necessary work-load needed to perform the unloading/loading during a specific day of November 1994 at terminal **T1**.

Figure 11. The Work-Load for a 24-hour period at terminal **T1**.



IV. Conclusion

We have developed a new approach in order to calculate productivity. It appears to produce good results. Some of the advantages brought by this methodology for terminal management may be summarized as follows: 1) the evaluation of terminal operations efficiency; 2) the design of an important part of the costing system; 3) the making up of a schedule for the dockmen needed to handle the freight arriving at the terminal.

Continued discussions with terminal managers with respect to our model developed have supported its pertinence and validity. In addition, the feedback from the ultimate beneficiaries of this research is leading to refinements, as well as to the identification of needed innovations resulting from experimental application of the model.

In conclusion, it appears that this model provides meaningful answers to terminal managers. Moreover, recent advances in telecommunications and remote visual detection in the trucking industry may provide the processing capacity required by a more complete model.

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PALLETS THE GOOD, THE BAD AND THE UGLY

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I. Introduction

There are many myths that exist in the marketplace regarding the handing of shipments on pallets. In part this paper will try to dispel the following myths:

- Palletized freight is always cheaper to handle.
- Linehaul productivity is not impacted by pallets.
- The cost of returning pallets is minimal.
- There are no hidden costs associated with the handling of pallets.
- All pallets and pallet programs are alike.

These myths came about by observing time and cost savings realized by moving palletized freight across the dock. It is easy to visualize a fork lift truck carrying 50 boxes on a pallet versus several trips moving a few boxes at a time on a hand cart. This paper deals with the rest of the story.

The efficient handling of freight concerns both shippers and carriers. In order to be competitive in today's global economy the most cost efficient method of handling each type of freight, and even each shipment, must be of paramount concern to all parties involved in the supply chain. This paper will discuss the handling of palletized freight by less-than-truckload (LTL) common carriers operating within Canada

The unique problems associated with handling palletized freight have always existed. The problems have come to the forefront due to the dramatic increase in the use of pallets for LTL freight. The use of pallets has more than tripled over the last 20 years increasing from 20% 1/ in the mid 70's to 65% 2/ of total LTL shipments in the early 90's. The percent of LTL freight handled on pallets is highest in Ontario and Quebec with Western Canada handling the lowest percentage of freight on pallets. Over the past 20 years LTL freight on pallets has gone from the exception to the norm. This increase coincides with a 150% 3/ increase in the annual sales of powered fork lift trucks between 1967

and 1990.

Approximately 60% 2/ of the shipments on pallets include the return of empty pallets. The shipments without pallet return are in most cases on disposable softwood pallets. Return pallets include program pallets, custom pallets and other hardwood pallet exchange procedures. Determining the best method of handling palletized freight is an important decision that is made by operations personnel every night . It needs to be a conscious decision made after reviewing the handling requirements, impact on linehaul productivity, service standards and whether pallets are to be returned. An incorrect decision can and will dramatically impact the cost of handling individual shipments. For this reason FCA/NFB conducted research to assist the industry in determining the impact of different variables on the cost of handling freight on pallets.

II. The Basis of Costing

The costing model used in this study was the Less-Than Truckload Cost Information System 4/ developed by the Transportation Consulting Group. The costing model is recognized by the Canadian and U.S. LTL carrier industry as one of the best and most flexible systems available.

In order to eliminate as many variables as possible, all the shipments were costed using the same general parameters. The general parameters used were as follows:

1. Density was held constant at 11 pounds per cubic foot.
2. Trailer length of 48 foot with a cubic capacity of 3,072 cubic feet.
3. Linehaul costs were fully allocated.
4. Average stop weight at pick up was used in calculating pick up costs.
5. Increased billing costs for the tracking of return pallets was used when calculating the cost of pallet return.
6. The distance of pallet returns was based on half the distance of the original linehaul move.

Selected shipment costing parameters were adjusted as the distance of the shipment changed. As the length of haul increases the relative importance of linehaul costs also increases. For this reason long haul carriers stage and load freight differently than short haul carriers. A carrier handling both short and long haul freight will stage and load the long haul freight differently in order to obtain a better linehaul average load factor. The cube utilization was therefore increased from 68% on short haul shipments to 85% on shipments moving 700 miles or over. The space occupied by the pallet itself (4 foot x 4 foot x 4-6 inches) was also accounted for on shipments moving 700 miles or over.

In order to analyze the impact of shipment weight and distance on the use of pallets, shipments of various weights and distances were costed. Weights of 193, 687, 1398, 3000 and 6804 pounds were used. These weights reflect the average weights within each weight group utilized for LTL pricing (For example for the less than 500 lb. weight group the average weight of shipments handled was 193 pounds). Shipments of distances ranging from 50 to 2,000 miles were costed to enable the analysis of the distance variable on different types of shipments on pallets.

Each shipment was costed in four different ways as described below:

1. Loose pieces - costs were based on the movement of loose pieces (i.e. not on pallets).
2. Stackable pallets - costs were based on freight moving on ideal pallets. These pallets were able to be stacked and contained little wasted space.
3. Unstackable pallets - costs were based on freight moving on pallets that could not be stacked. The freight remained on the pallets throughout the move in spite of any loss of linehaul productivity.
4. Unstackable Pallets, Stripped - costs were based on freight moving on pallets that could not be stacked. The cost of stripping the pallets and marking the pieces at the origin terminal was added. The costs for the remainder of the movement were calculated based on loose pieces.

The cost of pallet return was also calculated treating pallets in the same manner as freight. The linehaul distance used was half the distance of the original shipment.

III. Where Are The Potential Savings/Costs Associated With Handling Palletized Freight

In order to understand the results of this study it is important to understand where the potential savings are when handling palletized LTL freight. The savings take place in pick up, dock handling, and delivery. Pick up and delivery can be divided into three components, driving (stem) time, variable running time and stop time. Driving time is the time it takes to drive from the terminal to the first stop and the time it takes to drive from the last stop back to the terminal. Variable running time is the time spent driving between stops. It is obvious that these two components are unaffected by whether the freight is loose, on pallets or stackable. Stop time, the time spent at each stop, is the

component affected by how the freight is packaged.

Stop time includes both a fixed and variable portion of expenses. The fixed portion which includes waiting time, backing the truck to the door, signing the bill of lading and leaving the dock area is not affected by whether the freight is on pallets. The variable time at the stop, which includes counting, checking and the actual loading or unloading of the freight is where the savings occur. Savings also occur in handling of the shipments across the dock at the origin, destination, and breakbulk terminals.

There are also additional hidden costs caused by the handling freight on pallets. These additional costs include:

1. Administrative cost to reconcile the number of pallets in the system for various customers;
2. Cost of repairing damaged pallets;
3. Cost of replacing damaged or lost pallets;
4. Miscellaneous handling of empty pallets;
5. Capital outlay for purchase of pallet pool;
6. Additional loss or damage claims due to the stripping of unstackable pallets;
7. Pick up costs when a special trip is required to pick up empty pallets.
8. Cost for disposal of pallets.

With the exception of items 6 and 7 shippers will also incur these additional costs. Home Depot 5/ recently switched to plastic slipsheets in lieu of wooden pallets . Home Depot reported that they had been spending $700,000 per year in freight charges to dispose of their old pallets.

Loss of linehaul productivity is another hidden cost. This applies for pallets that cannot be stacked. There is a distance for these shipments where it becomes cost efficient to strip pallets that cannot be stacked at the origin terminal in order to improve linehaul productivity. This is true even if the freight must be counted and marked as well. The freight is then handled for the remainder of the movement as loose pieces .

IV. Results of The Study

The following 8 tables provide a comparison of the cost of moving the freight packaged and handled operational as described above. Tables 1 - 4 are based on palletized freight that required the return of empty pallets.

Table 1 - Stackable Pallets vs. Loose Pieces (Includes Pallet Return)

	Weight In Pounds				
Miles	193	687	1,398	3,000	6,804
	% Above Or Below The Cost of Handling Loose Pieces				
50	23	-9	-17	-25	-28
350	22	-6	-11	-15	-16
700	23	-4	-8	-11	-11
1,000	23	-3	-6	-8	-7
2,000	22	0	-2	-3	-2

Table 1 compares the cost of moving freight on return stackable pallets to the cost of handling the same freight as loose pieces. For low weighted shipments the cost of pallet return more than offsets any savings due to the easier handling of freight on pallets at the origin, over the dock, and at destination. For example, transporting a 193 lb. shipment 50 miles on a returnable pallet is almost 25% more expensive than handling the same shipment as loose pieces. Distance is an important element to consider. As the length of haul increases the relative importance of dollar savings due to palletization decreases. This is evidenced by the minimal difference in total costs when handling a 6,800 lb. shipment 2,000 miles.

Table 2 - Unstackable Pallets vs. Loose Pieces (Includes Pallet Return)

	Weight In Pounds				
Miles	193	687	1,398	3,000	6,804
	% Above Or Below The Cost of Handling Loose Pieces				
50	24	-7	-14	-22	-24
350	27	4	1	-4	2
700	38	23	21	19	28
1,000	43	31	29	27	38
2,000	53	47	44	40	52

Table 2 compares the cost of moving freight on return pallets that cannot be stacked to the cost of handling the same freight as loose pieces. The results differ dramatically from those of stackable pallets. The cost of pallet return and the loss of linehaul productivity combine to make the freight moved on pallets more expensive than loose pieces except for heavier shipments moving short distances. For the low weighted shipments the pallet return and the loss of linehaul productivity contribute somewhat equally to the cost premium. For the heavier shipments moving greater distances the largest factor is the loss of linehaul productivity.

Table 3 - Unstackable Pallets, Stripped vs. Loose Pieces (Includes Pallet Return)

	Weight In Pounds				
Miles	193	687	1,398	3,000	6,804
	% Above Or Below The Cost of Handling Loose Pieces				
50	32	12	4	-2	-5
350	30	11	5	0	-2
700	30	10	5	1	0
1,000	29	10	5	2	1
2,000	26	8	4	2	2

Table 3 compares the cost of transporting freight on unstackable pallets that are stripped at the origin terminal to the cost of handling the same freight as loose pieces. Savings due to palletization are greater than the additional cost required to strip the pallets only for the heavier shipments moving short distances. For all other shipments the cost of handling this freight is greater than the cost of handling loose pieces.

Table 4 - Unstackable Pallets, Stripped vs. Unstackable Pallets Not Stripped (Includes Pallet Return)

	Weight In Pounds				
Miles	193	687	1,398	3,000	6,804
	% Above Or Below The Cost of Handling Loose Pieces				
50	7	21	22	26	25
350	2	6	3	4	-4
700	-6	-11	-13	-15	-22
1,000	-10	-17	-19	-20	-26
2,000	-18	-27	-28	-27	-33

Table 4 compares the cost of moving freight on return unstackable pallets that are stripped at the origin terminal to the cost of handling the same freight on unstackable pallets that are not stripped. This table helps to locate the break even point when a shipment should be stripped off the pallets in order to improve linehaul productivity. It is a trade off between the extra labor needed to strip the pallets at the origin terminal and handle them as loose pieces vs. the higher linehaul costs associated with not stripping them. The distance at which freight should be stripped decreases as the weight increases. For heavy weighted shipments pallets should generally be stripped if they are moving over 300 miles. Lower weighted shipments should be stripped if they are transported over 425-475 miles. The largest savings due to stripping the pallets is for the longest distances and the heaviest weights.

The cost comparisons on tables 5 - 8 exclude the cost of pallet return..

Table 5 - Stackable Pallets vs. Loose Pieces (Excludes Pallet Return)

	Weight In Pounds				
Miles	193	687	1,398	3,000	6,804
	% Above Or Below The Cost of Handling Loose Pieces				
50	-6	-26	-30	-35	-38
350	-5	-20	-22	-23	-23
700	-4	-17	-18	-19	-18
1,000	-3	-15	-15	-15	-14
2,000	-2	-10	-10	-9	-8

Table 5 compares the cost of moving freight on stackable pallets to the cost of handling the same freight as loose pieces. It is cheaper in all cases to move the shipments on stackable pallets. The cost savings for freight on pallets increases as the shipment weight increases and as the distance gets shorter. For example the cost of moving a 6,804 lb. shipment 50 miles on pallets was 38% less expensive than handling the same freight as loose pieces.

Table 6 - Unstackable Pallets vs. Loose Pieces (Excludes Pallet Return)

	Weight In Pounds				
Miles	193	687	1,398	3,000	6,804
	% Above Or Below The Cost of Handling Loose Pieces				
50	-5	-24	-27	-32	-33
350	0	-10	-9	-12	-5
700	7	10	11	11	21
1,000	11	19	20	19	31
2,000	21	37	37	34	46

Table 6 compares the cost of moving freight on pallets that cannot be stacked to the cost of handling the same freight as loose pieces. The cost of handling unstackable pallets not stripped becomes more expensive as the distance increases. The break point is about 500 miles for most shipments with the lowest and highest weighted shipments hitting the break point at 400 miles or less. If the pallets are not stripped the cost can be as much as 46% higher than that of handling loose pieces.

Table 7 - Unstackable Pallets, Stripped vs. Loose Pieces (Excludes Pallet Return)

	Weight In Pounds				
Miles	193	687	1,398	3,000	6,804
	% Above Or Below The Cost of Handling Loose Pieces				
50	3	-5	-9	-12	-15
350	3	-4	-6	-8	-9
700	3	-3	-5	-7	-7
1,000	3	-3	-5	-5	-6
2,000	2	-2	-3	-3	-3

Table 7 compares the cost of moving freight on unstackable pallets that are stripped at the origin terminal to the cost of handling the same freight as loose pieces. For low weights the additional cost of stripping the unstackable pallet will exceed any cost savings. The largest savings, due to the handling of freight at pick up and into the origin terminal on pallets, occurs for the heavier shipments moving shortest distances. In all cases except at 193 lb. it was less expensive to strip the unstackable pallets..

Table 8 - Unstackable Pallets, Stripped vs. Unstackable Pallets Not Stripped (Excludes Pallet Return)

	Weight In Pounds				
Miles	193	687	1,398	3,000	6,804
	% Above Or Below The Cost of Handling Loose Pieces				
50	9	25	26	29	28
350	3	8	3	5	-4
700	-7	-12	-15	-16	-23
1,000	-12	-18	-19	-21	-28
2,000	-21	-29	-29	-28	-34

Table 8 compares the cost of moving freight on unstackable pallets that are stripped at the origin terminal to the cost of handling the same freight on unstackable pallets that are not stripped. This table helps to locate the break even point when a shipment should be stripped off the pallets in order to improve linehaul productivity. It is a trade off between the extra labor needed to strip the pallets at the origin and handle them as loose pieces vs. the higher linehaul costs associated with not stripping them. The distance at which freight should be stripped decreases as the weight increases. For heavy weighted shipments they should generally be stripped if they are moving over 300 miles. Lower weighted shipments should be stripped if they are transported over 425-475 miles. The largest savings due to stripping the pallets is for the longest distances and the heaviest weights. An unstackable shipment of 3,000 lb. being shipped 2,000 miles is 28% less expensive if it is stripped off the pallets.

V. Service Standards

The impact of service standards is another issue that cannot be overlooked. Service standards may in some cases prevent the stripping of unstackable pallets due to the time constraints on the dock. As the following picture illustrates, a carrier may determine that it is cost effective to strip a heavy LTL shipment at 300 miles. His one day service standard may not provide adequate time to strip this shipment. In this case the carrier must realize that extra costs are being incurred in order to meet this service standard.



VI - Conclusions

Based on these costing results we developed a few benchmarks that can be used to help the industry make operational decisions. The benchmarks have been separated based on whether pallet return is required. For palletized shipments <u>including pallet return</u> the benchmarks are as follows:

- No savings accrue to the motor carrier for any palletized shipment 500 pounds or less shipped any distance when the pallet must be returned.
- The cost of pallet return more than offsets any savings generated by handling palletized freight in this category.

- When shipping unstackable pallets the costs are higher than shipping loose pieces except for heavy weighted shipments transported short distances.
- It is best to strip unstackable pallets for any shipment transported over 400 - 450 miles. For shipments over 5,000 lb. this break point comes at about 300 miles.
- There should be a price differential for returnable vs. non-returnable pallets.

For palletized shipments that do not require pallet return the findings are as follows:

- The cost savings associated with handling stackable pallets decreases in relative importance as the distance the shipment is transported increases.
- Cost savings associated with handling stackable pallets generally increases as the weight of the shipment increases.
- It is best to strip unstackable pallets for most shipments transported over 424 - 475 miles.

Acknowledgments

The assistance of Doug Kerr in developing this paper and especially the slide presentation is much appreciated.

Endnotes

1. Performance studies conducted by the Niagara Frontier Tariff Bureau, Inc., 1975-1976.
2. Carrier surveys conducted by the Freight Carriers Association of Canada and the Niagara Frontier Tariff Bureau, Inc., 1992.
3. Transportation Executive Update (1994). "Trucking Productivity As Viewed From The Loading Dock". Falls Church, VA: July/August.
4. Less-Than Truckload Cost Information System, developed by the Transportation Consulting Group, 7910 Woodmont Avenue, Suite 835, Bethesda, MD.
5. Transport Topics (1994). "Home Depot, Yellow Freight Begin Slipsheet Program". Washington: November 21.

Long Combination Vehicle Operations in Canada

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INTRODUCTION

This paper is based on work undertaken for the Canadian Trucking Research Institute. It documents the extent of long-combination vehicle operations in Canada, provides figures on relative performance and discusses policy issues associated with their use.

Long-combination vehicles ("LCVs")[1] are truck configurations with two or three trailers exceeding normal length limits. Because of this extra length, they operate by permit under controlled conditions.

There are no reports available in Canada documenting the scale of LCV activities or the manner in which these operations are regulated. Consequently, the main purpose of the CTRI research is simply to describe LCV operations: which jurisdictions allow them? how do permits control their operation? what carriers are using these trucks? what freight is hauled? from where to where? and what configurations are used? and why?

BACKGROUND

Long doubles--two 40-foot trailers--were first allowed on Eastern turnpikes: Indiana in 1956, New York and Massachusetts in 1959 and Ohio in 1960. In the West, Nevada began allowing them in 1969 and they are now permitted in 15 Western states, in some cases on designated roads only and in other cases on all state highways. Triples were first allowed in Kansas in 1960, followed by Oregon (1967), Idaho (1968) and Nevada (1969). The expansion of the LCV network in the US came to an end in 1991 because of Federal legislation.[2]

In Canada, Alberta first introduced LCVs in 1969. Three other provinces followed in the early 1980s and more recently LCVs have been allowed to operate into North-west Territories. Ontario and British Columbia have conducted LCV trials but currently maintain that these trucks are not suitable for their roads.

While there is no standard definition of a long combination vehicle, in Canada, LCVs can generally be defined as truck combinations exceeding the length limits of

TABLE 1: Definition of a Long-Combination Vehicle

	Coupling Mechanism	Box Length		Overall Length
Double trailer	A-train	> 18.5 m	or	> 25.0 m
	B- or C- trains	> 20.0 m	or	> 25.0 m
Triple trailer	all	all lengths		all lengths

"Box Length" is the distance from the front of the first trailer to the rear of the last trailer. An A-train uses a single-drawbar converter dolly to couple the trailers; a B-train uses a hitching mechanism attached to the lead trailer; and a C-train uses a double-drawbar dolly.

the 1991 Memorandum of Understanding on weights and dimensions signed by all 12 provinces and territories (the "MoU" limits). These are shown in Table 1.

In the United States, there are several definitions of LCVs;[3] none are suitable for Canadian conditions. Despite the complexities and incompatibilities of the definitions, the most common LCVs are recognizable in the 26 US states and five Canadian jurisdictions where they operate. The three most common are: Rocky Mountain doubles, typically consisting of a 48-foot lead trailer and a 28-foot second trailer; Turnpike doubles, typically consisting of two 48-foot trailers; and, Triples, typically consisting of three 28-foot trailers. (*While regulations are in metric units, the industry uses Imperial measures to describe trailers.*)

There are many variations on these three LCVs, but the most significant difference between Canada and the United States concerns weight. In the US, generally both the definition of an LCV and the permit for an LCV involves an increase in weights over limits set for non-permit trucks. In Canada, LCVs represent **only** an increase in configuration length.[4]

LCV REGULATIONS

Actual regulations are considerably more complex than as shown in Table 2. First, there are controls on everything from tire loads to axle spacing to the length of drawbars. These are all based on the MoU limits. Second, distinctions are made in terms of the coupling mechanism used. For example, in Alberta, an 8-axle Rocky Mountain double is limited to 53.5 tonne if it uses an A-dolly, 60.5 tonne if it uses a C-dolly, and 62.5 tonne if it is a B-train. In Northwest Territories, the only LCVs recognized in the regulations are B-trains (*although as a matter of policy LCVs that are legal in Alberta are allowed into the territory*). Saskatchewan has taken this process the furthest with 48 specific LCV configurations defined. Included among these are "Queen City Triples" consisting of one 48-foot trailer and two 27-foot trailers (*these are maximum lengths with "soft" metric conversions*). A feature of the Saskatchewan regulations is that they encourage the use of C-converter dollies by allowing more weight on C-trains than A-trains. In Manitoba and Québec, other than following general MoU principles, the regulations do not encourage the use of one configuration (A- B- or C-train) over another.

TABLE 2: LCV Regulations: Maximum Weight (tne) & Maximum Length (m)

	Qué	Man	Sask	Alta	NWT
Rocky Mountain doubles					
weight	62.5	56.5	62.5	62.5	62.5
length	NR	29	29	30	29
Turnpike doubles					
weight	62.5	NP	62.5	62.5	NP
length	NR		38	37	
Triples					
weight	62.5	56.5	53.5	53.5	NP
length	NR	31.25	38	35	

"NR" = not regulated; "NP" = not permitted

Besides regulations on weights and dimensions, provinces control the operation of LCVs through permits or, in some cases, through formal agreements with carriers. These permit conditions may control:

Routes: LCVs are only allowed to operate on higher class highways as shown on the accompanying map. Provinces may also specify routes for particular carriers. The LCV network is about 11,600 kilometres in length--11,600 km for Rocky Mountain doubles, 4,465 km for turnpike doubles, and 5,248 km for triples. For the most part, turnpike doubles and triples are allowed only on four or more lane divided highways. Rocky Mountain doubles are allowed on a 6,500 km network of 2-lane, undivided highways in the four Western jurisdictions.

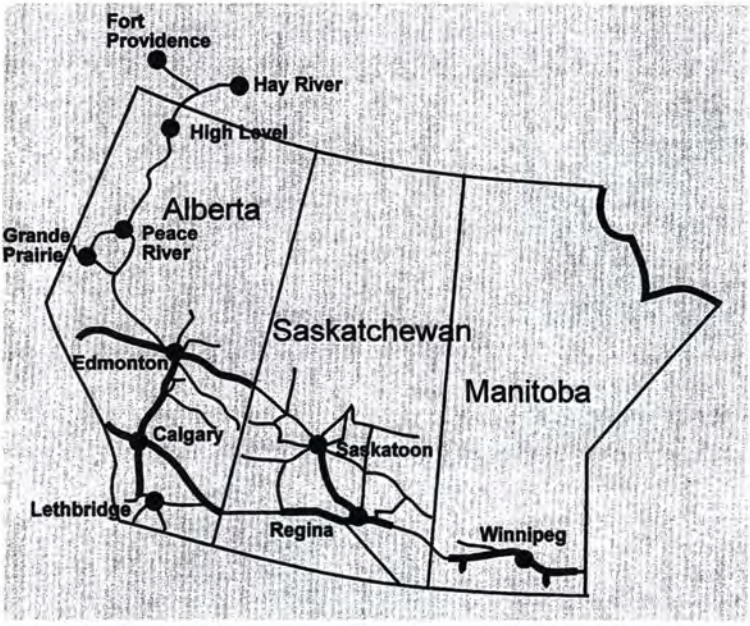
Access: Some provinces require LCV permit holders to obtain permits from municipalities to move LCVs from the highway into terminals; others specify access routes in the permit.

Driver qualifications: Each jurisdiction has a series of requirements for LCV drivers ranging from special licence endorsements, to specifications on training, to minimum ages, to a special demerit point system (*in one province*).

Type of equipment: Permit conditions set out requirements for the equipment used in LCVs. These range from horsepower-to-weight ratios (one regulated case, one "suggested" case), to the type of pintle hooks and mudguards that have to be used. Québec requires LCVs to display a sign on the truck (*"train routier"*).

Carrier operations: Permit conditions control LCV operations: requiring vehicle inspections, requiring safety supervisors on staff, requiring an approved training program, requiring the reporting of accidents (ie, special reports for accidents involving LCVs), or banning the carriage of dangerous goods (*one province*).

LCV ROUTES IN CANADA



Legend

4-lane divided highway

Rocky Mountain Doubles only

Loading requirements: All jurisdictions have a requirement that heavier trailers be placed in front of lighter trailers; some provinces also have requirements for the relative load on axles (*eg, drive axles must be heaviest*).

Vehicle performance: Several provinces have a requirement about minimum speeds (ie, LCVs must be able to maintain a speed that will not interfere with other traffic); one province has a complete braking performance test that LCVs must pass.

Hours of operation: Four jurisdictions limit hours of operation. In Québec this includes a ban on operating LCVs during the winter as well as the more general (in other provinces) time of day restrictions for certain days of the week.

Highway operations: All jurisdictions prohibit the operation of LCVs during adverse weather conditions; some go further and specify such things as the vehicle separation distances to be used while on the highway.

The remarkable thing about these permit conditions is that they vary considerably from jurisdiction to jurisdiction. They also vary as much among the US states. In both countries, there have been attempts at developing more uniform permit practices but to date there has been only minor progress.[5]

SCALE OF LCV OPERATIONS

The five jurisdictions allowing LCVs have issued, as of the summer of 1994, permits to 264 companies: Québec (85), Manitoba (16), Saskatchewan (19), Alberta (141) and Northwest Territories (3).[6] However, some firms hold permits in more than one jurisdiction; in Québec 34 permits are held by owner-operators working for other permit-holders; and, in Alberta, 11 permit holders own trailers only and rely on other permit holders to supply tractors. With this double-counting, and "out-of-business" accounted for, there are 175 companies with LCV permits in Canada. From this universe, 133 carriers completed a simple mail/fax/telephone survey in the fall of 1994 (76% response rate). Of the 133, 116 had permits and were actively using it in their trucking operations. From this sample of 116 active permit holders, the activity data on Table 3 were developed.

Estimated annual distances by the sampled firms is 54 million LCV kilometres. If the 76% of the active LCV carriers who responded to the survey typify the entire population, then total LCV activity in Canada might be near 71 million kilometres (*53.77 million/0.76*). There are no accurate estimates of total large truck distances in Canada, although it is possible to speculate that the figure is between 24 to 30 billion kilometres.[7] If so, LCVs only account for 0.2% to 0.3% of truck travel.

Estimated annual volumes for all LCVs are 3.3 million tonnes.[8] Tonnage is not the best description of output where freight density is low, but it is a conventional measure of truck activity. Total tonnage by larger for-hire carriers in Canada was 149 million in 1992 and 173 million in 1993 and estimates of total truck tonnages--

TABLE 3: LCV Activity, by Configuration (116 carriers, one week, fall of 1994)

LCV	Configuration	Trips[a]	Tonnes ('000 tne)	Distance ('000 km)
Rocky Mountain double	A-train	456	11.0	208.9
	B-train	33	0.8	31.6
	C-train	166	4.0	114.8
	Total	654	15.8	355.3
Turnpike double	A-train	1,040	25.6	507.0
	B-train	183	4.9	99.5
	C-train	50	1.2	26.5
	Total	1,272	31.7	633.0
Triple	A-train	177	4.2	88.6
	B-train	0	0.0	0.0
	C-train	38	0.5	18.2
	Total	215	4.7	106.8
A-train		1,672	40.8	804.6
B-train		216	5.6	131.1
C-train		253	5.7	159.4
TOTAL		2,140	52.3	1,095.1

a "Trip" is defined as one complete round trip (ie, truck returns to original point of dispatch). This means that for LTL carriers, trips were counted as half trips.

all for-hire and private--are 400 million.[9] Recognizing that 3.3 and the 400 million are both "soft," little precision is possible. Nevertheless, the point is that LCVs account for a small share of trucking activity, perhaps less than 1% of tonnage.

Total LCV activity--distances or tonnes--is relatively small in comparison to all truck activity in Canada. Part of the reason is the permit process, a restricted route network, seven jurisdictions not allowing LCVs, and regulatory diversity among those jurisdictions that do allow them. These factors limit the areas where LCVs may be used. But the other part of the reason concerns the service provided by LCVs. They are not ordinarily used for TL hauling, particularly where the service is hauling freight in bulk or where the service is for heavier, denser commodities. LCVs confer no payload-weight advantage in Canada. From the survey of 116 active LCV carriers, the largest number of respondents fell into one of two groups: LTL or parcel carriers--all of whom were for-hire; and what might be called the "warehouse-to-retail distribution"- carriers-mostly private, although in some cases for-hire operating as the trucking arm of a retail business. Both groups haul low-density freight. These two groups account for 66% of the LCV carriers, 74% of the LCV kilometres and 81% of the LCV tonnage.

Another characteristic of LCV activity apparent from Table 3 is the relative popularity of turnpike doubles. They account for 59% of the trips, 58% of the travel and 61% of the estimated tonnage moved during the survey period. There are major differences among the jurisdictions in terms of the popularity of various LCV configurations. (*No information was collected on travel in Northwest Territories, but only Rocky Mountain doubles are allowed.*)

	Proportion of Total LCV Distances Accounted for by:		
	Rocky Mtn	Turnpike	Triples
Qué	1.5	98.6	0.0
Man	96.2	0.0	3.3
Sask	36.5	46.2	17.3
Alta	38.8	48.9	12.3

These regional differences are explained by the nature of the LCV highway network. That is, the only LCV routes in Québec are open to all three LCVs and motor carriers have opted for the largest configuration. It is also suspected these differences have something to do with the higher freight volumes in Québec compared to the more sparsely populated Prairie provinces. For a given frequency of service, LTL operators have enough freight to fill 48-foot trailers for "off corridor" communities in Québec whereas on the Prairies there are towns where one pup trailer a day is sufficient capacity.

In terms of coupling mechanisms, A-trains are preferred, accounting for 74% of the travel during the survey week. B-trains account for 12% and C-trains the remaining 15%. Again, there are regional differences:

	Proportion of Total LCV Distances Accounted for by:		
	A-train	B-train	C-train
Qué	66.2	33.6	0.2
Man	38.8	0.0	61.2
Sask	22.3	8.8	69.1
Alta	85.6	5.7	8.7

One factor accounting for these differences is Saskatchewan's regulation that encourages the use of C-trains. This may also account for C-train usage in the neighbouring provinces--particularly Manitoba--where carriers are equipping so that they can travel through Saskatchewan. However, it would be a mistake to conclude from this that C-dollies are only used were regulations require or encourage them. There are carriers in Alberta and Manitoba that have a strong preference for the double drawbar converter dolly on its own merits.

The other regional difference that stands out is the popularity of B-trains in Québec. This is hard to explain as there is no regulatory advantage in using B-trains in

Québec (weight, cube, permit conditions). However, it may have something to do with unofficial encouragement by officials from the Ministère des Transports du Québec and a group of private carriers who have been convinced of the superior performance characteristics of B-trains.

COMPARISONS AND PERFORMANCE

Several measures can be used to gauge the performance of LCVs in comparison to other trucks. Those relating to the use of the road--the impact on bridges, pavements and a variety of geometric/stability measures--have been the subject of many investigations. Generally, LCVs have been found to perform as well as non-permit trucks in these studies.[10]

For this work, the performance of interest is the ability to carry freight. A costing model has been developed that portrays LCVs as they would be used in LTL operations. Results are shown in Table 4. The last two columns, showing the relative performance of different configurations, varies a great deal from company-to-company: different factor prices for such things as the bonus paid to drivers who drive LCVs or the amount of "hookup" time allowed for in the pay package; and different types of operations (eg, backhauls, annual utilization).

As shown, for the operation depicted in this particular case--relatively low-density freight (10 lb/ft^3) in a terminal-to-terminal LTL operation with a haul distance of 400 km--the largest cube truck (two 53' trailers) is clearly superior. It moves freight at 55% of the cost of a standard 48-foot tractor-semitrailer or 60% of the cost of the newer 53-foot semitrailers. It also uses only 57% of the fuel used by a 48-foot semitrailer to move one tonne of freight. (*Because this is an LTL operation, these savings in linehaul freight costs do not translate directly into comparable reductions in shipments costs. Terminal operations and pickup & delivery costs do not change with the use of LCVs and they account for a large portion of total costs.*)

Two factors affect the relative performance of the LCV in comparison to non-permit trucks: length of haul and freight density. In Figure 1, linehaul freight costs for two trucks--a standard 48-foot semitrailer and a triple consisting of three 28-foot trailers--are shown. When hauling distances are short, the triple cannot perform any better than the standard 48-foot semitrailer. The relative advantage of a triple (or, for that matter, any LCV) increases as haul distance increases. The reason is that most carriers pay higher factor prices for LCV operations than for non-permit trucks (drivers' bonus; longer allowance for hookup time; higher costs for C-dollies sometimes). There may even be other LCV costs that have not been captured in the figures shown in Table 4 (eg, costs that arise because of the permit conditions: not operating LCVs during adverse weather; more stringent standards for things like training, safety supervisors, inspections). Total linehaul distances per year tend to increase for longer haul distances and the effect of these higher factor prices can be spread over more kilometres. The relative advantage of an LCV--freight costs per tonne-kilometre--therefore, also increases with haul distance.

TABLE 4: Relative Performance

Configuration	Trailer (s) m	Available Cube m^3	Relative Linehaul Costs per km	Relative Linehaul Costs per tonne-km
Non-permit trucks				
5-axle tractor-semitrailer (48')	14.65	100.7	100.0	100.0
5-axle tractor-semitrailer (53')	16.2	111.3	100.3	90.6
6-axle double (2*28')	2 * 8.5	116.6	116.3	98.7
Long-Combination Vehicles				
Rocky Mtn double (48'+28')	14.65 +	159.0	118.3	73.7
Triple (3*28')	8.5	174.9	132.9	74.4
Turnpike double (2*48')	3 * 8.5	201.4	121.8	60.1
Turnpike double (2*53')	2 * 14.65 2 * 16.2	222.6	122.5	54.6

Note: Costs are based on Alberta conditions in 1993. The length of haul is 400 km and the freight density is 160 kg/m^3

In Figure 2, linehaul freight costs of three trucks are shown as a function of freight density. The trucks are the standard 48-foot semitrailer, the newer 53-foot semitrailer and a turnpike double with two 53-foot semitrailers. What all three curves show is that, for any truck, a point is reached where costs are constant no matter how dense the freight. This is the density at which a trailer "weighs out" (*ie, the maximum weight is reached before the cube of the trailer is filled*). For freight of this higher density, LCVs do not make much sense. Although not shown in Figure 2, a 6-axle tractor-semitrailer registered at 46,500 kg with a standard 48-foot trailer can haul freight at about the same cost as any LCV. Conversely, the lower the freight density, the better LCVs perform in comparison to non-permit trucks (*ie, the curves are further apart at 7.5 lbs/ft^3 than they are at 17.5 lbs/ft^3*).

POLICY CONSIDERATIONS

There are several policy questions raised by this work. The most fundamental is why some jurisdictions allow LCVs and some do not. In Canada, five provinces/ territories and, in the United States (*using definitions consistent with Canadian conditions*), 21 states allow their use. Mexico also allows LCVs. The question is: are road geometries, pavements, bridges, traffic conditions and other factors so different in these 27 jurisdictions in comparison to the other 35? It is difficult to believe that they are. It is more likely that there are many similarities among high-class roads in these jurisdictions and that it is really the debate over things like safety, intermodal competition and, perhaps, taxation that determines whether LCVs are allowed. These are controversial policy areas.

FIGURE 1: Linehaul Costs and Hauling Distance

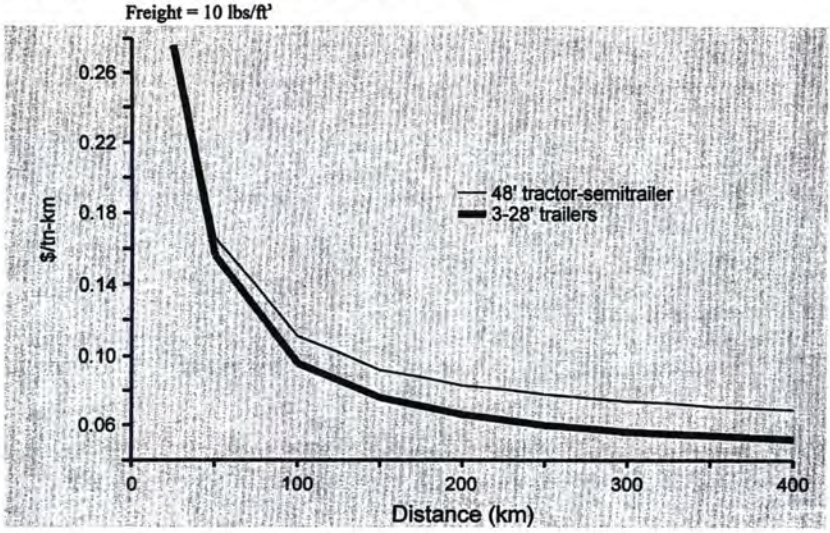
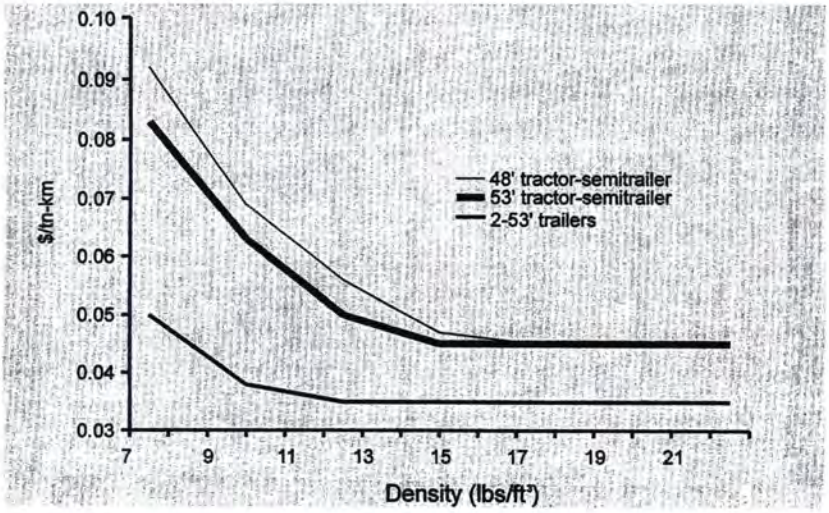


FIGURE 2: Linehaul Costs and Freight Density



On safety, the latest report from the United States, by the General Accounting Office, concludes that there are not enough data to address the question. Nevertheless, the authors note that the limited data that are available "indicate that LCVs have not been a safety problem on the turnpikes and western highways where they have operated." [11] They continue on to admit that they do not know if this apparent safety record would apply if LCVs were allowed to operate on the more congested highways of the Eastern United States.

In Canada, there is also a data problem (*no real measures of exposure*). What is known is that in the three largest LCV jurisdictions (Alberta, Saskatchewan and Québec), there were 10 LCV accidents in 1991 and 13 in 1992. These numbers can be converted to accident rates of 14.7 (1991) and 19.1 (1992) per 100 million kilometres (*based on the admittedly weak estimates of annual exposure from the survey*). While these are in the range of accident rates for all trucks in the United States[12] , there is no way of knowing whether such a comparison is meaningful. There are serious questions about whether accident rates reveal anything significant on the relative safety of one configuration in comparison to another. Because there are so many factors that may explain accidents, it is almost impossible to develop a sample size large enough to produce statistically valid numbers.

In terms of intermodal competition, the trucking industry and the rail industry compete for some of the same traffic. In general, anything that acts to lower trucking costs--such as allowing LCVs--will divert traffic from the railways to the roads. But in the particular case of Canadian LCVs, it is difficult to know whether this diversion would be significant. In the US, the latest report dismisses the railway association's own numbers and suggests that diversion would be relatively minor.[13] But in Canada, the intermodal diversion issue is quite different as the use of LCVs only changes truck cube (*not weight and cube as in the US*). Only the lowest density freight in Canada benefits from LCVs and it is not clear how much of this traffic the railways now carry. Besides, given the characteristics of the 116 carriers surveyed, the overwhelming use of LCVs--LTL and "warehouse-to-retail-distribution"--is not something in which Canadian railways specialize.

On taxation, there is not much to say in Canada. Unlike the United States, where the issues of truck size and weight and truck road-user taxes are joined, there is no such linkage in Canada. No province has an explicit policy that ties road taxes to vehicle characteristics that, in turn, are related to road costs.

Setting aside issues such as LCVs and roads (pavements, bridges, geometry) and the issues of safety, intermodal competition and taxation, the real policy issue is what LCVs mean for trucking productivity. The General Accounting Office report from the US uses an estimate of about 3% of annual trucking costs as the reduction in the freight bill that would occur if LCVs were allowed on a larger network. The public policy question in Canada is: what is the potential reduction in trucking costs--bearing in mind that LCVs in Canada are different than in the US and that the network of high class roads is more limited--and is this potential important in

considering such things as the GDP, the competitiveness of Canadian industry, or the location of firms in North America (particularly given NAFTA)?

Finally, one perhaps more minor policy question relates to regulatory diversity. From the survey, it is clear that the differences in the regulations in one province or territory and another have been limiting the amount of LCV activity across borders. Is this diversity justified? Would there be any benefits from more uniformity? The provinces themselves are asking these questions, but the answers are not yet clear. The Canadian questions on regulatory diversity become extremely complex when the issue of the 21 sets of regulations in the United States (and now Mexico) are brought into the matrix.

While answers to these policy questions are not available, it is important to at least raise these issues.

NOTES & REFERENCES

1. The Canadian Trucking Association has adopted the name E^2MV (energy-efficient motor vehicle) for these trucks.

2. Intermodal Surface Transportation Efficiency Act or "ISTEA"

3. The US General Accounting Office defines LCVs as doubles longer than a double 28' configuration or a triple-trailer configuration [US GAO. 1992. *Truck Safety: The Safety of Longer Combination Vehicles is Unknown*, Washington, D.C., p 1] ISTEA defines an LCV as "any combination of a truck tractor and two or more trailers or semitrailers which operates on the Interstate System at a gross vehicle weight greater than 80,000 pounds" [US Federal Register. June 13, 1994. *Department of Transportation, Federal Highway Adminstration, 23 CFR Parts 657 and 658, Truck Size and Weight; Restrictions on Longer Combination Vehicles and Vehicles with Two or More Cargo Carrying Units; Final Rule*, Washington, D.C., p 30392]; and the CVSA defines LCVs as either a single trailer in excess of 53' or a multiple trailer combination with a box length greater than 65 feet. [US GAO. 1993. *Longer Combination Trucks: Driver Controls and Equipment Inspection Should Be Improved*. Washington. D.C.]

4. For low density freight, as trailer length increase, so does total weight. The point is, however, that **weight limits** are not increased for LCVs as they are in the US. Second, it is true that some configurations in Canada are given higher weights when they are an LCV. For example, the MoU limits A-trains to 53.5 tonnes. Three provinces allow an A-train Turnpike double a maximum of 62.5 tonnes. This appears to be an increase in weight for LCVs contrary to the point made in the text. In fact the stability principles which form the basis of the MoU limits are not changed. These limit two 28' pups with an A-converter dolly to 53.5 tne but allow two longer trailers a higher weight.

5. In 1993/94, the Prairie provinces attempted to develop an agreement on common permit conditions. This led to the development of a draft agreement, however, for some reason the work came to a halt in the fall of 1994. In the US, the Western states have developed guidelines for common standards: WASHTO. 1993. *Guide for Uniform Laws and Regulations Governing Truck Size and Weight Among the WASHTO States.*

6. NWT may have issued more permits than this, however, as of the winter of 1994/95, it was known that there were really only three Alberta-based carriers operating LCVs into Hay River or Fort Providence.

7 There are 672,000 large trucks (registered weight of 4.5 tonnes or more) in Canada [Nix, F.P., 1994, *The Trucking Industry in Canada*, Canadian Trucking Research Institute, Ottawa.] For-hire trucks, including owner-operators, average 89,000 km/year (Statistics Canada), but the fleet average must be considerably lower than this as many farm trucks and urban trucks only operate a few thousand kilometres a year. Using a fleet average of between 35,000 and 45,000 suggests total kilometres of travel in the range of 23.5 to 30.0 billion.

8 Estimated tonnage is less accurate than the estimated distance travelled. Roughly one-quarter of the carriers responding to the survey did not provide payload information. The estimate used here is based on the average load of those carriers providing figures

times the number of trips (all carriers) given in the survey week times 52 weeks (3 provinces) or 39 weeks (Québec).

9. StatsCan is the source for the for-hire tonnages [Statistics Canada, *Trucking in Canada, 1991*, cat # 53-222] and the CIGGT is the source of the second [Canadian Institute of Guided Ground Transport, 1994, *Estimation of Railway Freight Market Shares – 1990-1991*, Kingston.]

10. The US GAO concludes that the expanded use of LCVs would not increase pavement wear; that the increased bridge costs would be in the range of $1.3 billion (considerably less than some estimates); and that many interchanges should be up-graded. On this last point, though, the GAO also points out that many interchanges need up-grading for existing trucks [US GAO. 1994. *Longer Combination Trucks: Potential Infrastructure Impacts, Productivity Benefits, and Safety Concerns*, Washington. D.C.] These findings are not applicable to Canadian conditions where LCVs operate at the same weights and axle loads as existing MoU trucks. In terms of stability, all LCVs in Canada are configured according to regulations developed for the MoU limits and, therefore, incorporate the same stability principles.

11. US GAO. 1994. op. cit., p 43.

12. US DoT, FHWA. 1993. *Larger Dimensioned Vehicle Study*, Final Report. Washington, D.C.

13. US GAO. 1994. op. cit., p 34 ". . . it does not appear that selective expansion of LCV routes would significantly affect rail traffic."

AN INCENTIVE COMPENSATION SYSTEM FOR PICKUP AND DELIVERY DRIVERS

by

Darcy B. Toms

KPMG Management Consulting

A. Introduction

This paper describes the development of an incentive pay system for pickup and delivery drivers at CP Express and Transport (CPET), a major less-than-truckload motor carrier with operations throughout Canada. The project was a joint effort of CPET management, the Transportation and Communications International Union, and KPMG Management Consulting.

The paper begins with an overview of the project context, and a brief theoretical perspective on incentive pay. It then focuses on the project objectives, methodology, and testing process. The paper also outlines critical success factors for an incentive pay system, and discusses the scope for further application of incentive concepts within the trucking industry.

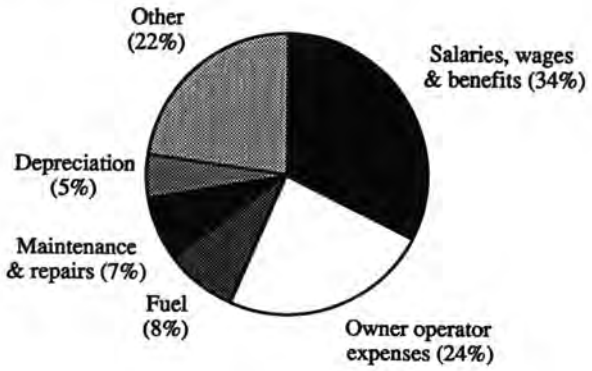
B. Background

The Canadian trucking industry is emerging from a very difficult period. The combination of relaxed economic regulation and a deep recession has forced many carriers out of business.

Exhibit 1 shows major expense items for Canadian for-hire carriers. Labour and benefits account for approximately one third of total operating expenses. During the recession, many carriers implemented wage freezes or wage rollbacks to cope with strong price competition. As shown in Exhibit 2, annual driver earnings have declined in real terms since the mid 1980's.

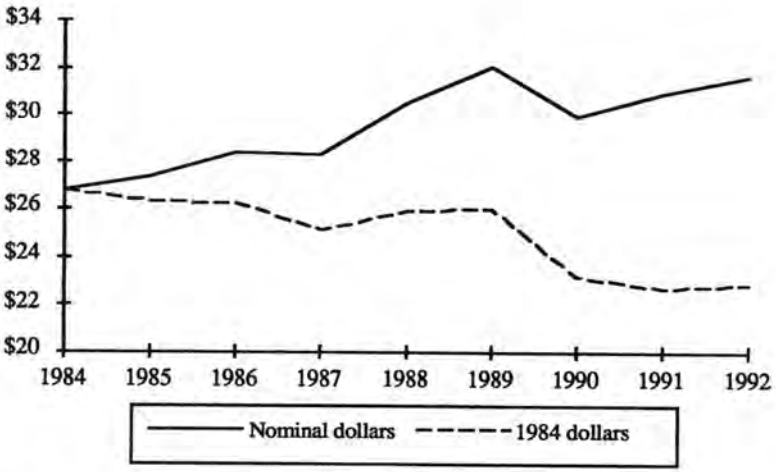
Like many carriers, CPET and its affiliated companies incurred heavy financial losses during the early nineties. As a result, the parent company (Canadian Pacific Limited), announced plans to divest or wind down its trucking subsidiaries. In February 1994, CPET management and union executives agreed to design and implement a variable rate compensation system for pickup and delivery drivers as part of an employee buyout plan. Management and union representatives set the following terms and conditions for the incentive system:

Exhibit 1
Major expense items for Canadian for-hire carriers



Source: Statistics Canada, *Trucking in Canada 1992*, Catalogue 53-222

Exhibit 2
Canadian average annual driver earnings, 1984-92 ($ thousands)



Source: Statistics Canada, *Trucking in Canada*, Catalogue 53-222; and *Consumer Price Index*, Catalogue 62-001

- Compensation will vary by individual and will be based on specific work flow and performance.
- The existing level of business will be served by 15% fewer pickup and delivery drivers.
- The new variable rate compensation plan will permit employees to return to existing levels of total individual compensation upon achieving the required 15% increase in productivity.
- With productivity increases beyond 15%, employees' compensation will surpass current levels.
- The new system will promote enhanced customer service and new business.
- The new system will allocate work to drivers in accordance with bidding and principles of seniority, and will protect drivers against arbitrary assignments by management.

KPMG Management Consulting was engaged to help management and the union design and implement the incentive compensation plan.

C. A theoretical perspective on incentive pay

Before designing the incentive pay system, we carried out a literature review and an industry survey of less-than-truckload executives in Canada and the United States. Both of these activities were aimed at identifying successful models of incentive pay in the trucking industry.

The industry survey revealed a great deal of interest in incentive pay. This was consistent with a 1990 survey carried out by KPMG, which identified driver incentives as a key factor in improving the productivity of trucking operations [1]. However, there were relatively few examples of successful incentive systems among less-than-truckload carriers. Where incentives did exist (e.g., flat rates per shipment) they usually applied to owner operators rather than company employees. Truckload carriers, on the other hand, frequently apply incentive pay (e.g., mileage or trip rates) to both company drivers and owner operators.

Our literature review uncovered a paper by Lantz [2], which discusses theoretical issues associated with incentive pay. The key issues and principles covered by this paper are summarized in Exhibit 3.

Exhibit 3
Principles and issues associated with incentive pay

- Incentive rates should be based on a target hourly rate and production standards established through a time study. Time studies should be conducted several times and at random intervals.
- Companies that manipulate incentive rates rarely achieve the desired effect. Rate cutting can lead to low morale and excessive turnover.
- Quality must matter more than quantity. Effective quality control is required to avoid abuse of company equipment and potential safety problems.
- Incentive rates should be comparable to what an average worker could earn elsewhere or turnover is likely to be excessive.
- Incentive rates can create anxiety among employees because their pay varies from period to period. As a result, many companies establish minimum pay rates, which are usually significantly below what an average worker can earn under the incentive system.
- If incentive rates are competitive, they can help a company attract and retain highly productive workers (whose compensation would be lower with hourly pay).
- To be effective, incentive rates must be carefully planned and administered, and employees must be kept informed.

D. System objectives and compensation framework

The principles agreed to by CPET management and union representatives served as the basis for the incentive system objectives:

- Improve productivity (by at least 15%).
- Control fixed compensation costs.
- Motivate employees to be more productive, and enable them to achieve superior earnings when superior productivity levels are reached.
- Improve or at least maintain existing levels of service.

Exhibit 4 provides an overview of the agreed upon compensation framework. The total compensation package is divided into two key components.

- **Individual operating performance** covering variable compensation for pickup and delivery activities plus payment for specific activities or a minimum base rate that is activated when compensation falls below a set limit. Compensation for individual operating performance assumes that the driver is operating in a safe manner and is providing quality service to customers.
- **Work quality factor** which accounts for exceptional safety and lost time performance in the form of a quarterly bonus for eligible employees.

Exhibit 4
Compensation framework

<table>
<tr><td colspan="3">A. Newco total compensation (A=B+F)</td></tr>
<tr><td colspan="2">B. Individual operating performance
B = Greater of (C+D) or E</td><td rowspan="3"></td></tr>
<tr><td>C. P&D variable rate
Weight (per shipment)
Km traveled (including stem time)</td><td rowspan="2">E. Minimum base rate
Minimum base compensation</td></tr>
<tr><td>D. Specific activities
Dock work
Training</td></tr>
<tr><td colspan="2"></td><td>F. Work Quality Factor (Q-Factor)
Safety & lost time</td></tr>
</table>

Exhibit 5 provides more detail on specific compensation factors. The compensation factors shown reflect the basic work activities carried out by pickup and delivery drivers:

- Driving from stop to stop.
- Picking up or dropping off freight and dealing with the associated paperwork (e.g., filling out bills of lading).
- Sorting freight and loading trailers (at some CPET terminals).
- Spotting empty trailers and picking up loaded trailers at customer locations.

Incentive rates include an allowance for daily activities carried out at the terminal before and after a driver's delivery route (e.g., pre-trip vehicle inspections, handing in waybills). CPET management and union executives also recognized that some routes should be exempted from the incentive compensation system (e.g., "tramp runs" that consist of deliveries with very long waiting times).

Exhibit 5
Compensation factors for incentive pay system

Activity	Performance measure	Compensation factors
Pickups & deliveries	Weight & number of shipments picked up and delivered	Pickup and delivery rate table based on shipment weight
Driving	Actual kilometres driven each day	Rate/km
Dock work (at specific terminals)	Time worked on dock	Rate/hour
Spotting trailers	Number of trailers spotted	Flat rate per trailer

The compensation factors outlined in Exhibit 5 were arrived at after considerable debate. In part, they are based on feedback from drivers who participated in pilot testing. Some of the alternatives considered during development of the system are outlined below.

- Two approaches were considered to compensate for driving time: payment based on standard kilometres (by route) and payment based on actual kilometres traveled. We found that it was very difficult to establish standard kilometres, as the distance traveled for a given route can vary significantly from one day to the next. Therefore, payment for driving time is based on actual odometer readings.

- We considered using a graduated rate per kilometre scale, with rates declining as the number of kilometres increased. The decision was made to simplify the system through adoption of a flat rate per kilometre regardless of distance traveled.

- The time required to make a pickup or delivery depends in part on the customer's facilities (i.e., whether or not there is a loading dock). We developed rates with and without distinction between regular and hand deliveries. Based on driver feedback, the decision was made to use a single set of rates.

- At some stops, drivers pickup or deliver more than one shipment. We considered two alternatives for these situations: payment based on total weight per stop and payment based on the weight of each shipment. The final system is based on payment for individual shipments.

E. Development of incentive pickup and delivery rates

Exhibit 6 outlines the methodology we used to establish incentive pickup and delivery rates. Each step is described in more detail below.

1. Determine relative rates

Relative rates are the foundation of our methodology. They are based primarily on company records (i.e., driver run cards), supplemented with observations from our trips with pickup and delivery drivers.

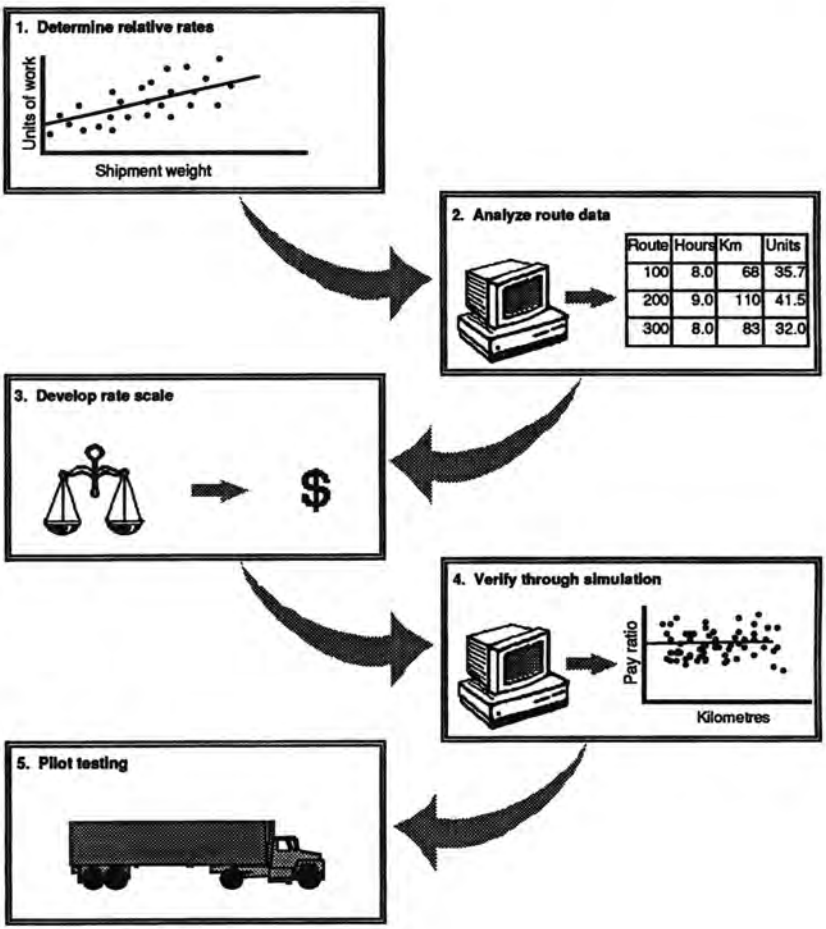
To develop the relative rates, we ran regressions of time per stop versus weight delivered. The results were used to estimate the relative "units of work" associated with each weight break. By definition, picking up or delivering a shipment in the smallest weight break (i.e., zero to ninety-nine pounds) is equivalent to 1.00 unit of work.

2. Analyze route data

We analyzed daily activity records by driver route at four CPET locations, including a mix of small and large terminals. For each trip (i.e., a given driver on a given day) we used the relative rate scale to determine units of work by stop, and total units of work for the day.

We also calculated the number of kilometres traveled based on reported odometer readings at the beginning and end of the driver's shift, and payment under the traditional compensation system based on the number of hours worked.

Exhibit 6
Rate development methodology



3. Develop rate scale

The results of steps one and two were used to establish the base pickup and delivery rate – that is, the payment for a shipment that weighs zero to ninety-nine pounds. The base rate was determined as follows:

	Compensation under traditional system (i.e., hours x $ per hour)
–	Payment for driving (i.e., kilometres x rate per kilometre)
–	Payment for trailer spotting (i.e., trailers spotted x rate per trailer)
–	Allowance for work quality factor (percent of traditional pay)
=	Dollars available for pickup and delivery compensation
÷	Units of work
=	Base rate per unit of work

This base amount was then multiplied by the relative rates from step one to establish an appropriate payment for other weight breaks.

4. Verify rates through simulation

After developing the rate scale, we ran a simulation using our sample data. For each trip, we determined the ratio of projected compensation under the incentive system to actual compensation under the traditional hourly rate. We plotted this ratio several ways (e.g., by route kilometres, by average weight per stop) to verify that there was not a systematic bias present.

5. Pilot testing

Pilot testing was carried out at CPET's Ottawa terminal over a six week time frame (i.e., three full pay periods). Results of the pilot test were very encouraging. Average shipments per hour, which was selected as a benchmark productivity measure, improved by more than 21%. By the third pay period, eighteen of the twenty-one drivers were earning more than the minimum (i.e., more than 85% of the traditional hourly rate). Ten drivers earned more than they would have earned under the traditional compensation system.

In addition to these quantitative measures, there was considerable anecdotal evidence to suggest that the system was working.

- Drivers were able to maintain existing service levels and continued to operate in a safe manner.
- Drivers spent less time in the terminal at the beginning of their shift.
- Dispatchers reported that many drivers were calling in for pickups in the afternoon. This allowed CPET to operate with fewer runs (i.e., they did not have to bring in on-call drivers to handle afternoon pickup requests).
- Drivers paid close attention to the way their vehicles were loaded, so they could make their deliveries as efficiently as possible (i.e., avoid

back tracking due to freight that is blocked in at the front of their trailer).

- Drivers began to identify shipments with inaccurate (i.e., too low) weights reported by the customer.

The pilot testing process identified several constructive ideas to simplify and improve the incentive system. As discussed above, many of these ideas (e.g., single rate scale, payment per shipment rather than combined weight) were incorporated into the final version. CPET is now rolling out the incentive program at its terminals across Canada.

F. Critical success factors for an incentive compensation system

Our experience with this project has helped us identify eight critical success factors for implementation of an incentive pay system.

- **Strong commitment to the concept of incentive pay.** Developing an incentive compensation system can be a long and arduous process. If commitment is lacking, there will be temptation to revert to traditional methods of pay. In this case, management and the union had a strong incentive to make the system work, since CPET would have been wound down if the employee buyout failed.

- **Driver representation on the project team.** The union representatives and drivers who participated in developing and testing the system played an important role in its success. First, they made many constructive suggestions for improvements. Second, they helped explain and sell the system in the field. If a carrier tried to implement incentive pay without consulting its drivers the system would likely fail.

- **Effective communications.** Compensation is a highly sensitive issue. It is important to keep drivers informed, and to answer their questions as openly and honestly as possible. Otherwise, potentially harmful rumours will emerge to fill the information gap.

- **Simplicity.** The system must be easy to understand and administer. At the end of the day, the driver must be able to quickly calculate what he has earned.

- **Flexibility.** The system must be flexible enough to work for the majority of delivery routes. At the same time, there will be some routes (e.g., tramp runs) for which it is more appropriate to pay drivers on an hourly basis.

- **Effective quality assurance factors.** Drivers will focus on achieving what is measured and rewarded. Therefore, it is important to incorporate quality assurance factors in the compensation system.

- **Effective testing.** Testing is required to ensure that the system is equitable and that it can meet its overall objectives. Pilot testing is a good way to identify and iron out wrinkles in the system. The test period must be long enough to give managers and drivers an opportunity to adjust to the new work environment.

- **Good management information systems.** Information systems must be modified to support incentive pay calculations. Compensation should be based on measurable factors and quality operating data.

An independent advisor such as KPMG can fulfill two important roles for companies implementing an incentive compensation system. The first role is bringing specialized technical skills and experience to the project team. This can include a variety of areas, such as design of the compensation framework, simulation and testing, and development of an effective communication program. The second role, which is also very important, is to act as a facilitator in the development and implementation process.

G. Conclusions

This paper has described an incentive compensation system for pickup and delivery drivers at a major less-than-truckload motor carrier. Based on our experience with this project, the following conclusions can be drawn.

- Incentive compensation principles can be applied successfully to pickup and delivery drivers.

- Incentive pay can be advantageous for drivers as well as carriers. Nearly one half of the drivers who participated in pilot testing achieved higher earnings than they would have achieved under the traditional hourly rate.

- We have identified eight critical success factors for an incentive compensation system. Trucking companies should review these factors carefully before attempting to implement an incentive program.

- Incentive pay can have beneficial side effects in addition to its direct impact on labour productivity. For example, it encourages drivers to provide good service to customers because higher volumes translate into higher pay. It may allow a carrier to reduce the size of its fleet, and it gives drivers an incentive to correct under-reported shipment weights. Most importantly, it can help a company attract and retain highly productive employees by providing an opportunity to maximize earnings.

Given the benefits described above, we can expect to see more examples of incentive compensation in the trucking industry over the next few years. We can also expect incentive concepts to spread to other areas of trucking operations (e.g., dock workers, administrative staff). In principle, any job where output can be defined and measured is a candidate for incentive pay.

References

[1] Bowland, J.M. and D.B. Toms, *Productivity Improvements in the Trucking Industry*, Proceedings of the 26th annual CTRF meeting, May, 1991.

[2] Lantz, Brenda, *Piecework: Theory and Applications to the Motor Carrier Industry*, Upper Great Plains Transportation Institute, Staff Paper No. 107, October, 1992.

FIRST STEPS TOWARDS A NATIONAL TRANSPORTATION DATA STRATEGY

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DELCAN Corporation, Ottawa

I. Introduction

A strategy is needed to coordinate the development, application and dissemination of Canada's transportation data bases. Pressures on the collection and maintenance of these resources limit their potential application and, in some instances, may threaten their long-term viability in the absence of a strategy. This paper identifies some of the relevant issues, and proposes ways of addressing them. The paper is by no means the definitive word on the subject; rather, it is meant to serve as a starting point for action. The perspective is that of the practitioner. However, it is evident that the interests of service providers (i.e., government and private carriers) and of academia also are at stake.

II. The Situation Today: Key Issues

At issue are the transportation data upon which decisions for transport investments are based -- in short, data for transportation planning. These data typically include origin-destination (O-D) surveys, market surveys, performance indicators and other related information (such as socio-economic characteristics) that describes who uses a transportation service, and how.

Investment in a transportation facility (such as a new highway or rapid transit system) or the provision of a service (such as a new air or shipping route) require a certain expenditure of resources. Relative to the magnitude of the resource expended, the costs of collecting and maintaining data are small, but the value they add to optimizing the allocation of these resources is substantial. However, in this supporting role, the data tend to be somewhat invisible and, as a result, they are vulnerable to budget considerations. The situation is not unique to today's difficult economic climate, nor is it simply a matter of inadequate funding.

Rather, the situation suggests that the transportation community may not be using its existing data resources effectively. This is, or should be, the key issue of concern regarding the long-term viability of these valuable resources. The issue is manifested less in technical or technological concerns (upon which most discussions of this topic focus), but more in jurisdictional and institutional constraints. This is evidenced by the following:

- **Divided responsibilities for transportation investments and services among the three levels of government.** By design, these were meant originally to be complementary. However, many of the distinctions among federal, provincial and municipal areas of interest have become blurred over time. Examples include the expansion of urban development beyond a local government's boundaries, the elimination of inter-provincial and international entry barriers to new operators, and the growing role of the private sector in providing transportation services.

- **Lack of standards in data collection.** Global access to information increasingly is focusing data bases to be set to common standards; otherwise, they cannot be used. This relates to the content of the data (i.e., the reason the data are being accessed), the units by which they are defined and measured, and the software and data base structures used to store, maintain and access them. It is not a matter of compelling, by law or dictum, different jurisdictions to use common data reporting schemes (which is one pre-condition for federal funding in many transportation investments in the United States). Rather, data base 'owners' will be forced to do so by the market place. This will happen because increased access -- i.e., greater use -- will lead to lower units costs of collection, storage and maintenance. (One implication is that the trend towards 'per-use' charges for the data will continue and expand.)

III. Consequences

Among the consequences of the current situation are the following:

- **Irrelevancy of data for decision making.** Decisions for major investments and policies are made increasingly in the absence of information that is current, or which is pertinent to the question at hand. It is understood that not every need can be met, or can be anticipated when data are first collected. However, a 'second-best' solution is to ensure that a set of data concerning, for example, transportation accessibility in Saskatoon is readily available by a user

in Ottawa. This requires that the Ottawa user is aware that the data exist, that she/he can access them easily and that the Saskatoon owner of the data has provided a context (i.e., not just the data alone but an interpretation of their meaning and validity).

A related consequence is the frequent replacement in decision making of fact by opinion. It is understood that decisions never should rely strictly upon the numbers alone; judgement and political considerations being necessary components of sound decision-making in both the public and private sectors. However, the daily use of passenger and goods transportation services by the public at large means that facts often are confused with perception. In addition, public and political visions often imply significant changes in current travel behaviour -- for example, with respect to eliminating vehicle pollutant emissions or reducing the dependency upon the private auto. However, neither current conditions nor the means of achieving the targets are often understood fully, which decreases the likelihood of successfully achieving the vision. The point here is that the data -- i.e., observations of current conditions -- often exist, but are not exploited.

A topical urban planning example concerns the advocacy of 'self-contained' suburbs, as a means of controlling traffic growth. 'Self-containment' describes the ability of residents to live and work in the same community. The resultant shortened commuting distance is conducive to travel by modes other than the private auto which, in turn, responds to the public (and fiscal) pressures to limit new road construction. Self-containment targets of 40-50% of all work trips are not atypical, but a simple review of Census Place of Work / Place of Residence linkages would provide a meaningful indication of the likelihood of achieving the targets or, at least, would indicate what travel habits would have to change, and by how much..

- **Duplication of effort.** Many data are collected to support 'one-off' applications. (The federal and civic censuses are exceptions.) On the one hand, it makes economic sense to collect certain data only when they are needed -- for example, market surveys for a new air route. However, data collection activities of a larger scale -- such as O-D surveys or provincial highway count programs -- could benefit greater numbers of users of areas of commonality among jurisdictions could be identified. This would allow different agencies to develop a hierarchy of data collection activities. For example, using a common, agreed framework (with common units of measure), individual agencies could then add items of specific interest to their own needs. This concept is not new, but the intent is to encourage cooperative, trans-jurisdictional

data collection. The potential benefits include reduced unit costs of data collection, the ability to focus resources on data of particular interest, possible reductions in sample size (since more sites are sampled), improved understanding of the data and improved products that benefit from the synergy of several participants sharing common interests and experiences.

- **Gaps in need.** Data must match the issues at hand. The multi-disciplinary nature of issues, to speak nothing of the growing need to transcend boundaries when dealing with problems and the dynamic nature of these problems, describe succinctly the challenge of maintaining both adequate coverage and currency. Of growing concern are data that describe interprovincial and international passenger and freight movements in a coordinated manner, that takes into account all modes under a single framework. This is in contrast both to the existing reporting structures, which are focused upon individual modes and/or jurisdictions, and to trends elsewhere -- notably, the United States where the recent ISTEA legislation promotes the integration of transportation services at the both municipal and the state levels.

  A related consequence concerns the use of data base beyond their original intended application. For example, vehicle ownership information is an important indicator of travel mode. The only sources of this information are provincial vehicle registries. However, the registries were designed for legal and fiscal purposes. This means that the data often are inappropriate for planning purposes (for example, a company vehicle leased by the Montréal head office but used by an employee residing in Aylmer), or have incorrect or missing pieces of information that are not necessary to registry purposes, but which limit their use for planning. In addition, access to at least one registry is limited by provincial confidentiality regulations.

- **Interpretation of the data is required.** Much of the focus in the transportation community is on the use of computer-based technological innovations to collect, validate and store the data, a notable example being geographic information systems (GIS). However, the full richness of the data cannot be exploited unless there is more emphasis on interpreting and explaining them in terms that are meaningful to the user. It follows that increasing the 'user-friendliness' of the data in this way will result in new, unforeseen applications and, ultimately, in cost savings and technical innovations in the collection and use of future versions or additions.

IV. Response: First Steps Towards a National Strategy

Possible actions towards the development of a coordinating strategy are proposed below. These are based upon the following principles:

- **Minimize legal interventions.** Voluntary participation is the most likely means to encourage compliance. That is, the pressures of the market (for example, maintaining competitiveness with other providers of the same service within and outside Canada) will force compliance, and will also allow the strategy to evolve over time according to internal and external pressures. This is also an effective way of transcending jurisdictional and institutional constraints. The rationale behind reducing dependency upon legal (i.e., institutional) mechanisms is that many of these likely would require extensive or far-reaching changes to existing regulations and, in many cases, could not be achieved in a short time frame.

- **Broad perspective.** It is important to consider not only the collection and storage of the data, but what they mean and how, and by whom, they can be used.

- **Step-wise approach.** Although the ideal may be to establish national standards that are accepted by all members of the transportation community, a more practical approach may be to address issues in a sequential manner. The key is to put these in perspective; that is, to recognize that each is but one step towards achieving a final vision.

- **Broad input.** It is important that there be representation from all members of the transportation community, including government (all levels), academia, carriers and consultants, as well as consumers of transportation services.

The strategy should address the following:

- **Precision of goals** -- i.e., definition of the types of data to be considered, and a statement of the objectives and scope of the strategy.

- **Inventory of data and identification of needs** -- a broad listing of the data that exist, possible gaps and possible duplications. The listing would describe the data, the units used to measure them, the developers (owners), means stored, the frequency at which they are updated, and their availability.

- **Models** -- i.e., different approaches used to achieve commonality

among data bases. This would encompass both provincial efforts concerning their own data, as well as approaches used in other countries.

- **Hierarchical framework** -- a structuring of the sequence of data; that is, the identification of increasingly detailed frameworks upon which different levels of data can be 'hung.' The objective is to identify the relationships among different pieces of data.

- **Accessibility requirements** -- an examination of the technical requirements for providing access to different data sets, as well as the institutional and legal constraints within which the strategy must evolve (for example, confidentiality laws).

- **Comparability requirements** -- an examination of the issues associated with allowing data to be compared; that is, identifying both the opportunities and potential benefits to making data as 'user-friendly' as possible, as well as the obstacles.

- **Technological requirements** -- an examination of the technologies and media that are being used, or which could be exploited (or encouraged for use), in order to collect, store, maintain and disseminate data.

- **Operational and financial requirements** -- an examination of the means by which data are, or should be, made available. This would address financing, cost recovery, and exchange protocols.

- **Monitoring and performance** -- a program to ensure that changes in needs can be anticipated and monitored as they evolve.

V. Putting the Strategy into Action

The short-term goals of a national transportation data strategy should be to attain agreement with regard to its objectives, then to develop and promote guidelines for its implementation. As a first step, commitments must be ascertained from the individuals and agencies who have the most to benefit (and the most to contribute).

It is important that members of the transportation community work together in achieving a national transportation data strategy. This paper has attempted to identify the pressures facing the community in a critical aspect of its activities. The opportunities and benefits of a common strategy are there to be taken; the outstanding question is, will we do it?

RECENT TRENDS IN CANADIAN AIRLINE COSTS

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Introduction

In this paper, the expenses of the two Canadian major scheduled carriers (MSC's) and large charter carriers (CC's) are reviewed. Two types of approaches are included. One is a proportional analysis of the various types of expenses. The other approach is to use a ratio of expenses as a percentage of output, measured in tonne-kilometres performed.

In measuring expenses proportionally, it was found that in 1993, both groups spent roughly the same percentage on aircraft ownership costs. (These are aircraft rental, interest and depreciation on flight equipment.) The MSC's spent proportionally more on flight crew and less on fuel. In recent years, the MSC's have spent an increasing proportion of their expenses on aircraft, fuel and flight crew. This was driven by increases in their expenditures on aircraft costs, as well as cost cutting measures affecting all "other" costs. Meanwhile, expenditures on these "other" costs, as a percentage of tonne-kilometres performed, dropped in the years 1991 to 1993, particularly for the MSC's.

Methodology

Carriers Included

The Canadian MSC's include Air Canada and Canadian Airlines International Ltd. (CAIL). The charter carriers (CC's) included Air Transat, Canada 3000, Nationair and Royal (which began in 1992) and Worldways between 1988 and 1990.

Basic Items

Shown below are the operating expenses and non-operating items collected on the income statement.

Operating Expenses

- Maintenance - Ground Property and Equipment
- Aircraft Operations
- Maintenance - Flight Equipment
- In-flight Service
- Aircraft and Traffic Servicing
- Promotion and Sales
- General Administrative Expense
- Depreciation

Non-operating Expenses

- Capital Gains (losses)
- Interest Income
- Interest Expenses
- Miscellaneous Non-operating Income (expenses)

Of these items, only those that are known to be part of the continuing operations of the carriers (referred to as the basic items) will be included. Large scale write-offs, or a capital gain on the sale of an aircraft are not considered to be something that would normally result from the day to day operations of an airline. Therefore capital gains (losses) and miscellaneous items will not be included in this analysis.

Assumptions

1) It is assumed that the above noted expenses reported by the carriers in this paper are expenses which they incur while performing mostly transportation activities, the movement of passengers and freight. It is acknowledged that there will be some differences among carriers in the degree to which these expenses are the result of producing a product which may be incidental to transport (e.g. operating fuel services for other carriers, operating administrative services for other businesses etc.).

2) It is also assumed that, within the transportation activity, there is a similarity among carriers in their type of operations. For the carriers in this analysis, most of their revenue is generated from passenger operations. If this were not the case, the data would not be as comparable. For example, if the operations of one group were largely passenger transport, and the other's were primarily goods transport, it could have a substantial impact on how expenses are incurred in areas such as aircraft and traffic servicing.

3) One area in which the two carrier groups differ is the length of haul. Canadian charter carriers perform mostly long haul domestic and international services, while the major scheduled carriers do a great deal of short and medium haul. In 1993, the charter carriers had an average aircraft stage length of 3245 kilometres. Air Canada and CAIL had average stage lengths of 1459 kilometres and 1630 kilometres, respectively. Carriers that do more short haul will spend proportionally more of their total expenses on fuel (a component of aircraft operations) because of the larger number of takeoffs. However, they must also do more scheduling, and aircraft and traffic handling (components of general administrative expense) than carriers which do strictly long haul. It is assumed that on balance the length of haul does not reduce our ability to proportionally compare expenses between the two groups of carriers.

4) Another area of concern is the age, type, and size of aircraft (which carriers often adjust according to length of haul involved). It will also be assumed that, on balance, any differences in these areas do not prevent our ability to compare the proportional expenses of the two groups of air carriers.

Analysis of the Proportions of Various Expenses

Expense Items

For the purpose of this analysis, the basic items are grouped into four main categories.

1) Aircraft Ownership Costs including:
   Aircraft rental,
   Interest expenses minus interest income,
   Depreciation - flight equipment

2) Fuel and Oil

3) Flight Crew Salaries and Expenses

4) "Other" Costs including:
   Any remaining aircraft operations expenses (landing fees, aircraft insurance etc.)
   In-flight service (e.g. cabin crew costs, food, passenger liability, insurance etc.)

Aircraft and traffic servicing (inspection, fueling and parking of aircraft, enplaning and deplaning traffic, as well as expenses in preparing for enplaning and subsequent to deplaning)
Other general administration expenses
Depreciation - ground property and equipment
Maintenance - flight equipment
Maintenance - ground property and equipment

Considerations

As noted, aircraft ownership costs include aircraft rental, interest, and depreciation of flight equipment. This allows for costs to be attributed to aircraft ownership whether the fleet is rented, owned outright, or is being purchased over time with interest charges being paid on the outstanding debt. Net interest, (interest expense minus interest income) is used because of the way that carriers establish the available funds for acquiring aircraft. A carrier may acquire debt when interest rates are good, in anticipation of purchases to be made in the near future. In a given year, it is feasible that not all of a carrier's available funds will be in use throughout the period. This results in interest income being generated. In order to have a variable which reflects the net costs of having the debt in a given year, interest income is deducted from interest expense. Finally, it only makes sense to start with total interest expenses, as opposed to interest expenses on flight equipment, otherwise we would be subtracting interest income only from interest on flight equipment . The only problem in this methodology is that not all debt is associated with the purchase of flight equipment. For the purpose of this exercise, it will be assumed that because most debt is for this purpose, the variable net interest expense can be appropriately included with aircraft costs.

In this analysis, the expense data will be compared between the major scheduled carriers and the charter carriers. As such, one of the items, promotion and sales, which would normally have been included under other costs, will be excluded. A problem arises with this item when comparing costs between scheduled and charter carriers, because of differences in how revenues and expenses are reported by the two types of carriers. For scheduled services, the total revenue from sales is reported as revenue by the carrier. Commissions to the agent which sold the units are then deducted as an expense, which is included in promotion and sales. For

charter carriers, their revenue is not the price of the product to the consumer, but is net of the cost of selling the space (and any profit from this activity). The cost of this activity is also not included on the expense portion of the income statement for charter carriers. Essentially, a cost and a corresponding revenue appears for scheduled services that does not exist for charter services. Therefore, for this analysis, the item promotion and sales will not be included in the "other" costs.

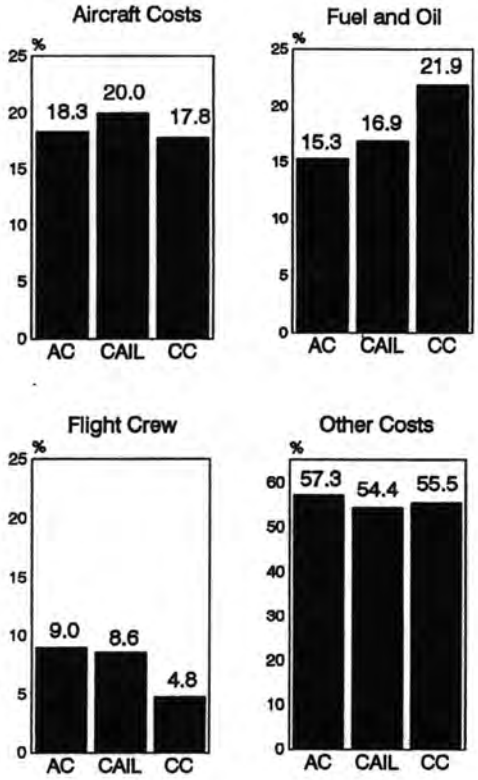
Results

A) Comparison of Canadian MSC's and CC's - 1993

Figure 1 shows 1993 expense data split among the four cost categories, for each of the two types of carriers, the MSC's and the CC's.

Figure 1

Component Costs as a Percentage of Total, Canadian Carriers - 1993



The data shows little difference between the MSC's and the CC's in their 1993 aircraft ownership costs. However, fuel and oil costs for the CC's are roughly six percentage points higher than the MSC's. Part of this is attributable to a slightly higher average rate per litre (0.8 cents) paid by the CC's (3.2% higher, or 25.87 cents for the CC's compared to 25.07 cents for the MSC's). But some of this difference is due to the fact that the CC's spend proportionally less for all other expenses in total. One area in which the CC's spend less is flight crew. This is largely due to the fact that they have a lower cost per pilot/co-pilot. The CC's paid an average of $67,000 per pilot/co-pilot in 1993, compared to $123,000 for MSC's. If the MSC's had paid the same rate per pilot/co-pilot as the CC's, the proportion spent on flight crew would be within one percentage of that of the CC's. However, the CC's would still spend proportionally much more on fuel and oil. This is because the CC's use more fuel relative to the other inputs than the MSC's do. This is at least in part due in part to the fact that CC's consistently fly at a very high load factor, while the MSC's reported a combined passenger load factor of 66% on scheduled and charter operations in 1993.

B) Annual Time Series - Canadian MSC's and CC's

Figures 2A to 2D show the costs as a proportion of total expenses.

Figure 2A

Aircraft Costs as Percentage of Total Expenses

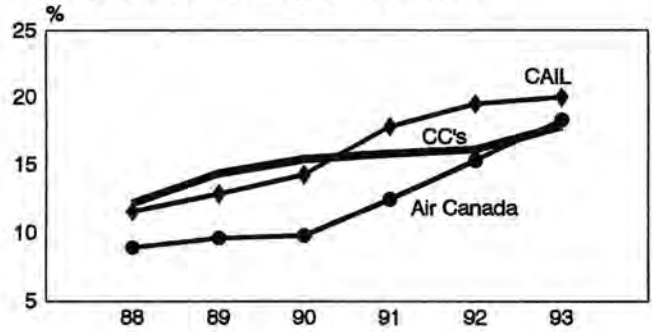


Figure 2B

Fuel and Oil Costs as Percentage of Total Expenses

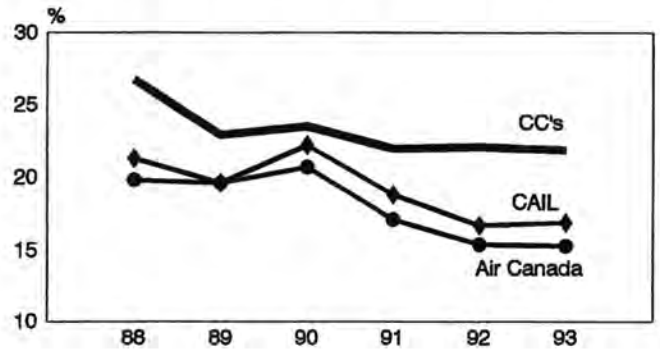


Figure 2C

Flight Crew Costs as Percentage of Total Expenses

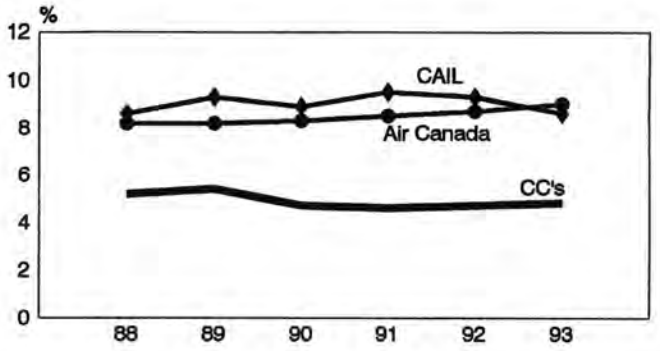
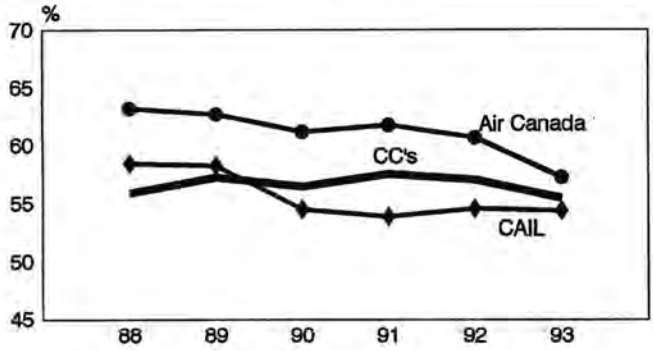


Figure 2D

Other Costs as Percentage of Total Expenses



While flight crew costs remained virtually stable for both the MSC's and the CC's in the period 1991 to 1993, aircraft ownership costs and fuel and oil shifted substantially as a proportion of total expenses. Aircraft ownership costs rose from 10% of the total expense bill, to 19% for the MSC's, while the CC's reported an increase from 12% to 18%. Fuel and oil costs decreased proportionally for the MSC's from 20% to 16%, and from 27% to 22% for the CC's. (The effect of increased oil prices in 1990 is clearly seen in Figure 2B). "Other" costs decreased as a proportion of total costs for both of the MSC's (six percentage points for Air Canada and four for CAIL). For the CC's, other costs as a proportion of total expenses were virtually the same in 1988 and 1993.

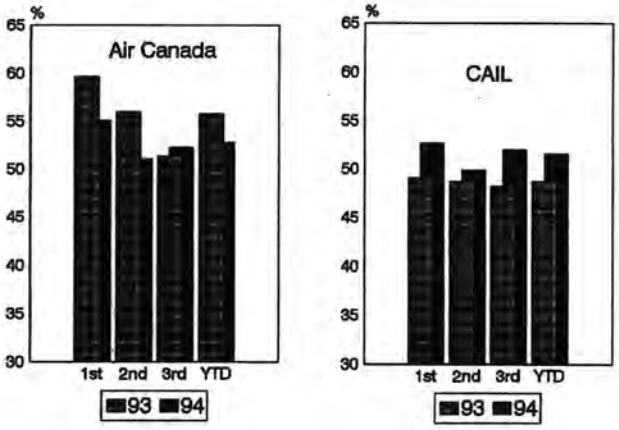
C) 1994 Quarterly MSC Data

Quarterly data for the first three quarters of 1993 and 1994 indicate in that in 1994, Air Canada is continuing in the direction it has taken in the last few years with decreases in "other" costs as a percentage of total expenses. Data for CAIL indicates an increase in the proportion of expenses spent on "other" costs. However, these quarterly trends may be influenced by a slight difference in methodology. Specifically, in the quarterly data, "other" costs do not include depreciation on flight equipment or any components of air operations expenses. (This is because in the quarterly data, depreciation

is not split between flight equipment and ground property. Also, total air operations are not filed by individual component in the quarterly data). Therefore, if CAIL experienced substantial decreases in an item such as aircraft insurance, for example, in 1994, the quarterly data could reflect a proportional increase in "other" costs without any associated decrease in the total of aircraft ownership costs, fuel and flight crew.

Figure 3

Other Costs as Percentage of Total Expenses,
Three Quarters and Year-to-date, 1993 and 1994



Ratio Analysis

Considerations

As noted earlier, it was assumed that carriers in this study produce a fairly similar product. Thus, we could reasonably compare the types of costs among the groups of carriers. However, there are some differences in the proportional mix between goods and passengers between the two groups. In addition to having an impact on how costs are allocated to the various types of expenses, this will have an impact when attempting to measure output in the form of total tonne-kilometres reported. For example, carriers from Group A may produce more tonne-kilometres per dollar of expense than those from Group B. However, Group B may concentrate more on passengers, which have a different set of characteristics affecting both the

expenses and output which are generated. With total tonne-kilometres, we are implicitly assigning the same value to one passenger tonne-kilometre as one goods tonne-kilometre. This is not necessarily the case.

Similarly, in assessing costs by proportion it was assumed that differences in length of haul did not prevent us from making comparisons. Length of haul is more of a factor in assessing expenses per tonne-kilometre. Essentially, carriers with longer stage lengths will be able to generate more passenger-kilometres and goods tonne-kilometres with an equal amount of "other" costs. Therefore, this section will focus largely on changes to the ratio for individual carriers or a carrier group.

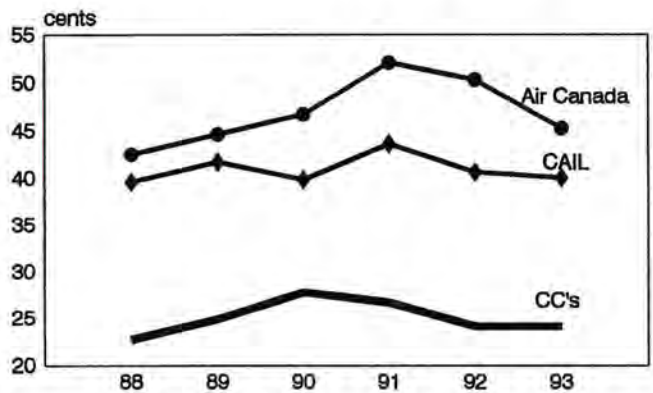
Results

A) Comparison of Trends in Expenses per Total Tonne-kilometres, 1988 - 1993

While the proportional analysis showed (on balance), a shift of expenses out of "other" costs by the MSC's, this section will review the expense data (in particular, the "other" costs,) as a proportion of total tonne-kilometres.

Figure 4

Other Costs as Percentage of Total Tonne-kilometres



This data is particularly useful in observing the changes which have occurred since the MSC's began to streamline their operations and reduce the number of employees. The major economic downturn hit the MSC's in 1991 and there was essentially no recovery in 1992 or 1993. In 1991, total tonne-kilometres fell for Air Canada and CAIL. In 1991, they reported 82% and 87% of their 1990 levels, respectively. By 1993, these levels had only risen to 83% and 92% of their respective 1990 totals. As a result, any cutbacks in the proportion of expenses spent on "other" costs in 1991 do not show up in the ratio of "other" expenses to total tonne-kilometres. However, between 1991 and 1993, with relatively stagnant demand, the effect of streamlining on "other" costs, by both Air Canada and CAIL is apparent. Air Canada's ratio of "other" costs to tonne-kilometres dropped by seven percentage points from 1991 to 1993, while CAIL's dropped by 3.6 percentage points.

Meanwhile, the CC's reported a drop in this ratio of 2.7 percentage points from 1991 to 1993. However, the CC's reported a steady increase (16%) in total tonne-kilometres performed during the period 1991 to 1993. Generally, it should be possible to reduce the ratio of "other" costs per tonne-kilometre, when demand is increasing.

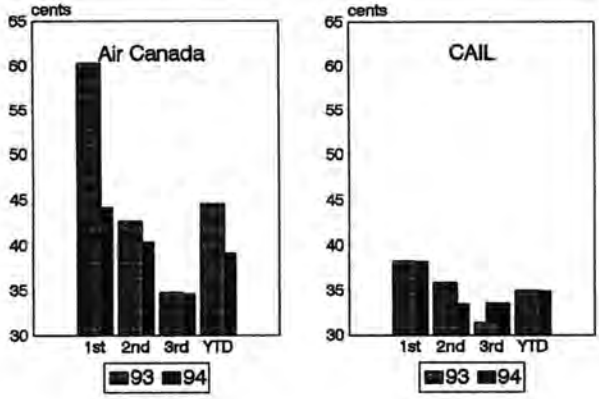
Finally, as noted above, the difference in the absolute levels of the ratio of "other" costs to tonne-kilometres, among Air Canada, CAIL and the CC's, is clearly related to the fact that differences in average stage length exist among the carriers. Some of the improvement in this ratio by CAIL over the years 1991 to 1993 may be related to the stage length increases as well as increases in total tonne-kilometres. CAIL's average stage length rose by 10% over the period while its ratio decreased by 8%. Air Canada's average stage length was unchanged from 1991 to 1993, while its ratio decreased by over 13%.

B) Quarterly Data

On a year-over-year basis, in the first three quarters of 1994, total tonne-kilometres performed by Air Canada increased by 9%, while CAIL reported a 4% increase. From the quarterly data, it appears that as demand increased, Air Canada was able to make substantially further reductions in its ratio of "other" costs to tonne-kilometres. CAIL reported little change in this ratio during the first three quarters of 1994. (Once again, the quarterly data items collected are different from the annual data).

Figure 5

Other Costs as Percentage of Total Tonne-kilometres, Three Quarters and Year-to-date, 1993 and 1994



Conclusions

The data shows that the MSC's and CC's have a similar portion of expenses dedicated to aircraft ownership costs. The MSC's spend proportionally more on flight crew and less on fuel. In recent years, the MSC's have spent an increasing proportion of total expenses on these three costs in total. This was driven by increases in their expenditures on aircraft costs, as well as cost cutting measures affecting "other" costs.

While proportionally, "other" costs decreased for the MSC's between 1988 and 1993, they did not end up producing more output per dollar of "other" cost spent over the six year period. However, after substantial cost cutting measures were introduced in the early 1990's, and the decreases in demand levelled off, both Air Canada and CAIL did decrease their expenditures on "other" costs as a percentage of tonne-kilometres performed. The CC's reported the same pattern in their ratio, (an increase, then a decrease after 1990), however these carriers grew in size continuously throughout the period 1988 to 1993. Quarterly data indicates that Air Canada is continuing to decrease its "other" costs as a percentage of output in 1994.

Note

The views and opinions expressed in this paper are those of the authors and do not necessarily reflect those of Statistics Canada.

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COMMERCIALISATION AND CANADIAN PORTS ARE THEY READY?

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Introduction

Canada's ports are exposed to competition both internally from our multi-faceted national system of ports and externally from U.S. ports. Contributing to heightened degree of inter-port competition is an increasingly integrated continental transportation system. Canadian and American shippers benefit from transporting export and import goods through the most cost and service efficient routings regardless of the port and country being used. Some U.S. shippers are using Canadian ports to avoid the increasingly onerous harbour maintenance fees being assessed at American ports.[1] Similarly, Canadian shippers often use U.S. ports, particularly on the west coast for shipments to/from Asia, due to lower costs and more efficient double-stack rail services and the frequency of shipping service.

Canadian ports represent capital intensive, non-mobile facilities serving a highly mobile clientele; mobile both on the water-side as shipping lines shift from one port to another in their quest for cost reductions and service rationalization, and on the land-side, as railways cut costs and reduce under-used trackage. Thus ports are often placed in a reactive position as the crucial decisions affecting their operations and cargo throughput are made by others, frequently located in remote inland centres. Most shippers cannot afford loyalty to a given port or even to a national system of ports. Canadian ports like their U.S. counterparts cannot depend on throughput from a captured market within a defined hinterland region.

This paper explores the readiness of senior Canadian port managers to embrace intensive commercialisation by examining their responses to the various issues facing ports and contrasting their responses to others in the ports and transportation industry. The hypothesis being tested is that although Canadian ports have "commercialised" to a degree by serving as "landlords", they have not shifted enough to effectively compete continentally.

Methodology

This paper is based on an analysis of a three phased set of questionnaires administered to a panel of Canadian port experts during 1993-94. The selected expert panel of 90+ participants were divided into four distinct and approximately equal-sized groups:

- Port managers (M) from:
  - Canada Ports Corporation (Local Port Corporations and Divisional Ports);
  - Harbour Commissions; and
  - Transport Canada's Harbours and Ports Directorate;

- Federal and provincial bureaucrats (**B**) monitoring and regulating ports;

- Private sector managers (**P**) involved in port operations including:
  - terminal managers, railways and trucking firms, shipping lines, agents, freight forwarders; and

- A mixture of academics, consultants and journalists (**A**).

This paper reflects the opinions of this selected sample. Group responses were collated based on the mean of their responses to specific questions. Individual responses may well differ from the specific group means shown in the tables. The tabulated responses reflect a statistical analysis of the differences in the mean responses between the port managers and each of the other three groups. Statistically significant differences only are shown (at the 0.05 and, in many cases, 0.01 levels of confidence). This implies that for each of the tabulated responses the mean and spread of the responses define a distinct and different population than of the other one, two or three groups indicated. Where no difference is shown, the missing group (or groups) responded similar to the port managers. The exception to the use of statistically significant data are tables 1 and 5 where no statistical testing was carried out due to the small sample size in each category. Not all statistically significant results from the survey are tabulated to permit consolidation of redundant responses.

Canadian Port Structure

Canada's national ports system is fragmented into three separate systems:

- Canada Ports Corporation (CPC) - a federal Crown corporation comprised of:
  - 7 semi-autonomous Local Port Corporations (LPC); and
  - 8 smaller Divisional ports administered by the CPC Headquarters in Ottawa.

- Harbour Commissions (HC) - 9 semi-autonomous federal ports administered under their own Act of Parliament. Generally, HCs are more autonomous than CPC ports with a diversity on their Boards of Directors including some municipal appointees.

- Harbours and Ports Directorate in Transport Canada (HPD) - some 526 smaller ports directly administered by Transport Canada on a regional and national basis.

Canadian ports can be further classified by the degree of their commercial activities and the rationale for their continued federal government support as follows:

Level I — major commercial ports (includes LPCs, some CPC Divisional ports and most HCs) providing gateway and terminal services for international and domestic shipments;

Level II — minor commercial ports at a break-even level (including the cost of capital) or with a small public subsidy (includes some CPC Divisional ports, some

HCs, and some larger, more commercially oriented HPD ports) providing services for international and domestic shipments;

Level III — non-profitable ports supporting regional economic development (HPD ports and some private ports); and

Level IV — non-profitable ports providing maritime access to remote communities (such as in Northern Canada and Labrador) (HPD ports and others).

Canadian ports' challenges and the port managers' responses (as contrasted with the other three groups) are discussed as follows: international trade; transportation; financial concerns; marketing; technology impact; and institutional reform.

International Trade

In the phase I study of Canadian ports, the expert panel was asked to rank the top three driving forces impacting Canadian ports. The top two priorities for each of the four groups are shown in table 1. Port mangers see economic globalization as being more significant than growing trans-Pacific trade (the top priority for the other three groups). This difference may reflect the port managers' belief that globalization includes north-south trade which has been enhanced by NAFTA. For example, as shown in table 3, port managers tend to view NAFTA as less favourable to Canadian trade and their port operations than do the bureaucrats (B) and academics, consultants and journalists (A).

Transportation

The impact of increased north-south trade to the detriment of Canadian port throughput expressed by the port managers seems shared by the other three groups when the impact of continental port competition and intermodalism was shown as their first and second priorities in table 1. However, in testing for this same question in terms of support for NAFTA in table 3, port managers indicate that although NAFTA is an essential part of a competitive Canadian transportation system, they are not as strong in this view as are the bureaucrats and academics. From a broader perspective, when offered a choice between encouraging the development of a continental transportation system as opposed to Advantage Canada's initiatives in promoting the "Maple Leaf" route in table 2, port managers take a more moderate view than the bureaucrats who believe developing the continental system is critically important.

In terms of other transportation issues (table 2) port managers are more concerned about the changes to the Western Grain Transportation Act (WGTA) than are the bureaucrats. The port managers' concerns may reflect the possibility that providing direct grain subsidies could lead to alternative grain export transportation including the use of barges on the Mississippi River to Gulf ports rather than Canadian ports. In a similar vein, port managers are also critically concerned about the continued viability of Canadian ports in the face of rail abandonment as compared to the private sector and bureaucrats.

Table 1 - Driving Forces Impacting Canadian Ports in Rank Order (Phase I)

Forces	Port Managers (M)	Federal-Provincial (B)	Private Sector (P)	Academics Consultants Journalists (A)
International Trade				
Economic Globalization	1	----	2	2
Trans-Pacific Trade	2	1	1	1
North - South Trade	----	2	----	----
Transportation				
Continental Port Competition	1	1	1	1
Intermodalism	2	2	2	2
Financial				
Payment of Surplus Dividends to Government	1	----	----	----
User Pay	----	1	1	1
Deficit and Debt	2	2	2	2
Technology Impacts				
Electronic Data Interchange	1	1	2	----
Increasingly larger ships	2	----	1	1
Sophisticated cargo handling (capital costs)	----	2	----	2
Environmental				
Waterfront Gentrification	1	----	----	2
Impact Assessment	2	1	2	1
International Protocols	----	----	1	----

Thus, port managers tend to be more concerned about potential threats to the viability of their facilities from cargo throughput changes that may result from such factors as NAFTA, WGTA, and rail abandonment than are the other sampled groups.

Financial Concerns

One of the fundamental questions tested in this survey was the federal government's purpose in providing ports as a public service. As shown in table 2, although both port managers and bureaucrats agree the port's focus should be profit-driven performance rather than regional and local economic development, the port managers tend to be less convinced than the bureaucrats who see profit-driven performance as something the ports must undertake. On the other hand, in table 3, when questioned about the national interest in ports and the need for subsidization, an opposite perspective arose with the bureaucrats tending towards subsidization and port mangers (along with the private sector and academics) favouring competition in a continental ports system. This national service perspective was reinforced when the panel was questioned on the need for central port planning and development versus port autonomy in table 3. In this case, the bureaucrats and private sector respondents are more neutral compared to port managers who strongly favour autonomy and competition. However, the position of the port managers can be contrasted to the academics in table 3, where the latter more strongly support a system of decentralized ports planning and financial control.

From another perspective, shown in table 1, port managers tend to see the payment of surplus dividends to the federal government as more important than the implementation of a user pay policy (the top priority for the other three groups). However, all groups considered the federal government's debt and deficit problems to be their second top priority. In the private sector's opinion, the implementation of the federal government's proposed user pay policy is a major impeding factor to port development as shown in table 2. This view is not shared as strongly by port managers (and the others). Obviously, the private sector participants perceive greater direct financial losses from user pay policies than do the port managers. In the phase I survey (not tabulated), the port managers believed the annual dividends paid to the federal government were excessive while the bureaucrats did not think this was the case.

Both the bureaucrats and the private sector believe it is critically important for Canadian ports to monitor the financial performance and profitability of each service the port provides. As shown in table 2, port managers tend to agree with this but not as strongly as the other groups. The bureaucrats also strongly believe there should be a defined market need for capital expenditures with approval resting with the port's Board of Directors rather than the federal government's Treasury Board. Port managers are less certain of this requirement.

In table 2, a contrast between port managers and academics is shown in terms of the need to amend the *Canada Ports Act* to delegate to LPCs authority for land transfers and capital expenditures. In this case, the port managers do not see this amendment as critical to the success of their ports.

Finally as discussed above, table 3 shows that port managers strongly believe that Canada's major and minor commercial ports (i.e., profitable ports) should be financially autonomous and supported by their own revenues. The bureaucrats are less certain of this and accept more readily the concept that port operations and capital projects should be supported by the federal government.

Table 2 - Responding to Port Challenges (Phase II)

Major Trends	**No impact ——— High impact**
User pay policy detrimentally impacts some ports and improves others' competitiveness	1 2 3 4 **M** 5 **P** 6 7
Electronic Data Interchange (EDI) is a necessity for competitive and efficient ports	1 2 3 4 **M** 5 **PB** 6 7
Keys to Success	**Not important —— Critically important**
Encouraging Advantage Canada's "Maple Leaf" routings	1 2 3 **M** 4 5 **P** 6 7
Encouraging continental transportation versus Advantage Canada's initiatives	1 2 3 **M** 4 5 **B** 6 7
Interacting with shippers to develop alternative routings and shipping services	1 2 3 4 **AB** 5 **M** 6 7
Changes to the WGTA affects west coast ports	1 2 3 **B** 4 5 **M** 6 7
Continued abandonment of rail trackage threatens port viability	1 2 3 **B** 4 **P** 5 **M** 6 7
Amend CPC Act to delegate authority to LPCs for land transfers and capital expenditures	1 2 3 **M** 4 5 **A** 6 7
Canada Ports Corporation should promote the economic advantages of Canadian ports	1 2 **M** 3 4 **P** 5 6 7
Critical Port Management Functions	**Need not do ——— Must undertake**
Focus on profit-driven performance instead of economic multipliers to local and regional area	1 2 3 4 **M** 5 **B** 6 7
Monitor financial performance and measure profitability of each port service	1 2 3 4 **M** 5 **BP** 6 7
Clearly define market need for capital expenditures for approval by port's Board	1 2 3 4 **M** 5 **B** 6 7
Monitor technology development and implement most beneficial into port	1 2 3 4 **M** 5 **A** 6 7
Impeding Factors	**No impact ——— High impact**
The federal government's user pay system is implemented	1 2 3 4 **M** 5 **P** 6 7
Port system creates a "non-level" playing field among commercial and non-commercial ports	1 2 3 4 **M** 5 **P** 6 7

This section on financial concerns reflects ambivalence by port managers. They appear to want competition and autonomy but seem unconcerned with profit-driven performance and monitoring the profitability of each of the services provided. Port managers also seem less concerned about defining the market need for capital expenditures. However, when it comes to direct financial losses such as the payment of surplus dividends to their shareholder, port managers become quite concerned. However, when faced with indirect financial losses, as might be expected through a user pay policy, port managers seem less concerned in contrast to the private sector respondents. This seems to be a case of wanting to be competitive but not willing to tackle the harder tasks of ensuring a profitable and efficient port. This may arise from a misunderstanding of the questions being asked or from a genuine lack of knowledge about the implications of operating a market-driven, profit-oriented, competitive port system in contrast to government support that has dominated the Canadian ports culture for decades.

Marketing

Examining the survey results in terms of port marketing activities provides interesting differences of opinion. As shown in table 2, the private sector believes encouraging Advantage Canada's "Maple Leaf" routings is more important to the success of Canadian ports than do the port managers. Similarly, having the CPC lead in the promotion of the economic advantages of using Canadian ports is supported by the private sector but considered unimportant by port managers. Possibly the lack of support shown by port managers for these two CPC initiatives reflects support for enhanced local autonomy and decreased central planning and marketing initiatives.

From another marketing perspective, shown in table 2, port managers believe it is critically important to their success to interact with shippers to develop innovative packaging for cargoes, alternative routings and shipping services, i.e. working closely with customers to meet their needs. Surprisingly, the bureaucrats and academics are less convinced of this need and do not see it as a critical to the ports' success.

Technology

In table 1, both port managers and bureaucrats see the top technology driving force as being Electronic Data Interchange (EDI) and other similar communication systems. However, although both concur, the level of agreement on EDI's importance to Canadian ports varies. As shown in table 2, both the bureaucrats and private sector respondents strongly believe that EDI is a necessity for competitive and efficient ports while port managers are less impressed with this need. This perspective was first noted in the phase I study (not tabulated) in which the bureaucrats believed EDI reduced cargo transit time through ports while the other groups, including port managers, were less convinced.

The differences in responses between port managers and academics in terms of technology is shown in table 2. The academics strongly believe that a critical port management function is monitoring technology development and implementing the most beneficial changes into port operations. Although port managers agreed, they are less convinced of its critical nature. This finding is reinforced with the technology priorities shown in table 1. Both the private sector and academics see larger ships as having a

technological impact on ports, while port managers see this as a second priority. In addition, the impact of technologically sophisticated cargo-handling systems is rated higher by the bureaucrats and academics than by port managers.

Table 3 - Public Policy Options (Phase III)

Ports Culture		
Ports serve the national interest and should be subsidized if required	1 2 3 **B** 4 **M** 5 **PA** 6 7	Ports operate competitively in a continental system
National ports policy should include central planning and development for all ports	1 2 3 **B** 4 **P** 5 **M** 6 7	National ports policy should promote port autonomy and foster competition
Canadian ports should be controlled by the federal government	1 2 3 4 5 **M** 6 **A** 7	Level I, II ports need autonomy to respond to the market
Level I, II ports provide essential public service for shippers	1 2 3 4 5 **M** 6 **A** 7	Level I, II ports must be profit-making and market-oriented
NAFTA is detrimental to national systems of ports and should be abandoned	1 2 3 4 5 **M** 6 **BA** 7	NAFTA is an essential part of a competitive Canadian transportation system
Structure		
Level I ports as Harbour Commissions and other ports consolidated in a ports dept	1 2 3 **M** 4 5 **B** 6 **A** 7	Level I, II ports should be Local Port Authorities (leasing federal assets)
Level I, II ports should be LPCs, level III, IV ports consolidated into a federal ports department	1 2 3 **M** 4 5 6 **A** 7	Level I, II ports should either be LPAs or privatized (sale of federal port assets)
Level I, II ports should be controlled by Ottawa office	1 2 3 **P** 4 5 **M** 6 **A** 7	Small secretariat is sufficient for federal liaison
Boards of Directors		
Boards of Directors only required for Level I ports	1 2 3 **M** 4 5 **P** 6 **A** 7	All ports need a BoD to provide commercial advice
Port BoDs should be replaced by a regional administrator	1 2 3 **M** 4 5 **B** 6 **A** 7	A regional BoD representing all ports is appropriate
Minter of Transport should appoint all Board Members and Commissioners	1 2 3 **M** 4 5 **B** 6 **A** 7	Others should also appoint Board members (provinces, private sector, municipalities)

Federally appointed members should be in the majority on the port's BoD	M BA 1 2 3 4 5 6 7	Locally appointed members should be predominant with federal members in minority
All appointed Board members should reflect national interests	M A 1 2 3 4 5 6 7	Regionally and locally oriented stakeholders should be on BoD
Programs		
Port operations and capital projects should be funded by the federal government	B P M 1 2 3 4 5 6 7	Level I, II ports should be financially autonomous and supported by own revenues
Port planning and financial controls should be centralized	M A 1 2 3 4 5 6 7	Decentralized ports planning and financial control is essential
Provision of port facilities should reflect market demand and local/regional priorities	M A 1 2 3 4 5 6 7	Port facilities should be rationalized with the closure of redundant facilities

These findings imply that the introduction of new technology is greeted less warmly by port managers than by the others involved in this survey. As new technology impacts the port system, both operationally and financially, port managers may be reticent to recommend risky investments and to change their organizations to adapt to new technologies.

Institutional Reform

This phased survey was primarily designed to focus on port institutional reform, hence, it is not surprising to find varied opinions among the four groups. Part of the differences noted below may arise from the different levels of understanding that each group has with the institutional issues facing Canadian ports.

As discussed above, the Canadian ports system is divided into three separate groups: CPC; Harbour Commissions; and, Transport Canada's Harbours and Ports Directorate facilities. Each of these port systems operate under different rules, regulations and financial and costing regimes. Such differences create a "non-level" competitive situation within the overall Canadian port system - an impediment to the future success of ports as pointed out by the private sector respondents in table 2.

Board of Directors

Operating a port as a commercially-oriented enterprise usually requires a Board of Directors (BoD) providing commercial advice and policy guidance to port managers. As shown in table 3, both the private sector and academics express a need for BoDs for all ports. Port managers are less certain of this, favouring the appointment of BoDs for major (Level 1) commercial ports only. In considering a regional BoD for ports, the bureaucrats and academics favour this approach while port managers are again less certain of its need, favouring instead the appointment of a regional administrator.

In terms of appointments to the BoD for Canadian ports as shown in table 3, both the bureaucrats and academics favour appointments by others including: provinces; municipalities; and, other private sector organizations. The port managers are less certain of involving others besides the Minister in making BoD appointments. Both the bureaucrats and academics favour locally appointed members as the majority of the BoD with the federally appointed members being in the minority. Again, the port managers are less certain about this favouring a majority of federally appointed members. Similarly, the academics favour having local and regional interests on the BoD, while port managers agreed, they also wanted the BoD to reflect national interests.

The port managers' position on BoDs is interesting. Essentially what may be inferred from the questionnaire results is that the managers would rather not have a BoD with the exception of major commercial LPCs. However, if a BoD is required, they favour continued strong federal rather than a local or regional presence among the members. The port managers' perspectives may reflect "imprinted" values resulting from decades of a strong federal presence in Canada's ports.

Institutional Structures

From an institutional structure perspective, considerable differences arise among the groups. As shown in table 3, the academics believe that major and minor commercial ports (Levels I and II) must be profit-making and market-oriented while the port managers agree but less strongly. This same perspective is shown when the respondents were asked about the need for full autonomy for commercial ports to permit quick response to changing market forces.

When considering the re-organization of Canadian ports, the differences between the port managers and the academics and bureaucrats become more pronounced. As shown in table 3, both the bureaucrats and academics strongly favour the conversion of major and minor commercial ports (Levels I and II) into Local Port Authorities (LPA) in which federal assets are leased to a separate local corporation. The port managers are far less certain of this step and, in some cases, favour the conversion of the major commercial ports (Level I) into Harbour Commissions and the rest being consolidated into a federal ports department. Port managers continue to be uncertain about major and minor commercial ports (Levels I and II) being converted into LPCs. The academics have little hesitation in supporting the conversion of Level I and II ports into LPAs or their outright sale in a privatization initiative.

The relative ranking of the groups in terms of port restructuring options is shown in tables 4 and 5. The differences reflect the responses noted above. The first choice of the port managers is the Harbour Commission model in which LPCs are converted to HCs (benefiting from the commercial freedoms afforded to this group of ports) with a modified status quo for the remaining ports. The private sector takes a contrary view suggesting that HCs should be converted to either LPCs or Divisional ports within the CPC. In their view some of the fragmentation of the Canadian ports system would be reduced by removing one of the three groups of ports. The more radical option of privatizing major and minor commercial ports through their sale to the private sector is the first choice of the bureaucrats and academics.

Considering the second and third choices of each group leads to a wider spread of opinion. However, it is noteworthy that both the port managers and the bureaucrats include the Departmental Model in their third and second choices respectively. This model

consolidates Level II, III, and IV ports within a centralized ports department with Level I ports being converted to HCs. All ports would report to the Minister through an appointed Ports Commissioner in Transport Canada. This is the model proposed in legislation that did not receive Royal Assent in the mid-1970s. This centralized, departmental approach was replaced by the current CPC system in the early 1980s.

It appears that port managers and the private sector favour a more stable transition to port restructuring, while the bureaucrats and academics favour more radical action. One could conclude that the bureaucrats and academics have less to lose in the transition and thus support more radical solutions to the ports fragmentation problem.

Table 4 - Alternative Port Systems[2]

Harbour Commission Model:

LPCs converted to HCs, CPC continues to operate Divisional Ports, HCs continue with the addition of transferred LPCs, HPD continues with Level III and IV ports.

Consolidate Level I and II Ports:

CPC continues with LPCs and Divisional Ports (Level III ports transferred to HPD), HCs converted to LPCs or Divisional Ports, HPD transfers Level II ports to CPC Divisional Ports and continues with Levels III and IV ports.

Departmental Model (Canada Ports Commission):

Consolidate all Levels II, III and IV ports into a federal ports department with Level I ports being converted to HCs. All ports to report to the Minister of Transport through an appointed Ports Commissioner in Transport Canada.

Privatization Model:

Sell the federal port and waterfront assets of Level I and II ports (if possible) to the private sector; the federal role would be limited to harbour operations and safety and environmental regulations.

Local Port Authority:

Major LPCs leased to LPAs, others remain within CPC along with Divisional Ports, major HCs leased to LPAs, others remain as HCs, HPD continues with Level III and IV ports.

Regional Ports System Model:

Consolidate all Level I and II ports (commercial) into a regional ports system with a Regional Board of Directors reporting to a small ports secretariat in Ottawa (collapsed CPC).

Table 5 - Port Policy Options by Group

Options	Port Managers (M)	Fed/Prov Bureaucrats (B)	Private Sector (P)	Academics, Consultants, Journalists (A)
Harbour Commissions	1	----	----	3
Consolidate	2	3	1	----
Departmental Model	3	2	----	----
Privatization Model	----	1	----	1
Local Port Authority	----	----	2	----
Regional Ports System	----	----	3	2

Port Manager Profile

This 1993-94 survey of Canadian ports provides an interesting profile of Canadian port managers. As a whole, the sampled port managers reflected a surprising degree of ambivalence in their responses to the challenges and opportunities facing Canadian ports. In some cases, they seemed less enamoured with current transportation system rationalization and trade changes, while in other situations, they support increased autonomy and competition. However, despite this they tended to be less concerned with the justification of regional development for support but consider ports as essential services (thus warranting some public sector subsidization) rather than being fully market-driven.

Port managers tend to have a shorter term and more local view of their operations. For example, they were more concerned about the implications of paying surplus dividends to their federal shareholder than they were about the impact of a user pay policy; the latter could lead to longer term financial problems for Canadian ports while the former is of a more immediate and direct concern. The local focus of port managers also led to a lack of support for centralized programs such as Advantage Canada's "Maple Leaf" routes and CPC's marketing promotions. In general, they favoured greater local autonomy in their operations. This local orientation was also reflected in the port managers' priorities with respect to environmental issues in table 1. In this case, they selected waterfront gentrification as the top environmental issue facing Canadian ports, while the other groups tended to take a broader view in selecting environmental impact analyses and international protocols as top priorities.

Despite their interest in running their own operations, port managers seemed reticent to tackle the major tasks needed to become more efficient and market-responsive. For example, they were not overly supportive of:

- monitoring the profitability of each of the services their port provided;
- justifying capital expenditures on the basis of defined market need;

- implementing EDI;
- monitoring technology developments; or
- having the authority to undertake land transfers and set capital budgets.

This implies that port managers may not be fully conversant with the needs of "commercialized" operations.

From an institutional perspective, Canadian port managers appeared less supportive of using a commercially-oriented BoD for all ports opting instead for an appointed regional director. If a BoD is required, the managers favoured continued Ministerial appointments and maintaining a federal majority in the membership -maintaining the status quo. Some of this support for federal appointees may stem from the role of members of boards of Crown corporations. As pointed out in the *Introductory Guide to Their Roles and Responsibilities*,[3] "Directors should be sensitive to the need to balance the Crown's broad policy objectives and priorities with the [Crown] corporation's commercial objectives." Thus, purely commercial objectives (akin to the BoDs of private sector firms) may be muted in current port BoDs.

In responding to possible institutional changes to Canada's port system, the managers reflected a reticence for dramatic change opting instead for moderate shifts and stability. What does all of this ambivalence, risk-aversion, stability-seeking and conservatism among Canadian port managers reflect? One way to examine these findings is to use the typology of managers' responses to significant environmental change provided by Miles and Snow[4] as follows:

Enthusiastic Prospectors

- those who continually see (and indeed create) change and uncertainty in their environment and who regularly experiment with innovative responses to new environmental trends;

Anxious Analyzers

- those who are aware of considerable change and uncertainty in their environment but who wait until another organization develops a viable response so that they can quickly adopt it;

Reluctant Reactors

- those who see some change and uncertainty but are unlikely to take action until forced to do so by external events; and

Domain Defenders

- top managers who perceive little change and uncertainty in their environment and thus have little inclination to adjust their organizations.

The 1993-94 survey generates a profile of Canadian port managers that reflecting "reluctant reactors." Herman Boshken earlier used this typology to evaluate the behaviour

and success of U.S. west coast container ports.[5] Changing technology enabling ports to efficiently handle containers in the late 1960s and 1970s allowed "enthusiastic prospector" ports (Oakland, Long Beach, and Seattle) to win new clients and increase their share of general cargo throughput. Similarly, "enthusiastic prospector" ports typically cooperated with or integrated environmental authorities into their operations. On the other hand, "reluctant reactor" and "domain defender" ports (San Francisco, Los Angeles, and Tacoma) adopted an adversarial role and actively sought to avoid environmental constraints. The general conclusion to Boshken's work is that ports should be either an "enthusiastic prospector" or "anxious analyzer" to succeed in our increasingly turbulent economic environment.

Although many Canadian port managers may act as "reluctant reactors" casting envious eyes at innovative approaches being introduced in other ports, the real need is for "enthusiastic prospectors" to cope with today's complex problems. Changes are emerging both externally in the continental transportation system and global economy and internally as the federal government rationalizes its activities and private sector operators change their operations to meet growing competitive challenges.

Ports' Challenge

The challenge for Canadian ports is converting them into full "commercial" entities without the trauma of massive lay-offs and cargo throughput disruptions. To achieve this goal, the process must start at the top by enhancing, where needed, the commercial perspectives of Canadian port managers.

Increasingly, in today's turbulent economic environment, innovative solutions to the myriad of problems facing ports must be found. This can only come from motivated and enthusiastic mangers and staff within Canada's port system. The results of the 1993-94 survey show that innovation and change may not come from port managers. Steps may be required to generate new commercial thinking and approaches within the Canadian ports community.

Some steps may involve changing imprinted "civil service" thinking arising from years of public service in federal ports. The difficulty is how to achieve this end. A harsh method involves removing proponents of non-commercial approaches by attrition and early retirement or by selected lay-offs. On the other hand, massive lay-offs would result in the loss of considerable experience in a unique industry.

Another more appropriate approach is the education and training of port managers. Education not in the form of conference attendance, but in terms of radically changing deep-seated core values - normally resulting from an intensive and long term educational process. This latter approach to changing the perspectives of port managers may involve corporate support for university education (business and commerce related) or developing custom designed long-term programs for in-house educational programs to aid all staff in their adaptation to this new era.

Change is the only certainty that Canadian ports face. Our ports system must adapt and change quickly if we are to effectively cope with the myriad of challenges facing us.

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Endnotes

1. Bruce Vail, "Canadian cargo diversion cuts both ways", *American Shipper*, 36:10, October 1994, p. 78

2. An additional three options (maintaining the status quo, minor adjustments only, and a provincial/municipal model) were provided in the initial phase III survey, but these options did not rank in the top three selected by each of the four groups.

3. Crown Corporations Directorate, *Directors of Crown Corporations: An Introductory Guide to Their Roles and Responsibilities*, The Conference Board of Canada and the Canadian Centre for Management Development, Ottawa, 1993, p. 7.

4. R.E. Miles and C.C. Snow, *Organizational Strategy: Structure and Process*, McGraw-Hill, New York, 1978.

5. H.L. Boshken, *Strategic Design and Organizational Change: Pacific Rim Seaports in Transition*, University of Alabama Press, Tuscaloosa AL, 1988.

ÉTUDE COMPARATIVE DES MODES DE TRANSPORT POUR L'APPROVISIONNEMENT EN HYDROCARBURES DE LA RÉGION DU SAGUENAY – LAC-SAINT-JEAN

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Bilan du trafic et importance relative des modes de transport

Le trafic quotidien des véhicules sur la route 175 est de l'ordre de 4100 passages (débit journalier moyen annuel ou DJMA, au sud de la jonction de la route 169). La circulation lourde représente 19% de la circulation totale de la route 175, et les véhicules transportant des produits pétroliers équivalent à 10% du trafic routier lourd ou 2% de la circulation totale de la route 175. Le volume total annuel de produits pétroliers acheminé vers le Saguenay – Lac Saint-Jean (SLSJ) est de l'ordre de 764 millions de litres ou près de 600 000 tonnes.

Ce trafic, longtemps effectué principalement par voie maritime, a fait l'objet d'une réorientation marquée depuis cinq ou six ans. Le camion s'est progressivement substitué au navire. Négligeable, la part du train est particulièrement destinée au marché de Chibougamau.

Tableau 1

ÉVOLUTION DU TONNAGE DES HYDROCARBURES TRANSPORTÉ VERS LE SAGUENAY – LAC-SAINT-JEAN, SELON LES MODES DE TRANSPORT, 1988 À 1992 (000 TONNES)

Modes de transport	1988	1989	1990	1991	1992
• **Total, tous les modes**	**±599**	**±599**	**±599**	**±599**	**599**
• **Transport maritime**	**422**	**352**	**390**	**303**	**154**
pourcentage	70,5	58,8	65,1	50,6	26,7
• **Transport routier**	**±177**	**±247**	**±209**	**±296**	**±445**
pourcentage	29,5	41,2	34,9	49,4	74,3
• **Transport ferroviaire**	**24**	**22**	**16**	**28**	**26**

Changement dans le choix des modes de transport

La rationalisation des activités de transport des sociétés pétrolières ainsi que la forte compétition et la baisse des tarifs de camionnage consécutives à la déréglementation du transport routier ont contribué pour une large part au changement observé dans le choix des modes de transport. Ce changement s'est fait de façon graduelle, avec le maintien ou la délivrance des plaques et des permis de transport.

Le démantèlement des infrastructures portuaires de réception et d'entreposage du Vieux Port de Chicoutimi a aussi contribué au changement. Les terminaux aménagés par la suite auraient nécessité de coûteux investissements pour offrir l'avantage multimodal et le caractère fonctionnel des installations du Vieux Port. Les produits transportés par voie maritime actuellement sont transités par les installations portuaires privées d'Alcan à La Baie. Le terminal pétrolier Albert-Maltais, situé près de Chicoutimi, est à toutes fins pratiques abandonné.

Impact du changement sur le niveau d'utilisation des infrastructures

Le changement dans le choix de transport des hydrocarbures vers le SLSJ est ressenti par la population et les usagers de la route. L'augmentation du transport lourd attribuable à cette nouvelle orientation est de l'ordre de 8 %.

Le transport par camion en général pose des problèmes d'encombrement et de détérioration des routes. La présence des camions est aussi très mal accueillie par les usagers des routes 169 et 175; elle contribue à rendre plus difficile la conduite des véhicules légers et de promenade.

Spécificités des différents modes de transport

Coûts directs

Le transport routier est actuellement avantageux en ce qui a trait aux coûts pour le transporteur et pour le consommateur. L'évolution du contexte concurrentiel du transport maritime des hydrocarbures au Québec ainsi que certaines indications sur la tendance des tarifs en vigueur portent à croire que les tarifs de transport maritime inclus dans le tableau qui suit se situent au-dessus de la moyenne des prix actuels et pourraient facilement varier à la baisse dans un avenir rapproché.

Les coûts de tous les modes de transport sont sujets à des variations importantes en fonction du contexte économique, de l'offre et de la demande, des alliances stratégiques et de nombreux facteurs extérieurs. Les tarifs de transport apparaissant dans le tableau qui suit doivent être lus et utilisés avec prudence (Tableau 2).

Tableau 2

COÛTS COMPARÉS DES DIFFÉRENTS MODES DE TRANSPORT DES HYDROCARBURES POUR DESSERVIR LA RÉGION DU SAGUENAY – LAC-SAINT-JEAN (référence: année 1993)

Éléments de coûts par mode, (cents/litre)	Maritime	Routier	Ferroviaire	
			Wagons-citernes	Conteneurs-citernes
Transport	0,65-0,80[1]	1,000	1,0-1,8	1 600
Transbordement	inclus	---	0,008	0,002
Entreposage	0,720	0,036	0,350	0,036
Distribution	0,330	0,017	0,350	0,017
Sous-total	1,70-1,85	1,053	1,708-2,508	1,655
Infrastructures[2]	---	0,257	---	---
TOTAL	**1,70-1,85**	**1,310**	**1,708-2,508**	**1,655**
Distance de transport	350 km	230 km	420 km	420 km

1. Dans le cas du transport maritime, il s'agit des derniers tarifs payés par les pétrolières en 1991.
2. Coûts collectifs.

Coûts collectifs

Pour les transports maritime et ferroviaire, il n'y a pas de coûts collectifs liés aux installations, puisque d'une part, les représentants de Port Saguenay nous ont précisé que le coût de l'aménagement et de l'entretien des infrastructures de transport maritime est payé à même les droits de port et de quai, qui sont inclus dans les tarifs des transporteurs. D'autre part, les représentants du CN nous indiquent que concernant le secteur ferroviaire, il n'y a pas de coût collectif lié à l'utilisation des infrastructures, puisque le coût de leur aménagement et de leur entretien est inclus dans les tarifs de transport.

Les coûts collectifs du transport routier sont les coûts d'aménagement, de réfection et d'entretien des infrastructures. Ils seront principalement basés sur la proportion de la dégradation des routes attribuable au trafic des hydrocarbures en fonction de la longueur du parcours routier, ainsi que sur les coûts usuels de construction, de réfection et d'entretien des infrastructures routières. Les droits et taxes payés à cet égard doivent être déduits de ces sommes.

Les coûts de construction et d'entretien des infrastructures routières comprennent les dépenses suivantes :

- construction: 1 000 000 $ par kilomètre au début de la vie utile (estimée à 40 ans);
- entretien courant été/hiver: 21 200 $/km annuellement;
- réparations importantes après 25 ans: 500 000 $/km.

Tableau 3

COÛTS DE CONSTRUCTION, DE RÉPARATION ET D'ENTRETIEN DES ROUTES

$ (93) /km/an	Coûts de construction[1]		Coûts d'entretien[2]	Coûts des réparations majeures[3]	
	Amortissement annuel	Intérêt annuel moyen		Amortissement annuel	Intérêt annuel moyen
	40 000	40 000		20 000	10 000
Total	**80 000**		**21 200**	**30 000**	

1. Les coûts de construction d'une route (telle que la route 175) entre Québec et le Lac-Saint-Jean ont été estimés à 1 million de dollars par kilomètre. Ces coûts comprennent à la fois les travaux de construction, les plans et devis, et tous les autres coûts entrant dans la construction de la route. La durée de vie d'une route dans cette région est d'environ 25 ans. L'amortissement est donc de 40 000 dollars. Par ailleurs, il faut considérer l'intérêt de l'emprunt public qu'a engendré cette dépense. En prenant un taux d'intérêt de 8 %, l'intérêt annuel moyen est de 40 000 dollars.

2. Les coûts d'entretien de la route 175 sont évalués à 21 200 dollars par kilomètre. Ils comprennent les coûts d'entretien en hiver (sel, abrasifs, outillage, main-d'oeuvre), qui s'élèvent à environ 12 000 $/km, les coûts d'entretien en été (nettoyage des fossés, réparations mineures), soit environ 1 200 $/km, et l'usure de la chaussée, soit en moyenne 80 000 $/km tous les dix ans (8 000 $/km/an).

3. Les réparations majeures et améliorations des routes sont évaluées à 500 000 dollars par kilomètre pour la durée de vie de la route, soit 25 ans. L'amortissement est donc de 20 000 dollars annuellement. On considère que ces réparations se font vers le milieu de la période de vie de la route. L'intérêt annuel moyen, avec un taux de 8 % est de 10 000 $ annuellement.

Il en résulte que les coûts collectifs pondérés du transport routier des produits pétroliers vers le Saguenay – Lac-Saint-Jean se situeraient à 0,2569 cent le litre.

Le financement public des infrastructures routières contribue à réduire le prix des produits au consommateur. Les coûts collectifs doivent tout de même être payés par le contribuable.

L'écart de coûts entre le mode de transport le plus économique et le plus coûteux est de l'ordre de 95%, ou 1,20 cent le litre.

Sécurité

L'analyse des statistiques obtenues de la Société de l'Assurance Automobile du Québec (SAAQ) sur les accidents de la route montre que le nombre total d'accidents sur la route 175, tout comme le nombre d'accidents impliquant au moins un camion lourd a diminué entre 1989 et 1992, malgré l'augmentation du transport lourd (Tableaux 4 et 5).

Tableau 4

NOMBRE TOTAL D'ACCIDENTS[1] SURVENUS SUR LA ROUTE 175 ENTRE STONEHAM ET CHICOUTIMI DE 1989 À 1992

ROUTE 175				
Gravité de l'accident	**1989**	**1990**	**1991**	**1992**
• Mortel	14	16	6	11
• Grave	27	26	16	20
• Léger	73	69	72	75
• Dommage matériel seulement	303	289	310	292
TOTAL	417	400	404	398

Source : Société de l'assurance automobile du Québec,
Direction de la statistique, 31 mai 1993.

1. Seuls les accidents avec blessures corporelles et les accidents avec dommages matériels dont l'ensemble des dommages est évalué à plus de 500 $ par le policier font partie de ce relevé.

Si le nombre d'accidents mortels ou ayant causé des blessures corporelles a généralement diminué durant la même période, le nombre de tels accidents impliquant au moins un camion lourd est resté stable, malgré une baisse passagère.

carbures seraient plus sécuritaires que celles de l'ensemble du camionnage, en raison notamment des règlements de sécurité très rigoureux imposés aux employés et aux sous-traitants des pétrolières.

Néanmoins, les données disponibles concernant les sous-traitants sont parcellaires et ne permettent pas de dégager avec certitude des conclusions sur l'ensemble du transport routier des hydrocarbures.

Tableau 5

NOMBRE D'ACCIDENTS[1] IMPLIQUANT AU MOINS UN CAMION LOURD SURVENUS SUR LA ROUTE 175 ENTRE STONEHAM ET CHICOUTIMI DE 1989 À 1992

ROUTE 175				
Gravité de l'accident	**1989**	**1990**	**1991**	**1992**
• Mortel	2	3	2	3
• Grave	3	2	3	0
• Léger	6	4	7	11
• Dommage matériel seulement	60	37	47	34
TOTAL	71	46	59	48

Source : Société de l'assurance automobile du Québec, Direction de la statistique, 31 mai 1993.

1. Seuls les accidents avec blessures corporelles et les accidents matériels dont l'ensemble des dommages est évalué à plus de 500 $ par le policier font partie de ce relevé. La responsabilité de l'accident n'incombe pas nécessairement au chauffeur du camion.

Efficacité énergétique

Dans le cas à l'étude, le transport ferroviaire domine ses compétiteurs en ce qui a trait à l'efficacité énergétique. Il est suivi du transport maritime, puis finalement du transport routier, qui est le plus énergivore malgré le fait qu'il bénéficie de l'itinéraire le plus court (Tableau 6).

Impacts sur le milieu physique

Le transport ferroviaire semble aussi être le mode le moins nuisible pour la qualité de l'air. Comme les émissions de gaz sont étroitement liées à la consommation de carburant, le transport routier obtient aussi la plus mauvaise note à ce chapitre (Tableau 7).

Le train et le navire présentent un risque d'accidents et de déversements de produits moins élevé que le camion. Toutefois, les déversements qui peuvent survenir en cas d'accidents ferroviaires ou maritimes sont susceptibles d'avoir des conséquences beaucoup plus graves, compte tenu du volume de produit pouvant être déversé et de la difficulté particulière pour effectuer le nettoyage complet (Tableau 8).

Tableau 6

CONSOMMATION DE CARBURANT, SELON LE MODE DE TRANSPORT POUR LE TRANSPORT DES HYDROCARBURES VERS LE SLSJ[1]

	MARITIME	FERROVIAIRE		ROUTE
	10 000 M^3	Train-bloc	Conteneurs-citernes	Citernes
Distance parcourue	350 km	420 km	420 km	230 km
Voyages par an	58	142	333	12 946
Consommation par voyage[2] Coût en carburant ($)	32 000 9 280	8 889 3 000	3 743 1 273	219 100
Consommation annuelle[3] Coût en carburant ($)[4]	1 864 200 540 600	1 253 100 426 100	1 253 100 426 100	2 835 700 1 276 100
Consommation en tonne par 1000 tonnes transportées	3,77	2,39	2,39	5,09

1. Volume annuel du transport routier de produits pétroliers en 1992 = 445 300 tonnes.

2. Consommation exprimée en litres de produits pétroliers.

3. Les données de consommation ont été fournies par des représentants du CN, des transporteurs routiers et des armateurs.

4. Les coûts unitaires estimés des carburants utilisés sont:
   Maritime : 0,29¢/l
   Ferroviaire : 0,34¢/l
   Routier : 0,45¢/l

Tableau 7

TAUX COMPARATIFS POUR CHACUN DES MODES DE TRANSPORT, DES ÉMISSIONS DE GAZ ET REJETS DE COMBUSTION RELIÉS AU TRANSPORT VERS LE SLSJ DES 445 000 TONNES D'HYDROCARBURES ACTUELLEMENT TRANSPORTÉES PAR CAMION

MODE DE TRANSPORT	ÉMISSIONS DE GAZ ET REJETS DE COMBUSTION kg/1000 t-km						
	Particules	NOX	CO_2	CO	COV	SO_2[1]	Somme
Maritime	0,0206	0,3317	31,5526	0,0592	0,0327	0,1588	32,1555
Routier	0,0811	0,8101	74,0398	2,1011	0,1761	0,1144	77,3196
Ferroviaire	0,0115	0,3655	18,0867	0,0704	0,0183	0,0182	18,5706

1. Estimation effectuée par extrapolation de données corrélatives.

2. Source : *Environmental Efficiency of Marine Transportation* (A.M. Khan, Ph.D., 1992), Annexe C: données basées sur l'année 1990.

Particules : Particules en suspension
NOX : Oxyde d'azote
CO_2 : Oxyde de carbone
CO : Monoxyde de carbone
COV : Hydrocarbures/organiques volatiles
SO_2 : Oxyde de souffre

Tableau 8

RISQUE COMPARATIF ANNUEL DE DÉVERSEMENTS SELON LE MODE DE TRANSPORT POUR UN VOLUME TRANSPORTÉ DE 445 300 TONNES

	MARITIME	ROUTIER	FERROVIAIRE
Facteur de risque d'accidents[1-2]	0,026	1,943	0,357
Milliers de t-km transportées par année	155 859	102 422	187 031
Risque d'accidents par année ou récurrence	0,0405 ou 1 / 25 ans	2,0 ou 1 / 6 mois	0,6677 ou 1 / 18 mois
Importance du déversement (tonnes)	420-555	38	115-170

1. Source: *Great Lakes and St.Lawrence River Commerce: Safety, Energy, and Environmental Implications of Modal Shifts*

2. Nombre d'accidents par 100 000 000 de tonnes-kilomètres de produits transportés.

Emplois

Le transport routier a l'avantage d'être générateur d'un plus grand nombre d'emplois que ses compétiteurs (Tableau 9). Par contre les activités d'entreposage, de transbordement et de distribution inhérentes au transport maritime ou ferroviaire pourraient avoir pour effet d'augmenter légèrement les emplois locaux reliés au transport des hydrocarbures vers le SLSJ.

Tableau 9

ESTIMATION DE LA MAIN-D'OEUVRE AFFECTÉE AU TRANSPORT DES HYDROCARBURES VERS LE SLSJ, SELON LA RÉPARTITION ENTRE MODES DE TRANSPORT ACTUELLE

	EMPLOI		
MAIN-D'OEUVRE	ROUTIER[1]	MARITIME[2]	FERROVIAIRE[3]
Directe	50 chauffeurs	18 membres d'équipage	
Indirecte	15 emplois administratifs 30 emplois d'entretien	5 emplois administratifs 2 emplois sur remorqueurs 3 emplois amarreurs et transbordement 10 emplois d'entretien	
TOTAL	95 personnes année	6 personnes année (38 à 15 % du temps)	0 personne année

1. Emplois à temps plein équivalents.
2. Emplois à 15 % du temps.
3. Le trafic des hydrocarbures est destiné à d'autres marchés.
4. Les emplois reliés à la distribution ne sont pas inclus.

Autres considérations

Le transport routier offre l'avantage d'une livraison directe à la plupart des détaillants et minimise de façon importante les opérations de transbordement et d'entreposage. Il offre de plus le temps de transport le plus court et permet la livraison «juste à temps» des biens et produits.

Quel que soit le mode de transport vers lequel le marché ou les politiques s'orienteront, les camions seront toujours nécessaires pour assurer la distribution finale des hydrocarbures.

Scénarios de transport

Les scénarios examinés ici permettent de comparer les différentes possibilités de transport (ou de combinaisons de modes de transport) à l'échelle des activités d'une année.

Scénario 1: Transport maritime via Grande-Anse et La Baie

Scénario 2: Transport maritime via le terminal pétrolier Albert-Maltais et La Baie, et livraison finale par transport routier

Scénario 3: Transport maritime via le terminal pétrolier Albert-Maltais et La Baie, et livraison finale par transport ferroviaire

Scénario 4: Transport routier principalement, et maritime via La Baie (statu quo)

Scénario 5: Transport routier

Scénario 6: Transport ferroviaire principalement (train-bloc), et maritime via La Baie

Scénario 7: Transport ferroviaire principalement (conteneurs-citernes «tank tainers»), et maritime via La Baie

Les modes de transport de référence utilisés dans ces scénarios sont les suivants :

Transport routier : véhicules semi-remorques avec trois essieux, dont la citerne peut contenir 50 000 litres de produits pétroliers. Le volume effectivement transporté est en moyenne de 45 000 litres par voyage. Ces camions semi-remorques pèsent 53 500 kilos lorsqu'ils sont remplis et 18 500 kilos lorsqu'ils sont vides.

Transport ferroviaire par wagons-citernes : Un train-bloc type se compose de 55 wagons d'une capacité unitaire de 75 000 litres, soit un total de 4 125 000 litres par livraison.

Transport ferroviaire par conteneur-citernes : Un train de conteneurs-citernes est composé de 70 conteneurs répartis en deux conteneurs par wagon (35 wagons). La capacité unitaire d'un conteneur serait de 25 000 litres, soit une capacité de 1 750 000 litres par convoi de ce type.

Transport maritime : Navire pétrolier d'une capacité de 10 000 tonnes.

Les scénarios basés principalement sur les transports maritime et ferroviaire impliquent des coûts plus élevés pour les pétrolières et, par conséquent, pour le consommateur. Il serait difficile pour ces deux derniers modes de concurrencer le transport routier, compte tenu des tarifs en vigueur actuellement. Les transports maritime et ferroviaire doivent aussi composer dans le cas présent avec des longueurs de parcours qui sont respectivement de 350 et 420 km, contre 230 km par route (Tableau 10).

Dans l'hypothèse où la totalité du transport des hydrocarbures se ferait sur le Saguenay, le respect des normes et règlements régissant les infrastructures d'entreposage et les programmes de prévention et d'urgence en cas de déversement pourraient nécessiter des investissements importants. La manutention d'un volume annuel d'hydrocarbures de plus de 500 000 tonnes implique le respect des règles relatives aux SIR (Secteurs d'intervention primaires) découlant de la loi C-121 modifiant la *Loi sur la marine marchande*.

Le retour à un niveau de transport maritime équivalent à celui de 1988 serait probablement soumis à des exigences moins strictes et permettrait par ailleurs d'optimiser l'usage des infrastructures locales et de libérer de façon sensible les routes 169 et 175.

Les coûts directs du transport routier sont payés par le consommateur à l'achat des biens et produits, alors que les coûts collectifs des infrastructures routières sont principalement payés par le contribuable. Cela rend difficile la comparaison des coûts des différents modes de transport, ceux-ci n'étant pas transparents.

Le transport bimodal train de type conteneurs-citernes/route offre, tout comme le transport routier, l'avantage d'une livraison directe tout en minimisant aussi les opérations de transbordement et d'entreposage. Il contribue de plus, en optimisant l'usage des deux modes de transport, à réduire les désavantages du trafic lourd, la consommation globale de carburant et aussi la pollution due aux émissions de gaz.

Limites de l'étude

Les informations de base de l'étude proviennent de diverses sources, et certaines données n'ont pu être obtenues avec toute la précision nécessaire pour des raisons de confidentialité, liées autant à la compétition dans le marché des hydrocarbures que dans l'industrie du transport. **La précision des données situe donc la présente étude à une étape préliminaire.**

Tableau 10
RÉPARTITION DU TRANSPORT DES HYDROCARBURES ENTRE LES MODES DE TRANSPORT, SELON LE SCÉNARIO

Tonnes/an	Scénario 1	Scénario 2	Scénario 3	Scénario 4	Scénario 5	Scénario 6	Scénario 7
Maritime							
TPAM		296875	296875				
TMGA	445312						
La Baie	153880	153880	153880	153880		153880	153880
Routier		14837	148437	445312	599192		
Ferroviaire						445312	
Train-bloc							
Conteneurs-citernes							445312
Tonnage total	599192	599192	599192	599192	599192	599192	599192
000 litres/an	Scénario 1	Scénario 2	Scénario 3	Scénario 4	Scénario 5	Scénario 6	Scénario 7
Maritime							
TPAM		388367	388367				
TMGA	582550						
La Baie	181096	181096	181096	181096		181096	181096
Routier		194183		582550	763646		
Ferroviaire						582550	
Train-bloc							
Conteneurs-citernes			194183				582550
Volume total	763646	763646	763646	763646	763646	763646	763646

CONCLUSIONS

L'étude comparative des modes de transport des hydrocarbures pour l'approvisionnement du Saguenay – Lac-Saint-Jean a permis de dégager diverses informations sur la consommation annuelle de produits pétroliers dans la région, sur l'importance relative des divers modes de transport, sur les facteurs qui conditionnent le coût du transport et sur certains des impacts du transport.

Le cas de l'approvisionnement en hydrocarbures de la région du Saguenay/Lac Saint-Jean ne permet pas de dégager avec la précision désirée les différences, les avantages et les inconvénients qui caractérisent généralement les modes de transport en cause, en raison surtout du tracé et de la longueur des parcours, qui varient significativement selon le mode, soit 230 km par la route, 350 km par eau et 420 km par le rail.

La déréglementation des transports a eu entre autres pour conséquence d'entraîner une compétition tarifaire non seulement entre le transport routier et les autres modes, mais aussi entre les transporteurs routiers eux-mêmes. Les tarifs de transport routier en vigueur actuellement sont même inférieurs à ceux de 1983.

Une étude similaire sur un cas où les parcours des différents modes de transport sont de longueur comparable, voire parallèles, par exemple le transport de marchandises vers la Gaspésie, la Côte-Nord ou l'Abitibi, permettrait un exercice comparatif plus précis ou nuancé.

Les trois principaux systèmes de transport des marchandises sont des éléments structurants de l'économie et devraient tous être maintenus, dans une certaine mesure, afin d'assurer la compétitivité des modes de transport reliant le SLSJ au reste de la province.

Toute intervention en vue de favoriser un renversement de la tendance actuelle en matière de transport des hydrocarbures vers le Saguenay – Lac-Saint-Jean devrait viser le maintien d'une saine compétition dans le domaine du transport en vrac, tout en tenant compte du coût pour les consommateurs et les contribuables, et des préoccupations de sécurité routière, d'efficacité énergétique, de protection de l'environnement et de maintien des emplois. Dans un tel contexte, et dans un monde de libre concurrence, les transports maritime et ferroviaire devront, pour reconquérir leur part du marché, s'ajuster à la compétition et dans certains cas recourir comme complément à d'autres modes de transport, ce qui pourrait leur conférer la flexibilité caractéristique du camionnage.

Les transports maritime et ferroviaire comportent des avantages certains par rapport au transport routier, que ce soit en ce qui concerne le réseau routier même (réduction des coûts d'entretien, réduction du trafic et de l'encombrement, amélioration de la sécurité), l'efficacité énergétique ou la réduction des émissions de gaz et des rejets polluants. Ces avantages doivent être mis en valeur, dans l'optique des objectifs et des priorités de la population et du gouvernement.

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CAPTIVE SHIPPERS: THE COAL AND SULPHUR INDUSTRIES

by John Heads*

This paper examines the concept of a captive shipper and shows that these still exist in the coal and sulphur industries. The research was carried out mainly for Western Economic Diversification Canada,[1] but the author is solely responsible for any opinions expressed in the paper.

1. WHAT IS A CAPTIVE SHIPPER?

A precise definition of the term captive shipper is somewhat elusive. Under section 278 of the *Railway Act*, as revised by the *National Transportation Act, 1967*, it would seem that a shipper captive to rail is defined as

> a shipper of goods for which in respect of those goods there is no alternative, effective and competitive service by a common carrier other than a rail carrier or carriers or a combination of rail carriers

This would seem to be a reasonable definition of a captive shipper and its implications are discussed later in this section. There is, however, only one problem. Section 278 of the *Railway Act*, which was enforced from 1967 until 1987, was always known informally as the captive shipper section - but there is no actual mention of the word captive or any derivation from this word in section 278 or, as far as we are aware, at any other place in the legislation.

Motor carrier transport had become an important form of competition for the railways before the Second World War and became increasingly effective in breaking down rail monopolies in the 1950s and 1960s. However, prior to the *National Transportation Act, 1967*, the attitude of the Board of Transport Commissioners towards rail regulation in Canada was somewhat ambivalent. Proceeding on the assumption that nothing had changed, the Board authorized general rail freight rate increases for all traffic, but the railways were unable to implement these increases where there was competition from motor carriers for high value rail freight. Yet, the Board was still trying to regulate the rail

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division of Canadian Pacific, the so-called "yardstick railway", in order to allow an adequate return on railway assets.

> The Board laid down a permissive level of income for the yardstick railway.... Then it tried to set freight rates at such a level that, if all went well, the Canadian Pacific would be able to meet its operating expenses (including depreciation) and taxes, the rail portion of the Corporation's fixed charges, 4 per cent on its preference and 5 per cent on its paid-up ordinary stock, and a surplus which it set at about 2 per cent on the total investment in rail property.[2]

This philosophy was still being followed into the late 1950s, even though it had been evident since the end of the Second World War that Canadian Pacific was not able to earn the full permissive income allowed. In 1961, the MacPherson Commission recommended that the formula to obtain a permissible level of income for the yardstick railway and the general rate increases be scrapped. Railways should then be given greater freedom in meeting competition in the hope that they would be able to cover their financial requirements. The Commission also wanted legislation designed to protect captive shippers and to prevent very low non-compensatory railway rates.[3]

The *National Transportation Act, 1967,* implemented the MacPherson recommendations in the area of rate regulation. Maximum rates were to apply only to captive shippers as defined in the earlier quotation from section 278 of the *Railway Act.* Minimum rates had to be compensatory and cover the long-run variable costs incurred in handling each traffic movement. Between these upper and lower limits, railways were to have more freedom to quote rates as they saw fit. These provisions did not extend to the statutory rates for the transport of grain. Rate freedom was also modified by investigation of rates which might prejudicially affect the public interest, as described in section 23 of the *National Transportation Act, 1967.*

Section 278 of the *Railway Act* allowed a captive shipper dissatisfied with a rate offered by a railway carrier to ask the regulatory agency to fix a rate. This rate was to consist of the variable cost for the carriage of the goods, plus 150% of this variable cost to establish the fixed rate. Moreover, variable cost of carriage was to be estimated on the basis of carloadings of only 30,000 pounds. If the carload rate were 50,000 pounds or more, the rate determined was to be reduced by a deduction equivalent to one-half the amount of the saving in variable cost. This reduction was not to carry through to the 150% addition applied to variable cost on carloads of 30,000 pounds. The details of this captive shipper

clause are arcane and only of historical interest, but they always were strange even in 1967.

Consider the following:

- Railway variable costs are equivalent to about 80% of fully allocated costs. An addition to variable costs of 150% would mean that the rate determined for the captive shipper would be double the fully allocated costs.[4]

- The rate calculated in the previous bullet was on the assumption that the product was shipped in a carload of 30,000 pounds or 15 tons. On data for 1968, immediately after the captive shipper provision came into effect, the average carloading for domestic traffic on Canadian railways was 48 tons.[5]

- The calculation for shipments in cars of 48 tons, as against 15 tons, could well result in a rate three times as high as fully allocated costs.[6]

It was appreciated at the time that section 278 of the *Railway Act* was going to provide scant protection for captive shippers. As Purdy wrote in 1972,

> It is likely that the Fixed Rate will be seldom used.... The Fixed Rate, as it is presently formulated, is not attractive to the shipper and even under monopoly circumstances he could almost certainly negotiate a better rate with the available carrier.[7]

During the twenty years 1967-87 when the *National Transportation Act, 1967*, was operative, only one captive shipper application was brought under section 278 of the *Railway Act*. This was an application by Domtar Ltd. to be declared a captive shipper in respect of shipments of liquified chlorine in rail tank cars from Beauharnois, PQ. The case dragged on for several years and finally it was ruled that Domtar was not a shipper without alternative means of transport, since highway transport was available.[8] In any event, the redress that Domtar could have expected to obtain was not substantial, particularly as Domtar was shipping liquified chlorine in 55 ton cars, as against the 15 ton base case envisaged in section 278.

The captive shipper provisions of the 1967 legislation were quite ineffective. In retrospect, this was due to three factors. Firstly, a shipper could not easily establish captive status because it was difficult to show that there was "no alternative, effective and competitive service". Secondly, the provision of a 150% add-on to variable costs in establishing a rate for a captive shipper

allowed an excessively generous contribution to railway fixed costs. Thirdly, it was inappropriate to base a rate for a captive shipper on carloads as low as 15 tons. Rather surprisingly, the 15 ton figure comes unadulterated from the MacPherson Commission, whose recommendations were so sensible in most other respects. The MacPherson Commission appears to have chosen 15 tons as the appropriate weight that would be carried by a motor carrier, if motor carrier competition had been available for the captive traffic.[9] This criterion was flawed, as it did not recognize that the real captive shippers in Canada were the resource shippers, using much heavier carloadings even in the 1960s, and not hypothetical manufacturers of finished products for some abstruse reason deprived of truck transportation and captive to rail.

In 1987, a new *National Transportation Act* became law, with a major stress on increased competition in the rail freight market. Until 1987, railways published rates on a joint basis, so that, if origin X and destination Y were served by both railways, both would offer an identical freight rate. The new legislation abolished this joint publication of freight rates and allowed shippers and railways to negotiate contracts on a confidential basis. These measures have had considerable success in stimulating competition.

The *Act* also introduced competitive access provisions - extended interswitching limits, competitive line rates, and final offer arbitration. Extended interswitching limits were to give a choice of rail carrier to shippers located within 30 kilometres of a competitive railway, while competitive line rates would mitigate conditions for captive shippers at greater distances from an alternative railway. The competitive line rate process was designed to give a captive shipper access to the line of a second railway, but this depended upon the cooperation of the second railway in allowing the shipper to obtain a connecting rate from the railway to which the shipper was captive. In Canada, CP has never cooperated with a shipper to obtain a competitive line rate against CN and CN has acted in a similarly "gentlemanly" fashion with respect to CP. The competitive line rate mechanism has been effectively dead, except on the few occasions when it has been activated by shippers in co-operation with U.S. railroads.

The third weapon in the competitive access armoury is final offer arbitration. When a shipper is dissatisfied with a freight rate, the shipper makes a final offer of what he is willing to pay, and submits this together with the last offer received from the carrier to the National Transportation Agency. The Agency then appoints an arbitrator, who must choose between either the shipper offer or the railway offer and is not empowered to negotiate any compromise solution. Among other considerations, the arbitrator "shall have regard to whether there is available to the shipper an alternative, effective, adequate and

competitive means of transporting the goods to which the matter relates" (*National Transportation Act, 1987*, section 51 (2)). So far, negligible use has been made of the final offer arbitration mechanism.

As explained earlier, using the definitions of the National Transportation Agency, roughly 80% of the total costs incurred by the railways are long-run variable costs and 20% fixed costs, with all these costs defined to include current expenditures, depreciation, and a return on the extensive capital investments used in railway transportation. On the average, the railways must add 25% (i.e., 20/80) to variable costs in order to cover fixed costs. It is not feasible for a railway to charge a flat 25% addition for fixed costs in all freight rates; some traffic would just not move under these conditions. The corollary of some traffic making less than a 25% contribution to fixed costs is that some traffic must pay more than 25%.

This situation in respect of the recovery of railway fixed costs has, of course, been common knowledge for decades. There is no fundamental fallacy in the railway argument that it is better to have some contribution to fixed costs from traffic where a 25% contribution cannot be obtained than to lose this traffic to other transport modes and receive no contribution. Otherwise, the contribution required of other traffic would be even higher, if some recovery of fixed costs were not obtained from traffic paying a contribution of less than 25%.

The railways have also argued for decades that captive traffic which has no alternative carrier still has one competitive weapon to be used in negotiation with the railways, namely market competition. Under this concept, it is argued that the railway does not want to charge a captive shipper so high a rate that the shipper would no longer be able to operate and the traffic would disappear. While this statement is true, nevertheless it hardly constitutes much protection for a captive shipper. In principle, it would allow the railway to fix freight rates on a captive shipper such that the railway would appropriate all the profits from the enterprise, leaving the captive shipper limping along, barely covering costs and with no incentive to make new investments. The so-called protection for captive shippers through market competition is rather a snare and a delusion.

To summarize, although the development of motor carrier competition has destroyed railway monopoly powers over large segments of traffic, some shippers are still left almost completely dependent on railway transport. These captive shippers are predominantly the resource industries of western Canada. Unless there are regulatory controls, the railways are free to extract a large contribution to fixed costs from captive shippers, with the only limitation that the railways do not want to drive these producers into bankruptcy and terminate the movement of their products. This problem has long been appreciated, but

it has never been dealt with adequately. The captive shipper provisions of the *National Transportation Act, 1967,* were completely ineffective. The *National Transportation Act, 1987,* has made improvements, but confidential contracts are of only limited efficacy when a shipper is confined to one carrier, while the competitive access provisions of this legislation have had limited effect. The paper now goes on to examine the specific problems of coal and sulphur producers in western Canada. A possible solution to the problem is outlined in the final section.

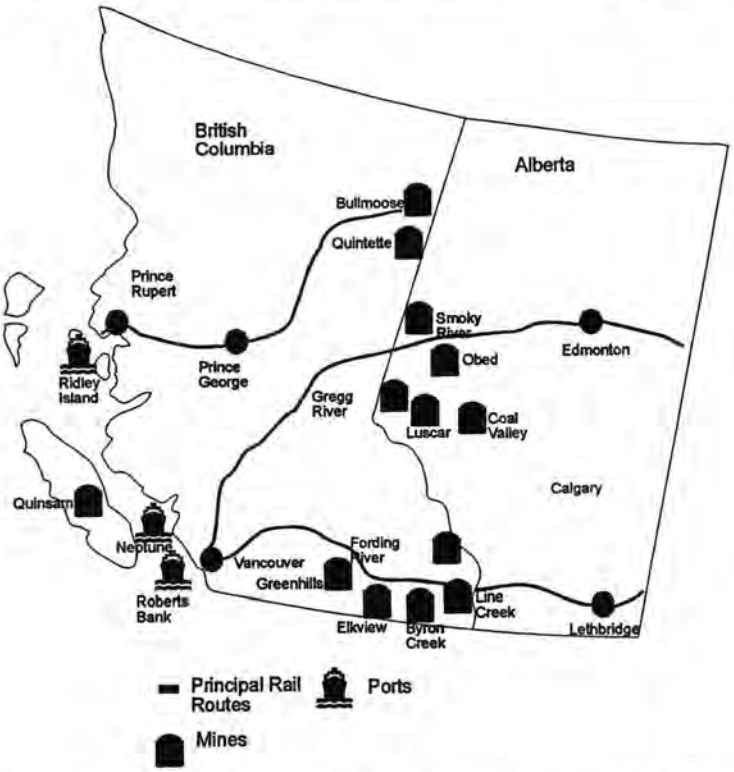
2. WESTERN CANADIAN BITUMINOUS COAL INDUSTRY

The bituminous coal industry of western Canada is located entirely within the provinces of B.C. and Alberta. The bulk of the production is exported to Pacific Rim countries, especially Japan. Exports are moved from the mines to tidewater at Vancouver and Prince Rupert over distances averaging 700 miles. Rail and port charges absorb about two-fifths of the value of the coal f.o.b. Vancouver. Bituminous coal is of two types. Metallurgical coal is used for steel-making. In 1993, Alberta and B.C. produced 25.3 million tonnes of metallurgical coal and this was virtually all exported through the west coast. The two provinces produced 6.0 million tonnes of thermal coal, of which about three-quarters was exported and the rest used in Canada.

Coal production in western Canada was increasing very considerably during the first part of the 1980s, as new coal mines came into operation. Since 1988, production has been fairly stable and the industry is no longer expanding. World demand for metallurgical coal has been depressed for several years and technological developments in steel-making suggest reduced future demand for metallurgical coal. World demand for thermal coal will be more buoyant, but there is strong competition from other producers, particularly Australia, Indonesia and South Africa. The future of the western Canadian bituminous coal industry is therefore problematical.

The western Canadian bituminous coal industry is remarkably compact. There are only 13 producing mines and these are owned by only six companies. The location of the 13 mines is shown in Figure 1.[10]

Figure 1: Bituminous Coal Mines of Alberta and British Columbia



With the exception of Quinsam on Vancouver Island, where coal is trucked to Campbell River and then moved by barge, each of the bituminous coal mines of western Canada is captive to one railway.

- The five mines in Alberta are all captive to CN North America. Three of these mines are owned by Luscar - Coal Valley, Obed and Luscar. Smoky River is owned by Smoky River Holdings and Gregg River by Manalta. These five mines together accounted for roughly 34% of western Canadian production of bituminous coal in 1993.

- The five mines in southeast B.C. are all captive to CP Rail System. Three of these mines - Fording River, Greenhills and Byron Creek - are owned by Fording, which is in turn a subsidiary of Canadian Pacific Limited. Line Creek is owned by Manalta and Elkview by Teck. These

five mines together accounted for 44% of the production of bituminous coal in western Canada in 1993.

- The two mines in northeast B.C. - Bullmoose and Quintette - are owned by Teck and are captive to BC Rail and CN. These two mines accounted for 20% of western Canadian production of bituminous coal in 1993.

With the exception of Quinsam, the coal mines of B.C. and Alberta are far from tidewater. In Alberta, the Luscar mine is 682 miles from Vancouver. In southeast B.C., the distance from Greenhills to Vancouver is even further at 722 miles, reflecting the rail routing through the Rocky Mountains. These are much longer distances than those incurred by Canada's major competitors in the coal trade. The average distance from mine to tidewater is of the order of 140 miles in Australia and 360 miles in South Africa. Canadian coal producers therefore face higher freight charges than their competitors in moving coal to tidewater.[11]

Unfortunately, precise data on railway freight rates for the transport of coal in Canada are not available in the public domain as these are all set through confidential contracts. At one time, Statistics Canada used to publish figures on railway revenues and tonnes carried for major commodities. This allowed an estimate of the freight revenue per tonne: in 1990, this was $20.03/tonne for all bituminous coal shipped in Canada.[12] Statistics Canada has ceased to publish these figures for subsequent years, presumably in the interests of preserving railway confidentiality.

In a world of confidential contracts, it is not easy to conjecture as to what has happened to railway freight rates on coal since 1990. On the basis of grain information in the public domain, railway costs fell by at least 6% between 1990 and January/June 1994. However, there is no reason why this should necessarily be reflected in coal freight rates. Rail rates on coal are partially tied to the selling price of coal in overseas markets; these markets have been weak in recent years and freight rates charged by the Canadian railways have almost certainly reflected this. Thermal coal has a lower selling price than metallurgical coal and therefore cannot really bear the same railway rates. The official position of the railways is that they make no distinction in their charges between the two types of coal. Yet, through confidential rates and reduced "developmental rates" for new sources of supply, railway rates are probably somewhat lower for thermal coal than for metallurgical coal. Relying on trade sources, as there is really no alternative means of obtaining relevant information, the railway freight rate for the transport of coal from Alberta/B.C. to west coast terminals must have been about $18.00/tonne in January/June 1994.

The next step is to try to relate the freight charges for coal to the long-run costs incurred in the movement of western Canadian coal to the Pacific Coast ports. Again, there are no data in the public domain, but estimates were made by Travacon Research Ltd. in November, 1993 in a study for the Province of Alberta, which has been given fairly wide public distribution. Although Travacon does not have access to official figures from the National Transportation Agency, the company has its own costing model. This attempts to replicate the format used by the National Transportation Agency and the input data on railway work units and railway unit costs needed to calibrate the model. The model therefore attempts to estimate long run variable costs. The major finding was that the long-run variable cost for the rail transportation of coal from Luscar, AB to Vancouver over a distance of 682 miles was $12.70/tonne.[13] This was in 1993 prices and railway costs in money terms have been declining since that date; a figure of $12.50/tonne is therefore used for the subsequent discussion in this section.

As explained in the previous section, the railways need an addition to variable costs of 25% on the average in order to meet fixed costs, but there is no way in which the railways can operate by charging a flat 25% addition to cover fixed costs on all traffic carried. Nevertheless, with long-run variable costs estimated at $12.50/tonne, the contribution to railway fixed costs in coal traffic would be 44% on a freight rate estimated at $18.00/tonne. This is a substantial contribution to railway costs and the coal mines have very little bargaining power in their negotiations.

- While the railways claim that "market competition" gives some protection to the producer in the sense that the railway would not wish to force freight rates so high that the traffic would disappear, this protection is scant comfort with such a large contribution to fixed costs extracted from coal in a period when coal markets were weak.

- Interswitching provisions are of no value to the coal industry, as no coal mine is within 30 km of a competitive railway.

- Competitive line rates are of no help to the coal industry for all-Canadian routes. CN and CP do not co-operate with shippers in competitive line rates aimed at the other Canadian railway. In addition, distances from CN coal lines to CP lines and from CP coal lines to CN lines are very considerable; the extra mileage involved for a mine to re-route via another railway would generally involve far too much in additional mileage to make this approach economic.

- Competitive line rates could probably be obtained to allow connections to U.S. railroads to transport Canadian coal through U.S. transportation routes. However, there would be considerable difficulties in implementing such an approach. Firstly, there is no U.S. coal terminal on the west coast north of Los Angeles and this is much too far to be competitive for moving Canadian coal. However, there is a possibility that a new coal terminal could be constructed in the U.S., probably at Portland, OR or possibly at Cherry Point near Bellingham, WA. Secondly, only the mines in southeast B.C. would be at risk to diversion through the U.S. as distances are far too great for this to be a factor in northeast B.C. or Alberta. Three of these southeast mines are owned by Fording and it is difficult to envisage that their coal would ever be shipped through the U.S., as Fording is a subsidiary of Canadian Pacific Limited. However, the other two mines in southeast B.C. have sufficient production for a new coal terminal of modest size. An initiative in this direction would probably lead to freight rate reductions by CP to keep this traffic in Canada. The construction of a U.S. coal terminal to divert Canadian traffic "may not be far-fetched" to quote a trade source, but it is far from being a certainty.

- The last competitive access provision which could be used by the coal industry is final offer arbitration. So far, use of this approach in Canada has been very rare and it has never been used in the coal industry.

To conclude this section, with the exception of Quinsam on Vancouver Island, the remaining 12 coal mines in Canada are all captive to one railway. The competitive powers available to each mining company in its negotiations with the railway are not great and the coal industry is making a substantial contribution to railway fixed costs.

3. ALBERTA SULPHUR INDUSTRY

Canada is the world's largest export of elemental sulphur, with a 38% share of world trade in 1993. Sulphur is mainly a by-product from the production of natural gas and oil. Alberta accounts for almost 96% of total Canadian production of sulphur.

Since 1991, Canadian production of sulphur has increased significantly, but this has not been accompanied by increased export sales. Sulphur markets were very weak in 1993 and overseas exports were down to 2.8 million tonnes, as against 3.7 million tonnes in 1992. With sulphur production a by-product of the energy industry, it is not possible to reduce sulphur production in response to reduced demand and there has therefore been very substantial stockpiling by

producers. Fortunately, sulphur exports overseas showed some recovery in 1994 to 3.8 million tonnes and the market continued buoyant in early 1995.

Fluctuations in export demand have substantial impact on sulphur prices. Contract prices (f.o.b. Vancouver) for the offshore export of Canadian elemental sulphur fell substantially from approximately US$100/tonne in January 1991 to a fifteen-year low of US$25/tonne in October, 1993. There has since been some recovery to approximately US$55/tonne as of early March, 1995.

The rail origins of Alberta dry sulphur are shown in Table 1.[14] There are striking similarities between the distribution patterns for Alberta sulphur and western Canadian coal. The average distance over which sulphur is moved is 746 miles, broadly comparable with coal movements. There are only 11 locations that have active forming facilities to create dry elemental sulphur destined for the offshore markets and this is comparable to the 12 inland mines in the coal industry. Each sulphur producing location is captive to one railway.

Table 1: Alberta Dry Sulphur Rail Origins and Mileages to the Port of Vancouver

Railway	Train Type	Origin Point	Miles	Plant Name	Company
CP Rail	Train Load	Rockyview	648	East Calgary	Petrogas
CP Rail	Train Load	Crossfield	660	East Crossfield	Amoco
CP Rail	Train Load	Shantz	692	Caroline	Shell Canada
CP Rail	Train Load	Pecten	785	Waterton	Shell Canada
CP Rail	Single Cars	Copithorne	609	Jumping Pound	Shell Canada
CP Rail	Single Cars	Minarat	684	Olds	Amerada Hess
CP - Average Rail Miles to Vancouver			680		
CN	Train Load	Bryan/Cadomin	668	Hanlan Robb	Petro Canada
CN	Train Load	Kaybob	929	Kaybob I & II	Amoco Canada
CN	Train Load	Ben Bow	908	Kaybob III	Chevron
CN	Train Load	Ram River	996	Ram River	Husky Oil Ltd.
CN	Single Cars	Ansell	633	Edson - Pine Creek	Talisman Energy
CN - Average Rail Miles to Vancouver			827		
CP and CN - Average Rail Miles to Vancouver			746		

Track mileages are to Pacific Coast Terminals Ltd. in Port Moody for CP origins and to Vancouver Wharves Ltd. in North Vancouver for CN origins.

Railway rates for the movement of sulphur are contained in confidential contracts and are not available in the public domain. Statistics Canada data for 1990 showed that the average rail charge to move sulphur in Canada was $30/tonne and most of this movement was from Alberta to Vancouver. The average length of haul was only slightly greater for sulphur than for coal, but the sulphur rail charge was 50% higher than for coal in 1990. Although coal may be easier to handle than sulphur and has shorter car cycles, the extent of this difference is still substantial.

Statistics Canada discontinued publication of data allowing the calculation of freight charges per tonne after 1990. Since that date, railway costs have been falling in current dollars. The sulphur industry has been suffering from very depressed prices and rate reductions have been given, although often only on a temporary basis. The new Shell Caroline plant, listed in Table 1, only began production in 1993 and rail shipments were covered by a separate contract negotiated with CP prior to the plant opening when sulphur prices had already declined. CN renegotiated its rail contract with the sulphur industry in 1993 and CP renegotiated its contract in early 1995. Sulphur rates are now less than in 1990, but there is really no way of estimating the rates other than taking into account trade sources. These placed the average freight rate in late 1993 at approximately $23/tonne. Since then, with rail rates tied partially to industry selling prices, even the modest recovery in sulphur prices has led to some increase in freight rates. The current (March, 1995) rate appears to be at least $24/tonne.

The Travacon Research Ltd. study for the Province of Alberta, referenced earlier in section 2, also gave an estimate of the long-run variable costs of moving sulphur. The 1993 cost estimate was $10.15/tonne for a haul of 648 miles from East Calgary to Vancouver. However, the average length of haul for sulphur is about a hundred miles longer than this and costs would be higher on that part of the traffic carried by CN. Relying on a second set of trade sources, perhaps an average long-run variable costs of $14/tonne would be reasonable.

If the average freight rate on sulphur is $24/tonne and the long-run variable costs $14/tonne, the freight rate would be 71% above long run variable costs. The bargaining position of sulphur producers is weak in that the railways are well aware that sulphur is a by-product and that it is therefore difficult for producers to cut back their output in response to higher freight rates. The competitive access provisions are ineffective. CN and CP do not use competitive line rates against each other, while the sulphur plants are not sufficiently close to alternative rail lines to use interswitching rates. In early 1995, the sulphur industry was considering an application to the National

Transportation Agency for final offer arbitration, but in the end it did not proceed with the application.

Turning to the possibility of routing Alberta sulphur to the Pacific coast by U.S. transportation routes, the most favoured outlet is Portland, OR. A competitive line rate would have to be obtained in Canada to the border at Kingsgate, with the sulphur transportation continuing on the Union Pacific to Portland. With the possible exception of the Husky Oil plant at Ram River, the CN locations would be at relatively little risk of diversion of traffic to U.S. routes because the additional mileage would be very substantial. The extra distances from diversion would be much less for product on the CP lines, with the extra distance generally in the range of 200-300 miles, except for the Shell plant at Waterton, where the U.S. routing would be 30 miles shorter than via CP. The similarities are striking in respect of the diversion risks for sulphur and for coal.

4. A POSSIBLE SOLUTION

Long-run variable costs account for some 80% of total railway costs, so that on the average the railways must add 25% (i.e., 20/80) to variable costs in order to cover fixed costs. It is inevitable that some railway traffic will make a contribution to fixed costs of less than 25% and that consequently some traffic must pay more than 25%. However, the contributions are very substantially above this figure for coal, estimated at 44%, and for sulphur, estimated at 71%. The individual producers in these two industries are all captive either to CP or to CN.

The burden of excessive contributions to railway fixed costs is less of a concern in other resource industries of western Canada. Under the *Western Grain Transportation Act*, the railways recover costs relating to grain dependent branch lines and all other volume-related variable costs, with a 20% addition as a contribution to fixed costs in respect of volume-related variable costs. In the potash industry, most mines are served by both CN and CP and the industry is reasonably satisfied with the competition that this affords. The potash industry also has the additional competitive factor of U.S. transportation routes through the port of Longview, WA.

Governments have been turning increasingly to competition rather than regulation in the transport industries as the best way to secure the most efficient provision of transport at the minimum cost. This was the philosophical basis of the *National Transportation Act, 1967* and even more so of the *National Transportation Act, 1987*. There would be general agreement that this reliance on competition has had very beneficial effects on Canadian transportation both from the standpoint of shippers and carriers. However, governments have

recognized that, despite their best efforts, competition just does not exist in some situations. This was recognized in 1967 in the captive shipper section of the legislation, although this proved quite ineffective. The competitive access provisions of the 1987 legislation were stronger, but they have not dealt entirely with the problem of the captive shipper.

The legitimate public policy question is asked - very frequently by resource shippers and the governments of all four western provinces - of whether it is in the interest of either natural justice or the economic development of Canada to allow some industries to be hit so hard in transportation charges. The railways may argue that shippers are protected by market competition so that the railway will not raise freight rates so high as to drive the shipper out of production. The view has already been expressed earlier in this paper that market competition offers very little protection to the shipper from the demands of the carrier. Moreover, the railways can sometimes be very slow in accommodating freight rates to the effects of competition in the resource industries. In October 1993, the price of sulphur had reached a fifteen-year low of US$25/tonne (f.o.b. Vancouver), which could hardly have covered rail and port charges at that time. In potash, the industry may never have used U.S. routes, if it had not been subject to very high Canadian freight rates in the years before the 1987 legislation.

The dangers of high freight rates and large contributions to railway fixed costs from coal and sulphur traffic are twofold. Firstly, traffic generated on CP lines in the south of Alberta and B.C. could be diverted to U.S. transportation routes. Secondly, high freight rates on facilities of limited profitability, for example the two coal mines in northeast B.C. which could be in difficulties when the guaranteed prices of their present contracts expire in the next three to four years, could lead to cessation of production. In both cases, the employment implications are substantial. Last minute freight reductions by the railways could save some of this employment, if the railways were forced into this position to avoid a loss of traffic. However, a better approach to safeguard captive shippers would be to install an overall cap on the maximum contribution to railway fixed costs to be allowed in any freight rate.

It is proposed that railways be limited to a maximum add-on to variable costs as a contribution to fixed costs on all freight rates. As an approximate figure, the cap might be about 35%. The cap should not be fixed immutably in time, but adjusted over the years to reflect changes in the railway industry. It would not be difficult to make this type of regulation operational and the intrusive effects on the railway would not be substantial.

What would this cost the railways? Based on the estimates of freight rates and variable costs in the earlier chapters of the report, probably about $1.10/tonne on 26.0 million tonnes of coal exported to the west coast in 1993 and about $5.00/tonne for 3.8 million tonnes of sulphur moved in 1994. In dollar terms, these round to $30 million and $20 million, respectively, for a total of $50 million. The Canadian operating revenues of CP and CN in 1993 were $5.9 billion (SC 52-216). Implementation of the proposal to limit the contribution to fixed costs to 35% would cost the railways $50 million on coal and sulphur, which is less than 1% of total operating revenues. It is also less than one-half of the average gain in total factor productivity that the railways achieve in a single year. The proposal would also affect railway revenues in some other traffic categories. Without access to detailed railway data, it is impossible to quantify this but, prima facie, the additional effect should not be large.

The proposal is to limit all freight rates to long run variable costs plus a maximum of 35% of long run variable costs as the contribution to fixed costs. This is by no means financially impractical and could almost be described as modest. It presents few administrative problems. Moreover, it is not a return to detailed regulation or a denial of the greater freedom given to railways in pricing matters in the legislation of 1987. The benefits of competition in transportation are substantial, but these are necessarily limited when a shipper is captive to one carrier. This problem has long been recognized and attempts were made both in 1967 and in 1987 to redress the poor bargaining position of the captive shipper. These efforts have not been completely successful and they need to be supplemented by a cap on the maximum contribution to fixed costs which the railways are allowed to incorporate into any individual freight rate.

ENDNOTES

1. John Heads et al., The International Competitiveness of Western Canadian Transportation, Report prepared by University of Manitoba Transport Institute for Western Economic Diversification Canada, Winnipeg, November 1994. John Heads was the author of the coal chapter of this report. Alex Phillips wrote the sulphur chapter and has kindly agreed to the incorporation of some of his material in this paper.

2. A.W. Currie, Canadian Transportation Economics, University of Toronto Press, 1967, p. 67.

3. ibid., p. 71.

4. The rate is 250% of variable costs and, as variable costs are 80% of fully allocated costs, it is therefore 200% of fully allocated costs.

5. Calculated from Canadian Transport Commission, Traffic and Tariffs Branch, Commodity Flow Analysis 1968 - 1972, Ottawa, 1974, Table No. 45.

6. As an arithmetical illustration, suppose that variable costs per hundred pounds were (a) for carloadings of 15 tons, (0.9a) for carloadings of 25 tons and (0.6a) for carloadings of 48 tons. The rate would be (2.5a-.05a)=(2.45a). The fully allocated cost for a shipment in 48 ton cars would be (0.75a), i.e., variable costs of (0.6a) plus a 25% contribution. The ratio of (2.45a) to (0.75a) is 3.27.

7. H.L. Purdy, Transport Competition and Public Policy in Canada, University of British Columbia Press, Vancouver, 1972, p.105.

8. Summary of Canadian Transport Commission Railway Cases, 1978, p. 397.

9. Royal Commission on Transportation (MacPherson Commission), Volume II, December 1961, pp. 50-51. I am grateful to Jed Cochrane of the National Transportation Agency for drawing this to my attention.

10. This is taken from The International Competitiveness of Western Canadian Transportation, op. cit., p. 4-7. The map was compiled largely from data provided by the Coal Association of Canada. The use of various Coal Association publications, particularly the 1994 Coal Directory, is acknowledged.

11. See, for example, Garnet T. Page Consulting Ltd., Transportation in the Coal Industry, prepared for Alberta Economic Development and Tourism, January 1993, p. 31.

12. Calculations from Rail in Canada, SC 52-216, 1990. This average would have been on the high side for the western movement, as it also included coal moved on the longer haul to Thunder Bay.

13. While 1991 data on the costs from southeast B.C. to Roberts Bank were consistent with the estimate quoted, this study also used the Travacon model, so that it cannot be regarded as independent verification. See Sandwell Inc., Evaluation of Railway Costs for Coal Transport, Final Report for the B.C. Ministry of Energy, Mines and Petroleum Resources, February 1993.

14. This is taken from The International Competitiveness of Western Canadian Transportation, op. cit., p. 6-13.

RISE AND FALL OF THE CATTLE TRAIN: HISTORY AND LOCATION IN THE CATTLE & CATTLE TRANSPORT INDUSTRIES IN CANADA

by Chris Loly* and Dr. Barry E. Prentice**

During the first half of the 20th century, vast numbers of cattle were shipped by rail from the western prairies to central Canada for processing. Today, some western cattle are still shipped live to central Canada (principally Quebec), but exclusively by trucks. This paper deals with the impact of inter-modal competition on long-haul cattle transport. The effects of greater competition in transport on the location of the beef packing industry are also examined.

There are at least three reasons to examine the history of cattle trains. First, the experience illustrates the effect of transportation on regional development. Second, this case is an example of inter-modal competition where the trucking industry was able to replace the railways in the market. Finally, it presents an interesting part of our history that has received scant attention.

1. THEORETICAL BACKGROUND

The transformation of live cattle into beef is a weight-losing process. The yield of beef is about half the weight of the live animal. The rest of the animal (hides, bones, hooves, and other offal) is valuable, but the production of beef is the primary reason for slaughter.

During transport, cattle require specific handling to maintain their health and to comply with government regulations. Live animals are required to be unloaded periodically during their journey to be fed and watered. The long distance transport of cattle causes bruising and shrinkage, as well as mortality. Of course, meat also requires specific handling. Fresh-chilled and frozen beef require a temperature-controlled environment. The technology for keeping beef refrigerated over long movements has been available, and continuously improved, since the 1880s.

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In Canada, the traditional centre of the cattle industry has been the western prairies. The traditional centre of demand for beef has been central Canada, where the bulk of the population resides. The distance between the centre of supply and demand has created the need for transportation. The raw materials (cattle) must be transformed into finished product (beef) at some point, either at the source, the final destination, or some place in between.

In a system with a single supply source supply of raw materials, and a single, different source of demand, the transportation system has a great influence on the location of processing. If the production is weight-losing in nature, it is more economic to process the raw materials at their source, so that the lowest transportation costs will be incurred. If the production process is weight-gaining in nature, then it makes more sense to process the raw materials at the place of final consumption, again, to minimize transport costs. The clarity of this idea can be obscured by the introduction of differential freight rates on processed goods and raw materials. In the weight-losing example, if higher freight rates are charged on finished products, then the best place to process the raw materials is not so obvious. If the differential is large, it could become more economic to process the raw materials at the place of final consumption.

When a transport firm has a monopoly over a certain market, they are almost certain to exert their market power to increase profit. In some cases, this exertion of power is prohibited by the government. One of the ways that a transport firm can increase profits is by practising price discrimination - charging different rates to different customers based on the value of the service provided. Under this value-of-service pricing regime, raw materials and bulk commodities tend to receive lower rates, while finished products tend to be charged higher prices. This charging of differential rates on the movement of finished goods and raw materials can affect the regional development of an industry, as noted above.

If the competitive position of the monopolist is weakened by new entry into the market, this may cause freight rates to approach the true cost of shipping the goods. This competition can be intra-modal or inter-modal. The addition of new firms may not always improve the rates the shippers receive - in some cases, the new entrants may come to an agreement (implicit or explicit) with the former monopolist to limit competition. As more firms enter the market, these agreements become more and more unstable, increasing the chances that the industry will enter into a competitive war.

The theory outlined above can be applied to the Canadian cattle and beef industries because there are several key similarities between the industry and the theory:

- The source of surplus cattle has been the western prairies, while the principal source of demand has been in central Canada.
- Cattle processing is a weight-losing undertaking.
- The railways charged differential rates on livestock and meat shipments, under the class rate system.
- There was an influx of competition in the transport industry.

The next sections examine the historical evidence for the idea that as competition entered the transport industry, the conditions for processing cattle in the prairies were altered and this led to an eventual shift in the locus of production from central Canada to the prairies. Moreover, the same forces caused a within-region shift as processing plants at the eastern end of the prairies (Winnipeg) were replaced by new meat packing plants in southern Alberta.

2. TRANSPORT INDUSTRY HISTORY

The government of Sir John A. Macdonald promised to build a railway across the nation as part of a deal that brought British Columbia into confederation. The completion of the Canadian Pacific Railway (C.P.R.) in 1885 enabled western cattle to be shipped to central Canada for slaughter and consumption. The western cattle industry experienced strong growth as a result of this innovation.

Following its completion in 1885, the C.P.R. had a complete monopoly over cattle shipments from western to central Canada. The railway made substantial infrastructure investments for the shipping of live cattle to Toronto and Montreal, constructing stock yards at various stops (eg. Winnipeg, MB and White River, ON) so that the livestock could be fed and watered. The C.P.R. was not in favour of increased cattle processing on the prairies, presumably because of their investments in the live cattle trade, and because live cattle need approximately twice the number of cars as the equivalent amount of beef.

> The C.P.R. was not prepared to invest in refrigerator cars to give Winnipeg-dressed meat access to eastern markets, nor were cattle-shipping firms like Gordon and Ironside ready to make such investment when established eastern packers already controlled the eastern Canadian markets. (Silver, 1994)

As reported in *The Commercial* (19 October, 1886) that the General Traffic Manager of the C.P.R. was quoted as saying that he was opposed to the development of the dressed meat trade in Winnipeg, in part because he believed that Winnipeg did not have the secondary industries necessary to absorb the offal. In addition to this, the manager was quoted as telling the Winnipeg industry, "Let others handle it for you; let Montreal men take it in hand" (*The Commercial*, 19 October, 1886).

The early history of Winnipeg's meat packing industry stands in sharp contrast to the U.S. experience at Chicago. The rise of Chicago as a meat packing centre towards the end of the 19th century is well-documented. The city was a trans-shipment point that funnelled mid-western cattle towards the large eastern U.S. market. In the 1880s, entrepreneurs in Chicago began to process cattle in their city, shipping only the beef eastward to the large market. Initially, the U.S. railways fought to stop or limit the use of refrigerated box cars because of the substantial investment already made in the live animal trade. In the end, the Chicago packers were able to circumvent the stubborn U.S. railways by shipping their product north of the border through Canada to the New York markets on the Grand Trunk Railway. In this instance, competition in the transport industry led to a shift of the locus of production towards the source of raw materials (cattle). In contrast to U.S. experience, it took much longer for the locus of production in Canada to shift to the location of the raw materials.

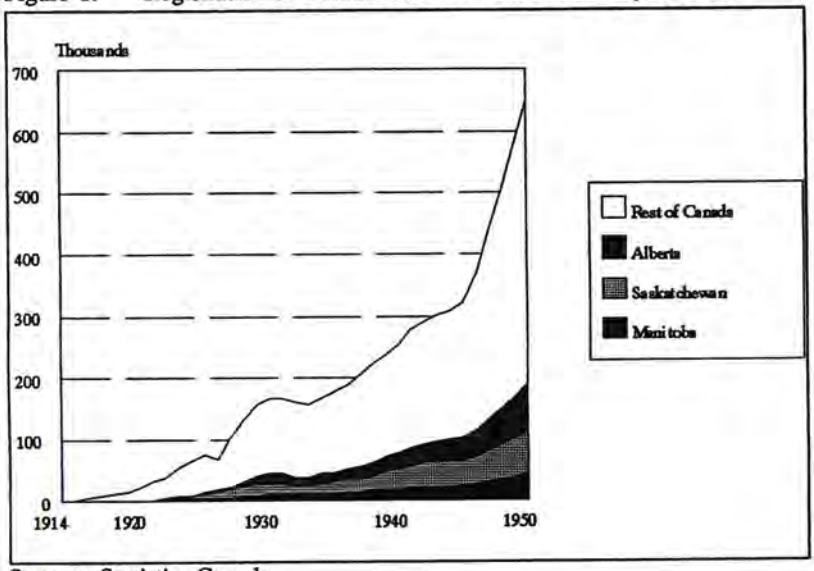
There were significant expansions to the trans-continental railway infrastructure in the first decades of the 20th century. Two new trans-continental railways emerged: the Canadian Northern and the Grand Trunk Pacific (G.T.P.). The routes of these two railways diverged from the C.P.R. lines at Winnipeg, taking a northward path to Edmonton via Saskatoon. Following a series of financial difficulties, the two new railways were merged into a single railway, under government control in 1923. This left just two trans-continental railways, the C.P.R., and the new Canadian National Railways (C.N.R.). It was claimed that the competition with other railways would moderate the monopoly rates charged by the C.P.R. The C.P.R. rates were the focus of much western bitterness, but the competition of a second railway did little to alleviate the concerns of the westerners who believed that the west was paying too much for moving freight.

The railways were regulated by the Board of Railway Commissioners, which looked into matters of freight rates. The rates charged by the railways were based on the class rate system, where high-valued goods were charged higher freight rates than lower-valued commodities.

The system of discriminatory freight rates set the stage for the rise of trucking. The internal combustion engine was well-developed by the end of the first decade of the 20th century, and this innovation soon led to the introduction of the motor car and truck. Initially the road system consisted of small dirt roads that were suitable only for wagons and bicycles. By 1925, automobiles were cheap and reliable. The provinces have always taken an active role in the construction of roads, and during the first part of the century, they invested heavily in surfacing and expanding the road system. By 1940 the trans-Canada highway was completed, and it was upgraded in 1948 so that all roads had hard surfaces. Naturally, these infrastructure developments helped to make the trucking industry more competitive. Figure 1 shows the registrations of commercial vehicles in Canada for the first half of the 20th century.
Trucks began to compete with the railways for traffic starting in the 1930s. The motor carriers were extremely competitive over short distances, and they expanded their competitive radius quickly. Railways maintained a grip on the long-haul traffic, but motor carriers began to erode the railway revenue base by diverting some of the high-value traffic that was charged the highest rates. Trucks offered more flexible service, less handling, and door-to-door deliveries.

Beef was an ideal commodity for diversion to the trucking industry: it is a high-value good, and it requires specific handling and monitoring. In addition to this, traffic originating in the prairies destined for central Canada received backhaul rates. Despite this, the sheer distance involved was a barrier to this diversion, which was eroded with successive technological improvements in trucking.

Figure 1: Registration of Commercial Vehicles in Canada, 1914-50

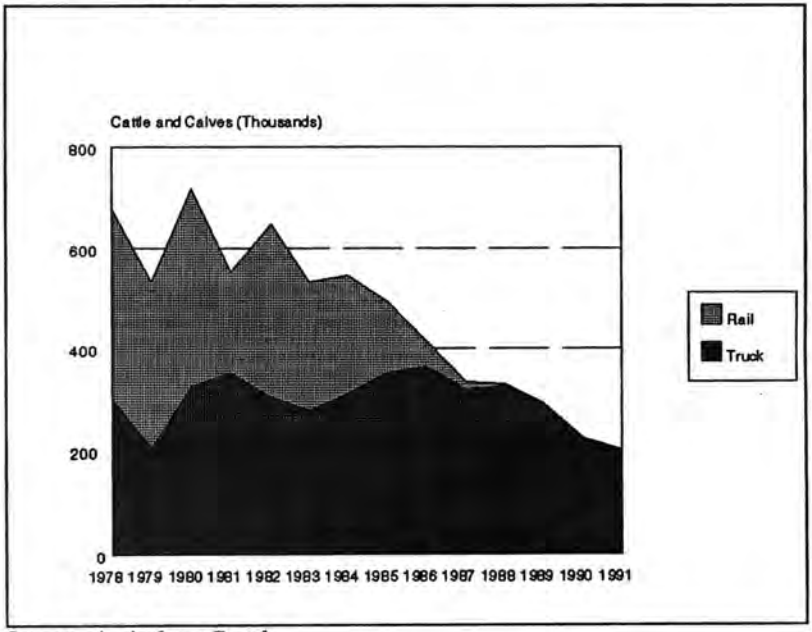


Source: Statistics Canada

The first years of rail-truck competition were relatively quiet - the macro-effects of the Great Depression and World War II blunted the impact of trucking competition. After the war was over, truckers began to gain market share. By 1950, trucks had captured 8% of domestic inter-city ton-miles, while rail undertook 63% and the remainder (29%) was carried by water. The efficiency and competitive radius of trucks increased consistently over the next 40 years. In 1990, railways carried 57% of domestic intercity tonne-kilometres, trucks 22% and water carriers 21%. These statistics do not do justice to the growth of the trucking industry because long-haul traffic is weighted more heavily than short-haul traffic. In terms of total tonnes carried, the railways and the trucking industry are approximately even today.

There are very few indicators about the modal shares of the west-east, long-haul cattle transport market before the late 1970s. Presumably, trucks began to transport some cattle from western Canada to Ontario and Quebec, and gradually increased their market share. The first available information comes in 1978, when Statistics Canada data show the modal breakdown of west-east cattle shipments. Figure 2 shows the numbers of cattle shipped from western Canada to Central Canada from 1978 to 1993.

Figure 2: Modal Shares of Cattle Shipped from Western to Central Canada, 1978-93



Source: Agriculture Canada

The information contained in Figure 2 is remarkable. In 1978 the railways had approximately 50% of the west-east cattle transport market. Within 10 years, that share had dwindled to nothing, while the numbers of cattle shipped by truck remained relatively constant. The decline in cattle shipped by rail is not entirely the result in rate-cutting by the trucking industry. If this was the case, then the total number of cattle would have increased, stimulated by lower truck rates. In order to understand better what happened in the west-east cattle transportation market, an analysis of the cattle and cattle processing industries is necessary.

4. CATTLE INDUSTRY HISTORY

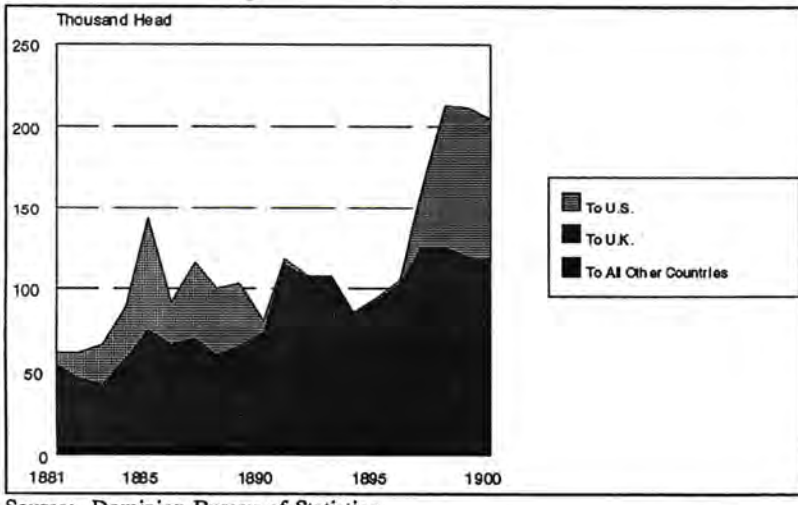
The western Canadian cattle industry began to expand during the last quarter of the 19th century with the introduction of cattle from the U.S. and eastern Canada. The industry experienced slow growth until the coming of the C.P.R., which acted as a catalyst. In this era, cattle were free to roam the open range.

Although some institutional constraints were imposed on the industry over the next years, the industry continued to experience strong growth.

Following the completion of the C.P.R., significant volumes of cattle were shipped from the prairies to central Canada for processing. Large numbers of cattle were also exported to the United Kingdom.

The export of Canadian cattle to the U.K. was stimulated by a prohibition on the import of U.S. cattle. This raised the price of live cattle in Western Canada, encouraged investment and the importation of breeding stock. The impact of this opportunity is illustrated in Figure 3, which documents the cattle exports to the U.K. during this early period. Large exports to the U.K. began to tail off by 1920. Subsequently, the domestic processing market began to take on increasing importance for Western Canada.

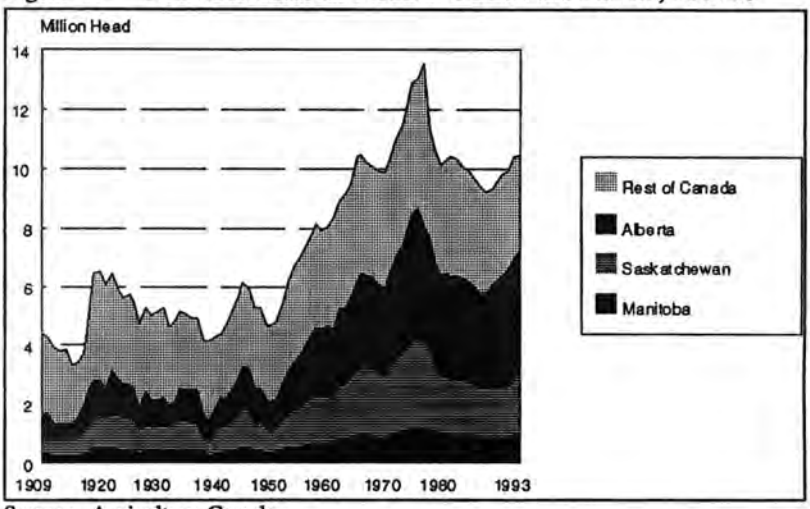
Figure 3: Canadian Exports of Cattle, 1881-1900



Source: Dominion Bureau of Statistics

Figure 4 shows the numbers of non-milk cattle in each of the prairie provinces and the rest of Canada for the period 1909-93. In 1909, the prairies contained 37.3% of the national cattle supply. By 1950, the prairie proportion had risen to 44.5%, and in 1993 it was 69% of the national total. Within the prairies, Alberta has always had the largest share of the supply, alone claiming 40.5% of the national supply in 1993. Clearly, the prairies have significantly increased their share of the cattle supply over the past 84 years.

Figure 4: Non-Milk Cattle on Farms in Canada and Prairies, 1909-93

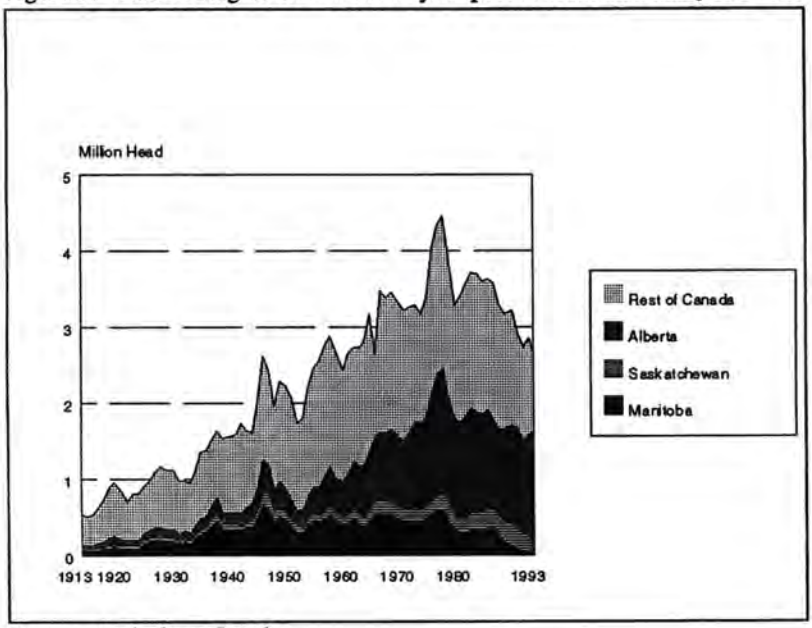


Source: Agriculture Canada

Initially, processing on the prairies was only for local consumption. As changes started to occur in the transportation industry, an important trend became evident in the location of cattle slaughtering: more processing began to take place in the prairies. In the mid-20s, Winnipeg became a major meat packing centre, taking advantage of its role as a trans-shipment point for cattle shipments to central Canada. Cattle from the prairies were funnelled through the city, and some entrepreneurs found it profitable to process cattle in Winnipeg, shipping only the beef to Ontario and Quebec for consumption.

Starting in the late 1940s, the locus of the meat packing industry began to shift westward into Alberta, the largest source of surplus cattle. The Alberta cattle slaughtering industry gained momentum over the next decade. Figure 5 shows the numbers of cattle slaughtered in federally inspected establishments from 1913 to 1993. In 1913, 26.1% of the national slaughtering took place in the prairies. In 1950, this had increased to 34.5%, while in 1993 it was 60.0%. Today, 52.8% of the national slaughtering takes place in Alberta.

Figure 5: Cattle Slaughtered in Federally Inspected Establishments, 1913-93



Source: Agriculture Canada

The markets for cattle and beef have remained relatively stable for the last century. The prairies have never been able to consume as much cattle as they have produced, and central Canada has been a cattle deficit region. In addition to the central Canadian market, cattle were exported to both the U.S. and the U.K., and to few other places. In recent years, however, there has been a dramatic change to the *status quo*.

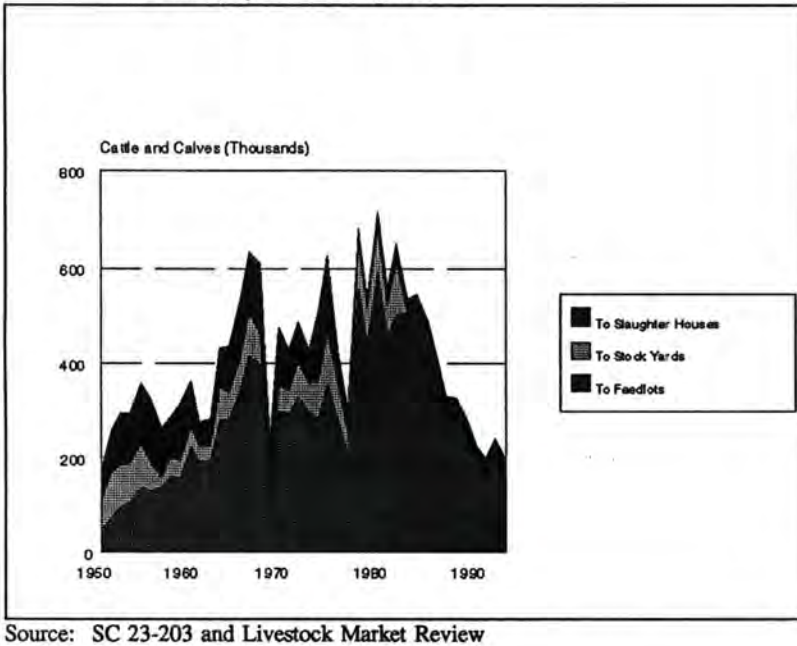
Changing patterns of trade have shifted influence away from east-west trade flows toward north-south flows. New markets have developed in the western U.S., Mexico and the Pacific Rim. Exports of beef are now more important than cattle exports, although significant numbers of breeding stock and feeder cattle are still exported. One of the main reasons for the rise of southern Alberta as a cattle processor is its proximity to these emergent markets.

As Alberta began to process more cattle, the number of cattle shipped out of the prairie provinces began to decline. Today, Alberta is a net importer of cattle, bringing in animals from Manitoba and Saskatchewan, and at times even

the U.S. As a result of the growth of livestock finishing in Alberta, the number of cattle shipped from the prairies to central Canada declined. This decrease in numbers has made it unprofitable for the railways to haul cattle because the rail system requires large volumes to cover the fixed costs of maintaining stock yards and feeding/watering stations along the route. Moreover, as the focus of the trade became dominated by feeder cattle, the shipping season became concentrated into a six week period each fall. Railways were obliged to carry enough equipment to manage for the peak period of activity. Another reason suggested for the significant decline in the numbers of cattle shipped to central Canada was that Alberta began to pay the "crow off-set", a payment to feedlot operators that enabled greater in-province consumption of barley. The creation of this payment in the late 1980s reduced the number of feeders being shipped out of province. Figure 6 shows the numbers of cattle shipped from western to eastern Canada by destination from 1950 to the present.

There are several other important factors that have affected the location of the cattle processing industry over the last century. Changes in refrigeration technology have lowered the cost of shipping processed meats. In the 1930s and 40s carriers still relied on salt and ice refrigeration. Mechanical refrigeration became prevalent in the 1950s, and this lowered the costs of moving fresh and frozen products. In recent years, the cost of refrigerated truck trailers has come down drastically, and the trucking industry, with their high equipment turnovers, are in a good position to take advantage of these decreases in cost. In recent years, the shift from "hanging" to "boxed" beef has furthered the efficiency and ease of shipping fresh and frozen meats long distances by truck.

Figure 6: Cattle and Calves Shipped from Western Canada to Eastern Canada, by destination, 1950-93



Source: SC 23-203 and Livestock Market Review

Changes in the economies of scale available to cattle processing firms have also been a catalyst for changes in the location of the plants. In the late 1950s, the scale economies available to firms were small. It has been reported that there were few cost advantages available to firms that slaughtered more than 42,000 head/year. In 1991, there were substantial reductions in cost available to firms up until output levels of 1,100,000 head/year (Ward, 1992). The changing technology of cattle slaughtering and packing has led to the construction of new efficient plants. While it is difficult to change the location of an existing plant, new plants are much more flexible, and will likely be built in the optimal location. Changes in technology have played a distinct role in the changing location of the cattle processing industry.

5. SUMMARY AND CONCLUSIONS

There is a very strong relationship between increases in competition in the transportation industry, and the migration of the locus of cattle processing towards the source of surplus supply. Other developments, such as the emergence of new southern and western markets, and changes in technology have also pushed the centre of processing towards Alberta.

No cattle are shipped from the prairies to central Canada by rail today, principally because of the ability of trucks to provide lower rates on feeder cattle and meat shipments. For the railways, the cost of providing the same handling became too expensive as volumes decreased and became more seasonally peaked.

The case of the Canadian cattle industry is somewhat different from the U.S. experience. In Canada, low levels of competition in the transport industry made for a slow transition of the centre of processing from the centre of demand to the centre of supply. The general idea that the structure of the transportation industry will have a significant impact on the location of other industries is supported by the case of the cattle industry.

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LIBERALISATION OF THE E.C. AIRLINE INDUSTRY
A PROGRESS INVESTIGATION

As part of the European Community's push toward a single economic market, efforts have been made to liberalise the airline industry. This report attempts to outline the legislation put forward by the EC, investigate the progress made toward stated objectives in a number of areas, and compare the effects to date on competition. The findings reveal that changes toward increasing competition are occurring, but that lukewarm political will is causing the pace to be slower than expected.

The report contains three sections designed to provide a clear and simplified format for better understanding this topic of significant proportions. First, the aims and legislation put forward by the EC are outlined. Secondly, developments in factors affecting competition are discussed, including Air Traffic Control (ATC) systems, NATO and military airspace, airport congestion and slot allocation, government ownership and state aid, mergers, acquisitions and alliances. The final section examines the predicted and actual impact on passenger airline competition pertaining to route operations and air fares.

EC AIR TRANSPORT POLICY: TOWARDS LIBERALISATION

The European Commission first initiated efforts towards a common EC air transport policy back in 1979. The results to date have been a series of three legislative packages aimed at liberalising the industry, with the intent of

creating a common market. Taken as a whole, Europe accounts for 31% of world passenger enplanements, worth an estimated $45 billion annually.[1]

Aims of Liberalisation

The EC's stated intention for its liberalisation policy is to increase competition with the hope of benefitting travellers in terms of reduced fares, improved service and choice. But it should be noted that liberalisation does not mean deregulation. The EC is deliberately trying to avoid the type of "abrupt" deregulation which occurred in the U.S. and resulted in airline consolidation and carrier dominance of hub airports. Significant regulation of the EC market will remain as the Commission attempts to create a level playing field for fair competition between a mix of government-owned and privately-owned air carriers. Future intentions also include the development of a European Union common external air policy, with the Commission holding preeminent power concerning negotiation of bilateral air treaties with non-EC countries. The underlying aim of making Europe and its carriers more competitive with the rest of the world is a strong driving force behind the liberalisation policy. A comparative investigation carried out by Windle employing 1983 data found that European carriers as a group lagged significantly behind U.S. and Asian carriers in both Total Factor Productivity and Cost of Inputs. The report concluded that European productivity could best be improved by increasing traffic density, and that a policy which would allow pricing and route freedoms would be likely to achieve this goal.[2]

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[1] Reed, Arthur. (1993, Jan.). What aviation liberalization? Air Transport World, p.64
World airline report. (1993, June). Air Transport World, p.68

[2] Windle, Robert J. (1991, Jan.). The world's airlines: a cost and productivity comparison. Journal of Transport Economics and Policy, pp.46-47

Legislation

Commission initiatives have taken the form of three legislative packages covering liberalisation, harmonization, infrastructure and external policy areas. Beginning in 1987, the first proposal addressed modest reductions in restrictions concerning air fares, capacity and market access. EC competition rules (Article 86 of the Treaty of Rome) were also made applicable to the air transport industry. The second package was approved in 1990, further loosening restrictions including the areas of multiple designations and Fifth Freedom rights. The latest liberalisation, implemented as of January 1, 1993, is the current focus of interest.

The Third Package completes the liberalisation of air fares, capacity restrictions and licensing. Airlines are now free to set their own fares, provided that they are not deemed "predatory" or excessively high as a result of being in a dominant position. All capacity limitations have been removed, except on routes with less than 30,000 passengers annually and new, small aircraft services. Licensing standards have been set for financial, technical and safety aspects. If a new applicant meets these standards, a member nation is required to approve the license. This eliminates the possibility of discrimination through excessively high standards.

Market access has also been greatly expanded. Member agreements which designated flying privileges to only two airlines, usually the flag carriers of each country, are now required to allow for multiple designations. Fifth Freedom[3] rights for members have been completely liberalised and Seventh Freedom[4] rights introduced. Cabotage rights[5] have

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[3] The right to pick up traffic during a foreign country stop-over and carry on to another country.

[4] The right to conduct purely foreign flight, originating in a foreign country and delivering to another.

also been implemented, but will be restricted until 1997 to "tag-end"[6] flights and less than 50% of the capacity on the route. The EC government views complete freedom of market access, including cabotage, as essential to creating a single market.

This, in summary form, is what the EC has legislated toward achieving its aims of a liberalised airline market in Europe. It is important to note that the three packages come in the form of Regulations, and as such, they have direct effect without further need for member state legislation.

FACTORS AFFECTING COMPETITION

In order to effectively create a unified air carrier market, the EC has had to address specific factors which are crucial in shaping the competitive environment. Five of the most important of these factors will be considered, including: integrating ATC systems, NATO and military airspace, airport congestion and slot allocation, government ownership and state aid, and mergers, acquisitions and alliances.

Air Traffic Control (ATC) Systems

It has been obvious that the heavily burdened European ATC system is a source of problems to the liberalised airline industry. Inability to handle increasing flight activity will act as a bottle-neck to expanding competition. At the time of the Third Package implementation 18% of European flights were being delayed by more than 15 minutes due to ATC

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[5] The right to fly between cities within a foreign country.

[6] Cabotage rights with the stipulation that the flight originate in the home country.

saturation.[7] These delays were costing airlines an estimated $4-5 billion each year.[8] Adding to the poor situation has been the forecast that demand for air transport will double by the year 2000 and triple by 2010 (see Appendix #1). The challenge facing EC legislators has been to come up with a plan to unify the system, increasing its efficiency and volume capacity.[9]

Attempts to change the system face tough technical and political problems. The current ATC network is very fragmented with 54 separate centres operating under 31 different systems. There are also differences in language and flight plan format. But getting member nations to give up control of air sovereignty has always proven to be a very sticky subject. For this reason, the EC has opted for harmonization of the current network over development of an entirely new, fully integrated one.

Objectives for European ATC harmonization were set out by the European Civil Aviation Conference (ECAC) in 1990. They include optimization of the current system in the near future, comprehensive radar coverage by 1995, and full integration of data communication between centres by 1998 (see Appendix #2). It is hoped that present capacity can be doubled through integration of existing systems and equipment.

The harmonization policy appears to be making substantive progress. Delays were reduced significantly in 1993. The busy London-Paris route was cited as an example where delays fell from 33 hours per month to 1.5. A trial project for ATC integration called Radar Data Interchange

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[7] Association of European Airlines - cited in: Hill, Leonard. (1993, Feb.). It's a private matter. Air Transport World, p.92

[8] Sparaco, Pierre. (1993, Jan. 18). Liberalization creates EC single airline market. Aviation Week & Space Technology, p.40

[9] Ibid. pp.39-40

Network (RDIN) is now operating. The network incorporates 10 civil and 6 NATO ATC centres in Germany, the Netherlands, Belgium and Luxembourg. Flow management consolidation has also been making significant progress. The task has been undertaken by Eurocontrol - an air navigation safety body comprised of 15 member states. The number of control centres has decreased from twelve in 1988 to five in 1993, and will be further reduced to one centre in Brussels later this year. Flight plan processing has been integrated to allow for central data storage and network distribution.[10]

By opting for the politically savvy policy of current harmonization with gradual integration, it appears the EC has soothed defense-sensitive fears and allowed efforts to be focused on tackling technical barriers.

The trend of the future in this field may well be the "privatization" of ATC agencies. Switzerland is currently the only European nation to have a fully privatized system (since 1921), but the German government recently announced that its agency must now be financially self-sufficient. As a result, ATC fees increased in that country by about 14% in 1993. Fee increases will inevitably occur across Europe as countries look for ways to pay for ATC upgrades. The new face of EC air traffic control could eventually be a federal system made up of ATC networks which have been restructured as commercial enterprises.

NATO and Military Airspace

The issue of NATO and military airspace is proving to be an obstacle to providing seamless ATC coverage and increased volume capacity. Inefficiencies arise from a lack of coordination between military and civil ATC units and military domination of large segments of airspace. The main

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[10] Hill, Leonard. (1993, Feb.). It's a private matter. Air Transport World, pp.88-92
Reed, Arthur. (1994, Feb.). Nurturing EATCHIP. Air Transport World, pp.67-69

problem areas are in France, Spain, Switzerland, and especially Germany. Five different air forces conduct operations in that country. Russian military aircraft have priority use of up to 60% of eastern German airspace until they pull out later this year. For Europe as a whole, military operations account for roughly 10% of all flights.

Only limited progress has been made in this area. The two ATC systems are intended to be gradually integrated by 1996 but so far, the only example of this has been the 6 NATO ATC centres which have been incorporated into the trial RDIN project. European governments have asked for and received reductions in military airspace use, but only by about a third of requested levels.

Any future developments in this area are likely to be guided by the ongoing debate surrounding NATO's changing role in the future. Reductions in military presence will be tied to stability in the former East Bloc and increasing budgetary constraints. Only as these factors progress will the civil air industry be able to benefit from more efficient use of airspace. Perhaps in time, the system of military priority will be replaced by the examples seen in Denmark and Sweden of optimal coordination.

Airport Congestion and Slot Allocation

One of the most common concerns surrounding liberalisation is that it will allow for increased competition in theory, but that it will not be possible in reality because there is simply no room for more airlines and air flights. A lack of suitable airport facilities and attractive flight slots will prevent the start-up of major new competition, and without it, there will be less reduction in fares.

A recent International Air Transport Association study predicted that 16 major European airports will reach capacity by the year 2000 (see Appendix #3). In the past two decades only two new airports have been built, Paris/ Charles de

Gaulle and Munich 2.[11]

The long-term nature of airport infrastructure development makes it difficult to conduct a meaningful evaluation of advancements over such a short period. However, the EC would be well advised to actively encourage airport construction and terminal expansion projects such as the one going on at Amsterdam/ Schipol.

Concerning take-off and landing slots, the EC has been following a cautious approach to change. The current allocation system is based on "grandfather rights." A carrier which held designated slots during the past year continues to have first priority in obtaining those same privileges for the following year. The Commission initially proposed re-allocating a set number of slots from current holders to new entrants. But this proposal was met by strong opposition from the established carriers and a majority of their governments. So for now, an interim regulation has been put in place which designates half of all opening-up slots for new entrants (those with less than four slots per day), to a maximum of four additional slots per day. This modest allocation does not allow a high level of flexibility for new competition. The EC's intention is to develop a system based on national neutrality in which air carriers are not allowed to carry over unused slots.

If there is to be a level of competition significant enough to bring about real consumer benefits, the slot allocation system must become more progressive. This factor appears to be a shadowed area where political stakes dig in safeguards against the threatening possibilities of real competition. If deliberate re-allocation proves to be an unobtainable task, then the benefits of increased slots derived from a more efficient ATC system should be directed towards new competition. Dynamic competitors like British

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[11] Sparaco, Pierre. (1993, Jan. 18). Liberalization creates EC single airline market. Aviation Week & Space Technology, p.40

Midland, which has access rights to numerous cities but can not obtain enough slots into all of the airports, would gladly make use of the opportunities.

Government Ownership and State Aid

As the Third Package was implemented on January 1, 1993, 11 of the 12 EC flag carriers were partially or fully government-owned (see Appendix #4). There has been a fear that increasing competitive pressures will result in a government subsidy race, distorting fair competition. For this reason, the Legislation ensured that the Commission has adequate power to control state aids.

Subsidies are not permitted if they are granted to cover operating losses. They must also not contravene Article 92 of the Treaty of Rome which disallows aid that distorts competition. Cases in which the Commission would permit aids include, subsidies for regional flights provided they are not used to cross-subsidize international flights, public service on some regional routes, and potentially viable turnaround strategies. Governments are permitted to continue providing capital, loans, and guarantees to their carriers as long as private investors would hypothetically do the same.[12]

Based on examples over the past two years, it appears that the Commission is taking a sympathetic stance towards the issue of state aids. Air France (AF) received approval for $988 million in aid from its government during 1991 and 1992. Losses in the following year totalled $1.2 billion. It is expected that the French government will request EC approval for an additional $856 million in aid during this year. Other cases of affirmative EC rulings have come with conditions attached. Spain's Iberia airlines received a $1.165 billion bail-out but was told not to use any of the money to buy other airlines. The Commission also said yes to a major rescue plan of Sabena that involved a 35% buy-in by

[12] Feldman, Joan M. (1992, Dec.). Transatlantic zigging and zagging. Air Transport World, p.74

AF accompanied by a large amount of aid from the Belgian government. The deal was approved on the condition that there not be any more aid given.[13]

The EC looks to have its hands full in the near future with applications for aid injection by other flag carriers. Late last year, proceedings began to consider a $260 million capital investment by the Irish government into Aer Lingus. The Commission must decide if the restructuring effort is a viable one, coming within the private investor principle. Other airlines lining up for aid approval include AF (as mentioned above), Greece's Olympic Airways and Portugal's TAP.[14]

There are numerous reasons why the removal of state aids is not going to be a clear-cut process. Governments and their airlines have always worked in close cooperation in the past. For some of the more conservative states like France and Italy, it is going to take time to change ideas about the way things are done. The French Transport Minister recently gave his opinion that EC initiatives are being based on the assumption of a strong politically unified Europe that does not yet exist. He also said that French public opinion would reject the notion of stronger carriers destroying others (ie. Air France).[15] Differing stances such as French conservatism and British pro-market support may continue to paralyse attempts toward real liberalisation. Hidden subsidisation is another real problem. In some countries, like Spain, airport management is state-run and gives a discount to Spanish airlines. The Commission is going to have to face both up-front political opposition and built-in national biases in order to achieve a level playing field for

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[13] Ibid. p.74

[14] State aids -- and Aer Lingus. (1993, No.4). European Trends, p.17

[15] Cited in: Sparaco, Pierre. (1994, Feb. 21). France resists wise men's report. Aviation Week & Space Technology, p.41

fair competition.

One development which is being predicted for the future and will help the EC to obtain its objectives is a trend toward privatisation. Governments are tiring of bailing-out airlines during a time when deficit reduction is gaining importance. Since the Act was passed, the Belgian government has reduced its stake in Sabena from 88% to 26.7%, and the German government has announced that it intends to reduce its holdings of Lufthansa. British Airways is probably the best example of what is possible, being the only fully privatized EC carrier and posting the highest operating profits.

Privatisation will most certainly lead to improved European carrier productivity. The report by Windle found that, "The European firm has 10.5 per cent higher unit costs as a result of government ownership. This effect is the result of excessive use of inputs (often labour) to produce an equivalent quantity of output."[16] He concludes that privatisation could eliminate this inefficiency.

Mergers, Acquisitions and Alliances

Through the early part of this decade, the prevailing expectation was that there would be a marked increased in European airline mergers, acquisitions and alliances. The main reason for this prediction was the attitude that only big carriers with economy-of-scale advantages would survive a shake-out in the industry. This same attitude could be seen globally in the trend toward world-airline networks. Some European airline executives were predicting that no more than five European carriers would survive by 1995, and that eventually there would be perhaps a dozen global "mega" carriers.

Given these prevailing forecasts, it is interesting to note that the EC has not yet adopted a formal merger policy.

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[16] Windle, Robert J. (1991, Jan.). The world's airlines: a cost and productivity comparison. Journal of Transport Economics and Policy, p.47

Rather, the Commission has been given certain powers concerning regulation and it utilizes these on a case-by-case basis. The Commission has the power to bar mergers or impose specific requirements in cases which might potentially lead to abuse of a dominant position. However, determining what is a dominant position, and what constitutes abuse of such a position, are tasks which are susceptible to highly controversial debate.

Two examples illustrate the range and flexibility of the Commission's powers. In 1990, British Airways (BA) and KLM held discussions aimed toward achieving a merger arrangement. Their plans included taking a controlling interest in financially troubled Sabena airways. But the EC objected to this arrangement and the plans were eventually scrubbed. Two years later, to the frustration of BA, Air France received approval for its buy-in of Sabena. The second example involves AF's acquisition of domestic rivals UTA and Air Inter. The EC gave its approval under condition that the flag carrier sell its 35% stake in Transport Aerienne Transregional (TAT), and that the French government license new competition on certain routes. Having retained ownership in TAT would have given AF control over 97% of French air traffic. BA has subsequently acquired 49.9% of TAT. Operating under a joint name, the BA/TAT team provides the only real competition to AF inside France.

For now, the cases of airlines combining operations have been mainly limited to expanding relationships between major and regional carriers (see Appendix #5). There is still too much national pride and allowances for state aid to be seeing outright mergers between flag carriers. Considering the case of deregulation in the U.S., the major airlines there did not bring about complete restructuring until approximately six years after legislation changes had been implemented. It is likely that the full affect of the Third Package on European carrier restructuring and consolidation will not be realized for a few years to come.

Alliances appear to be the preferred plan of action amongst the majors. Lufthansa Chairman Jeurgen Weber outlines the benefits:

> Alliances could improve profitability, expand networks and split costs of operation. They could overcome cultural differences, safeguard identity and provide flexibility for both customers and airlines.[17]

The partnership deal being discussed between Austrian, KLM, SAS and Swissair called Alcazar was one of the most significant developments arising from the liberalisation act. The plans called for the four companies to merge operations by 1997, creating Europe's largest airline with a 20% share of the market and total sales of $13 billion (US). But the deal came apart late last year. KLM managing director Leo van Wijk commented that the breakdown in negotiations was the result of different perceptions of what the partnership needed to survive:

> Austrian and SAS are Europe-focused airlines and had difficulties understanding why the issue of a U.S. partner should cause the break. We felt that the goal of Alcazar was not just to form a European carrier. We saw it as a stepping stone to a global system.[18]

KLM insisted on Northwest (49% KLM-owned) being the US partner, while the other three wanted the more financially solid Delta. The end result of the break-down is a loss of an estimated $1.3 billion in synergies and one less major European competitor in the global arena. Austrian, SAS and Swissair are expected to strengthen their previous alliance in the short term and to seek out partners from one of

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[17] Quoted in: Shifrin, Carole A. (1993, March 15). European airlines to enter 21st century with new look. Aviation Week & Space Technology, p.68

[18] Quoted in: Reed, Arthur. (1994, Jan.). The tumbling of Alcazar. Air Transport World, p.34

Europe's "big three" carriers for long term survival. KLM's response has been different, demonstrating a changing view toward liberalisation:

> We have two policies - to seek strong internal growth and to find a European partner. We have overachieved growth in the last couple of years. The partnership strategy was developed at a time when European liberalisation was not finalized. A year ago, it looked as if it would take place rapidly but there is now a slowdown in the process, and some people think there is a standstill or a reversal. Against this background, the need to find a partner is not as urgent as a year ago[19].[20]

The break-up of Alcazar must be seen as a blow to the EC goals of increased competition and stronger European forces in the world airline industry. The four-carrier group comprised a truly pan-European face, rather than a regional bloc, and would have proved a fair match against the other major competitors. If these carriers are eventually absorbed by the likes of BA, AF and Lufthansa, the end result may be a reduction in the level of intra-European competition as the surviving giants establish their own fiefdoms.

HOW COMPETITION HAS BEEN AFFECTED

When business travellers were asked how they thought liberalisation was going to affect competition, nearly 70% predicted that air fares would come down. Just under half said they expected to see a greater frequency of flights and more choice of airlines (see Appendix #6). This is exactly what the EC has said it hopes will happen, but what have been the results thus far?

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[19] Leo van Wijk, quoted in: Ibid. p.34

[20] Ibid. pp.33-34

Route Operations

The Third Package dramatically increased route access by establishing full Fifth Freedom rights, imposing multiple carrier designations on all member bilateral agreements, and introducing Seventh Freedom and cabotage rights. However, predictions have been made that these new rights would not be substantially used in the near future. The reasons given included: the fact that Europe is in a recession and there is not a lot of expansionist tendencies among the airlines, the difficulty of marketing such services in foreign countries, and the competitive advantages enjoyed by "native" carriers.

During 1993, European carriers began to slowly experiment with these new route privileges. Some specific examples include the following:

ROUTES: NEW IN 1993			
5th Freedoms			
AIRLINE	DEPART	TO	DESTINATION
British Airways	London	Turin	Saloniki
BA/TAT	Paris	Munich	Copenhagen
	Paris	Munich	Stockholm
SAS	Copenhagen	Brussels	Lyon
	Copenhagen	Stuttgart	Thessaloniki
Cabotage			
British Airways	London	Hannover	Leipzig
Lufthansa	Munich	Rome	Bari
	Frankfurt/ Munich	Genoa	Naples
	Frankfurt/ Munich	Naples	Palermo
SAS	Copenhagen	Hamburg	Leipzig

Liberalisation of Fifth Freedom rights has also been greatly utilized by the peripheral state carriers of Portugal and Ireland to establish hubs in other countries, such as Aer Lingus' hub at Manchester airport.

Specific information regarding flight frequencies has proven to be more difficult to obtain than new route destinations. But an Airlines of Britain survey conducted at the end of 1992 found that frequencies of flights on routes entered by new airlines increased by up to 11 times more than on routes of similar size which did not have a new competitor.[21] The fact that overall boarding and passenger capacity in Europe were each up by about 12% during 1992 further signals that airlines increased their frequencies in anticipation of an opened market.

The Commission has sufficiently opened up route access to the point where it will take carriers several years to fully explore all of the new possibilities. It appears that at least some airlines are ready and willing to experiment with new route combinations to increase their coverage and discover niche markets. However, these signs of increasing competition are still modest when compared to the amount of opportunity granted by the Legislation. The problems outlined earlier regarding airport congestion and slot allocation continue to hamper airlines' plans in this area. Future developments in route operations will be affected most significantly by mergers and alliance which come about, and also to a lesser degree by increasing competition from high-speed trains on shorter routes.

Air Fares

The high visibility and direct benefit to consumers of reduced air fares has made them a popular gauge of liberalisation success. Many of the airlines ushered in the

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[21] London School of Business survey, cited in: Reed, Arthur. (1993, Jan.). What aviation liberalization? Air Transport World, pp.64-65

changes of 1993 by offering temporary seat sales of up to 50% off. But an examination of the overall picture in the past 18 months does not produce such a rosy picture.

A 1992 private report of the EC's air transport policy found that, "The scope for fare reductions in the earlier two packages did not lead to significant fare reductions, partly because the necessary competitive conditions did not exist."[22] The report went on to say that the Third Package proposals should stimulate competition from new entrants, possibly resulting in significant fare reductions.

A review of air fare changes to June of 1993 reveals that fares have come down on four of the busier routes, from London/ Heathrow to Paris, Dublin, Amsterdam and Frankfurt (see Appendix #7). The reason for this is the aggressive pricing strategy of British Midland Airways (BM). The company, whose fares have usually been about one-third cheaper than other carriers, introduced a new business-class service with fares 9-43% lower than its competitors. However, on all of the other routes reviewed, prices either remained the same or increased.

The results demonstrate a trend that air fares decrease only when a new (third) competitor enters the route. In the cases mentioned above, BM has been a strong competitor, developing low price strategies from a solid financial foundation. Weaker entrants may be unwilling or unable to offer fares below the existing structure, thus not affecting positive fare benefits.

There is also evidence that weaker carriers are engaging in cross-subsidization strategies. AF is an example. It increased prices on flights from Paris to Madrid, Frankfurt, Amsterdam, Rome and Milan, where no new competitors emerged. The company may be hoping to maximize profits on these routes in order to make up for lower prices on the highly

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[22] Lewis, Claire Simone. (1992, No.2). EC air transport policy: Third Package proposals for liberalisation. European Trends, p.45

competitive Paris-London route. Looking at healthy BA, it also reduced fares on three highly competitive routes, but did not raise them on a number of other routes where dual competition was unchanged.

The liberalisation of air fares is going to continue providing an environment where some carriers can cross-subsidise their operations until the degree and distribution of competition increases. For example, the introduction of BA/TAT flights on a number of AF routes should produce price-cutting pressure.

There are a number of other factors besides competition which will have an impact on air fares. Higher ATC fees and the introduction of Value-added Taxes (VAT) on intra-EC flights will cause direct upward pressure. Airlines may also bump-up their prices to compensate for the loss of important revenue from on-board duty free sales, which have now been abolished. Better utilization of aircraft through Fifth Freedom and cabotage rights may lead to lower cost and price benefits.

CONCLUSION

The mixed picture of success seen in the area of air fare reductions corresponds with the liberalisation process as a whole. There are some areas of advancement, such as ATC harmonization and new route experimentation, but these are modest when compared with the overall pool of issues. Political differences remain the largest obstacles to achieving increased fair competition.

The Third Package has laid-out a solid framework for achieving the EC objectives of increased airline competition, consumer benefits and European competitiveness. However, progress towards liberalisation will continue to be linked to the pace of European unification as a whole and the creation of a level playing field in the area of social policy.

TABLE OF APPENDICES

1. Annual Traffic Growth Trends and Forecasts
Source: Reed, Arthur. (1994, Feb.). Nurturing EATCHIP. Air Transport World, p.68.

2. ECAC's Targets (ATC Objectives)
Source: Reed, Arthur. (1994, Feb.). Nurturing EATCHIP. Air Transport World, p.68.

3. Congested Airports
Source: Will Europe's crowded airports strangle competition at birth? (1990, April 14). Economist, p.70.

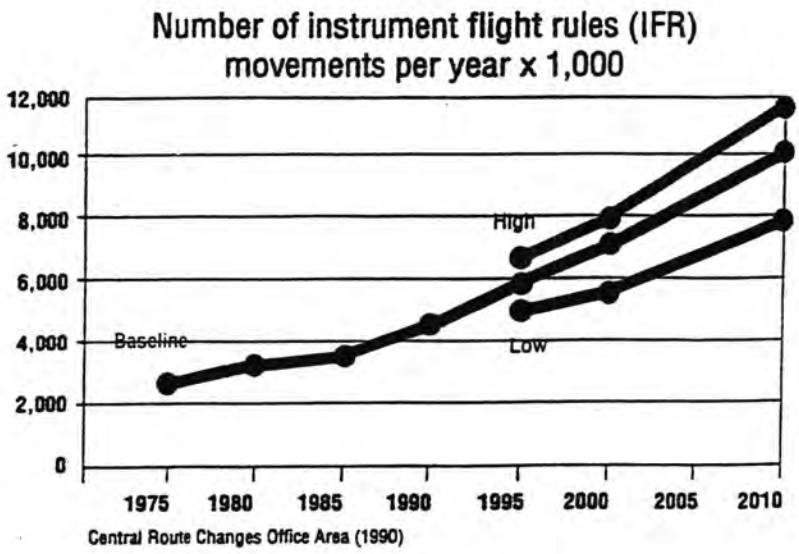
4. On a Wing and a Prayer (Government Ownership)
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5. Examples of European Acquired Holdings

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Source: MORI Survey, cited in: Reed, Arthur. (1993, Jan.). What aviation liberalization? Air Transport World, p.64.

7. How Liberalization Affected Fares
Source: Reed, Arthur. (1993, Sept.). E.C. liberalisation: Getting a toe in. Air Transport World, p.54.

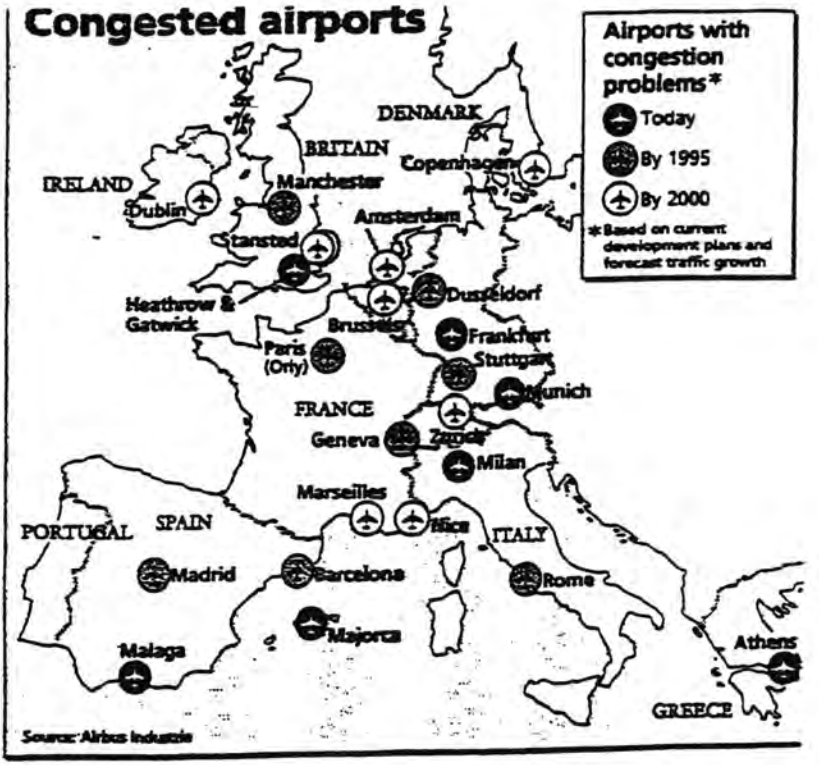
ANNUAL TRAFFIC GROWTH TRENDS AND FORECASTS



ECAC'S TARGETS

ATC operational objectives targeted throughout the 32-nation European Civil Aviation Conference (ECAC) area:

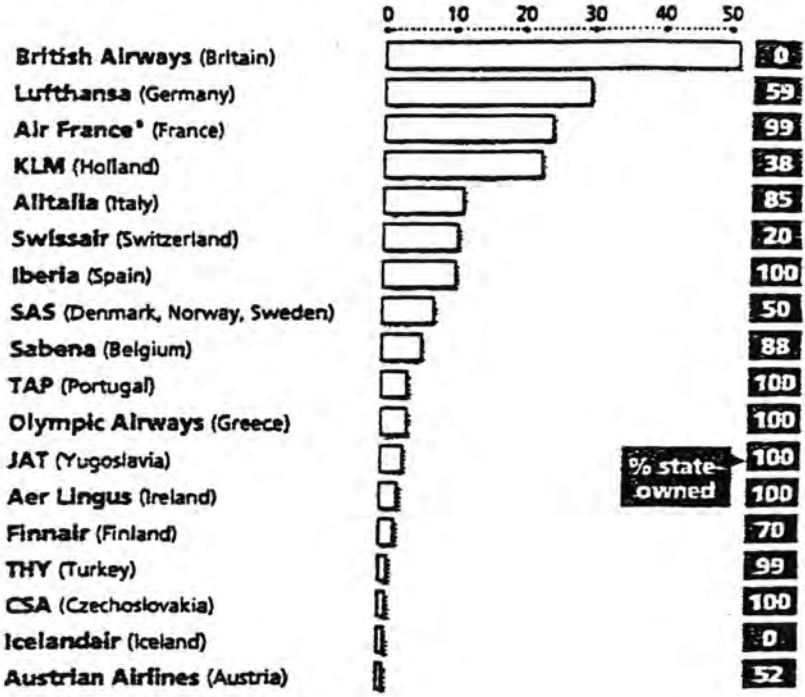
- **1993 onward:** Air traffic services route network and airspace structure to be optimized, supported by a widespread application of area navigation.
- **1995:** Completion of comprehensive radar coverage throughout the continental ECAC area. En route radar separation of 5 nm to be applied throughout high-density areas; separation of 10 nm elsewhere. ATC systems to be integrated progressively after being harmonized in the high-density areas; by no later than 1998 elsewhere.
- **1998:** Automatic data communication between ATC centers completed.
- **1998 onward:** Mode S air/ground datalink operational in a central area.


Congested airports
Airports with congestion problems*
Today
By 1995
By 2000
*Based on current development plans and forecast traffic growth
DENMARK
BRITAIN
IRELAND
Copenhagen
Manchester
Dublin
Amsterdam
Stansted
Düsseldorf
Heathrow & Gatwick
Brussels
Frankfurt
Paris (Orly)
Stuttgart
Munich
FRANCE
Geneva
Zurich
Milan
Marseilles
Nice
PORTUGAL
SPAIN
ITALY
Madrid
Barcelona
Rome
Majorca
Malaga
Athens
GREECE
Source: Airbus Industrie

On a wing and a prayer

Europe's top airlines

Passenger kilometres (billion) on scheduled long-haul services, 1990



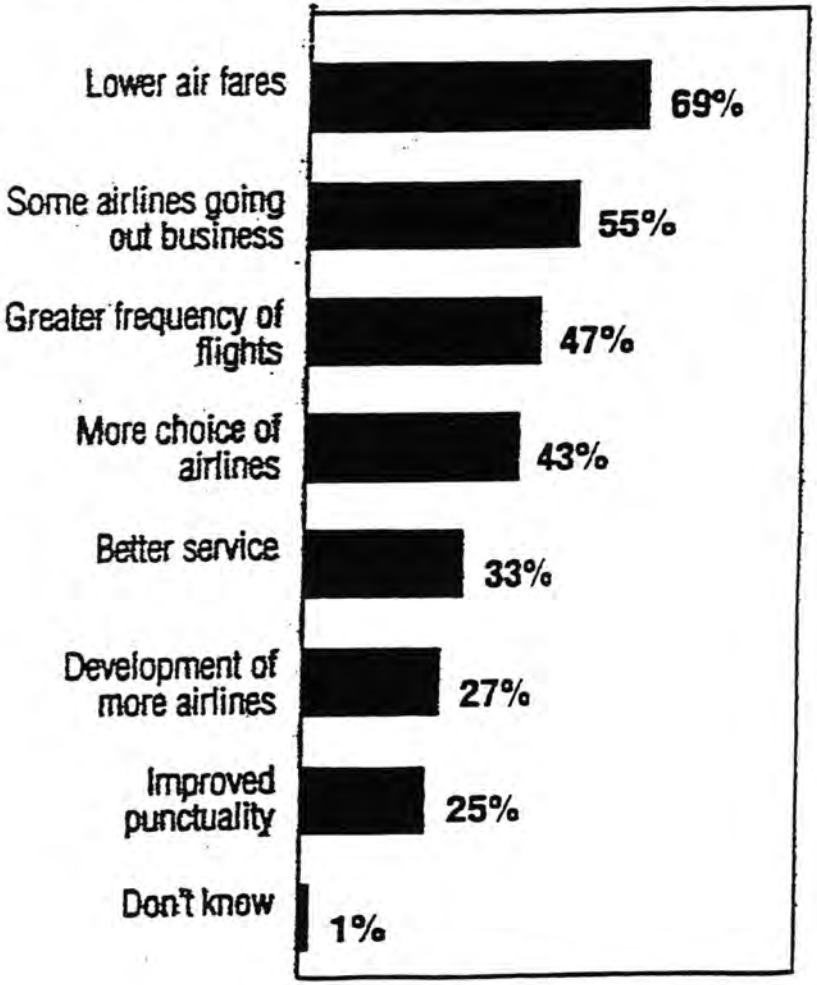
Sources: Association of European Airlines; company reports

*Includes UTA

EXAMPLES OF EUROPEAN ACQUIRED HOLDINGS

Air France	- 100% UTA and Air Inter 40% ($60M) CSA (Czechoslovakia) 35% ($180M) Sabena
Alitalia	- 35% ($100M) Malev (Hungary)
British Airways	- 49.9% TAT (option for remainder in 1997) 49% Deutsche B.A. others: Dan-air, Air Russia
Lufthansa	- DHL International ($400M, joint with Japan Air Lines) Lauda Air (Austria)

EXPECTED RESULTS OF DEREGULATION



HOW LIBERALIZATION AFFECTED FARES

Lowest fully flexible return fares

		October 10, 1982	June 6, 1983
Heathrow-Paris	BM	£286	£240
	BA	£316	£240
	Air France	£316	£240
Heathrow-Dublin	BM	£230	£230
	Aer Lingus	£258	£230
Heathrow-Amsterdam	BM	£236	£204
	BA	£274	£204
	KLM	£274	£204
Heathrow-Frankfurt	BM	—	£330
	BA	£366	£364
	Lufthansa	£366	£364
Heathrow-Brussels	BM	£246	£258
	BA	£304	£304
	Sabena	£304	£304
Paris-Milan	Air France	£518	£528
	Alitalia	£518	£528
Paris-Rome	Air France	£728	£748
	Alitalia	£728	£748
Heathrow-Rome	BA	£524	£524
	Alitalia	£524	£524
Heathrow-Milan	BA	£416	£416
	Alitalia	£416	£416
Paris-Amsterdam	Air France	£346	£359
	KLM	£346	£359
Paris-Frankfurt	Air France	£374	£381
	Lufthansa	£374	£398
Heathrow-Munich	BA	£436	£436
	Lufthansa	£436	£436
Heathrow-Dusseldorf	BA	£294	£294
	Lufthansa	£294	£294
Paris-Madrid	Air France	£566	£578
	Iberia	£566	£578
Heathrow-Copenhagen	BA	£452	£452
	SAS	£452	£452

BA-British Airways; BM-British Midland. Figures courtesy Airlines of Britain Group.

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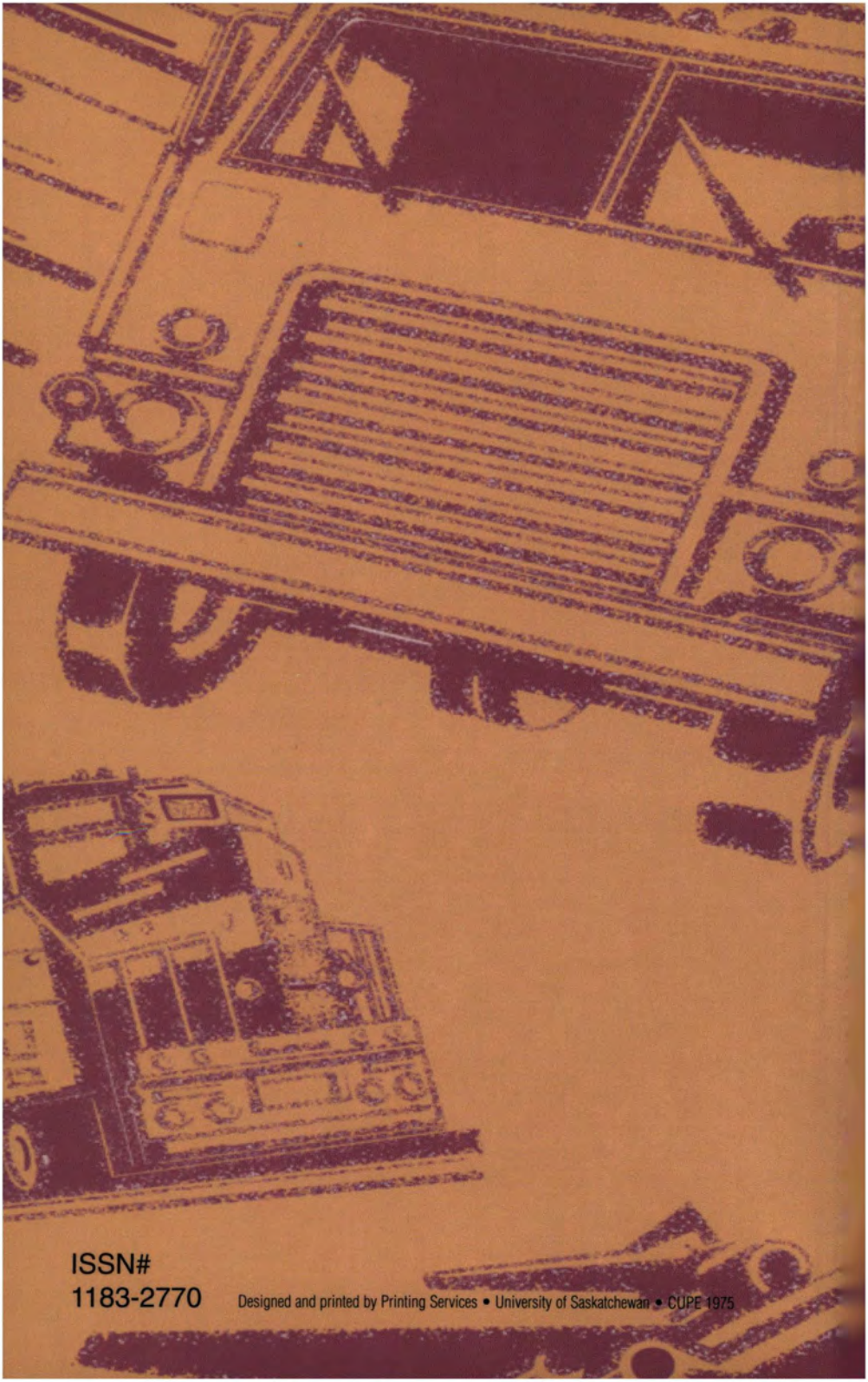
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