Transportation Visioning - 2002 and Beyond

PROCEEDINGS
of the 37th Annual Conference

Vision d'avenir des transports - 2002 et au-delà

ACTES
de la 37è Conférence annuelle

St. John's, Newfoundland May 12-15 mai 2002

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



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President's Message

Welcome to the 37th Annual Meeting of the Canadian Transportation Research Forum!

The conference theme, Transportation Visioning - 2002 and Beyond, was selected in an effort to prompt us to step back, look at the big picture, and try to understand where our industry is headed and what we might do to influence its path. In the wake of global events, the CTA Review, and as we look forward to the development of a national Transportation Blueprint, we can expect many changes.

This year's St. John's team, lead by Doug Shea and Harold Hefferton, has put a tremendous amount of effort into shaping both the forum's content and setting the ambience for a memorable meeting. Doug who works for the Newfoundland and Labrador Department of Works, Services and Transportation has taken on the role of VP Meetings while Harold who is with Transport Canada, has undertaken the duties of VP Program and Publications. We are deeply indebted to Doug, Harold, and their support team for their efforts. Hosting our annual conference is no small task.

These proceedings serve as a more permanent record of some of the discussions during this conference. Summaries of the Plenary Session, Debate, and panel sessions will follow through our newsletter, Forumation, and will be posted on our website at www.ctrf.ca. We are grateful to those authors, speakers, debaters, panelists, session chairs, and audience participants who collectively interact to exchange many interesting ideas and concepts.

Our conference has always strived to achieve a blend of technical and social content to meet our primary goal –the free and open exchange of ideas. It is our hope that you come away from this conference refreshed with new ideas and different perspectives, old friendships renewed, new friendships begun, and a stronger sense of community with your industry peers. Ideas are great, but let's move those ideas forward to affect change.

You will see a list of conference sponsors on a subsequent page. Without their contributions this meeting would not have been

possible. On behalf of the Board of Directors and our members – thank you.

It has been an honor to serve this year as president. I take away more than I could have ever given.

Kindest regards,

Eric Hildebrand, PhD, PEng
President

Message du Président

Bienvenue à la 37è Conférence annuelle du Groupe de recherches sur les transports au Canada!

Le thème de la conférence, *Vision d'avenir des transports – 2002 et au-delà*, avait été sélectionné avec la volonté de prendre du recul, de jeter un regard d'ensemble sur la situation, de comprendre la direction que notre industrie s'apprête à prendre et d'identifier ce que nous devrions faire pour influencer une telle évolution. Dans la foulée d'événements majeurs, dont l'examen de la Loi sur les transports au Canada et l'élaboration d'un Plan directeur des transports, nous pouvons nous attendre à de nombreux changements.

Cette année, l'équipe de St-Jean, TN, menée par Doug Shea et Harold Hefferton, a fourni de formidables efforts pour à la fois concocter le contenu du forum et offrir l'ambiance d'une rencontre inoubliable. Doug, qui travaille pour le ministère des Travaux publics, des Services et des Transports de Terre-Neuve et du Labrador, assume les tâches de VP-Conférence, alors que Harold, de Transports Canada, occupe le poste de VP- Programme et publications. Nous sommes profondément redevables à Doug, à Harold,et à leur équipe de soutien pour leurs efforts. Accueillir notre conférence annuelle n'est pas une mince affaire.

Les présents Actes servent à conserver de manière plus stable certaines des discussions tenues durant cette conférence. Le résumé de la séance plénière, le débat et les échanges en ateliers suivront dans notre bulletin d'information, *Forumation,* et

apparaîtrons à notre site Web, *www.ctrf.ca*. Nous sommes reconnaissants à tous les auteurs, orateurs, panélistes, présidents de séances et participants qui ont échangé collectivement sur de nombreux idées et concepts.

Notre conférence s'est toujours efforcée de parvenir à un dosage adéquats des contenus technique et social en vue d'atteindre notre premier objectif, à savoir l'échange d'idées libre et ouvert. Nous entretenons l'espoir que vous retournerez de cette conférence avec la fraîcheur d'idées nouvelles et de perspectives différentes, de vieilles amitiés renouées, du début de nouveaux liens amicaux et un sens plus fort de la communauté avec vos pairs. Si les idées sont grandes, tâchons de les pousser pour influencer le changement.

Vous remarquerez la liste des commanditaires dans une des pages suivantes. Sans leur contribution, cette rencontre n'aurait pu être possible. Un grand merci au nom des membres du conseil d'administration et de nos membres.

Ce fut pour moi un honneur de servir cette année à titre de président. J'en retire plus que tout ce que j'ai pu apporter.

Sincères salutations,

Eric Hildebrand, PhD, ing.
Président

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

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- 2003 CTRF ANNUAL CONFERENCE TO BE HELD IN OTTAWA, ONTARIO
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Economic Impact of a New Airport Terminal Building: An Ex Ante Assessment

Barry E. Prentice, Director and J. Jurgens Bekker, Research Associate
Transport Institute, University of Manitoba

Introduction

The creation of Canadian Airport Authorities has coincided with the investment cycle for many airport terminal buildings. Vancouver and Edmonton have completed new terminals. Toronto and Ottawa have renewals underway, and many other airports are in the process of initiating or planning such developments. New airport terminals are planned according to projected passenger requirements, but also contribute to civic pride, and inject a significant boost to the local construction economy.

This article reports the economic impact of a new airport terminal at Winnipeg. The project definition and methodology are presented with a discussion of some unreconciled conceptual issues.

Project Definition

Economic impact assessments (EIA) investigate benefits to society from a specific activity, but address neither economic efficiency, nor the feasibility of a capital investment project. Investment decision-making on a risk-return basis requires a comprehensive benefit-cost study.

The Winnipeg International Airport terminal construction envisions three phases. The economic impact continues for the duration of construction, but terminates once the final stage is completed. This paper does not address ongoing economic activity that may result from retail and concession opportunities upon completion of the newly constructed terminal.

Figure 1 presents an artist's rendition of the terminal building. The phases are numbered in order of construction, although it may be possible to accelerate consecutive phases. Also, the car park could be built prior to initiating the terminal building.

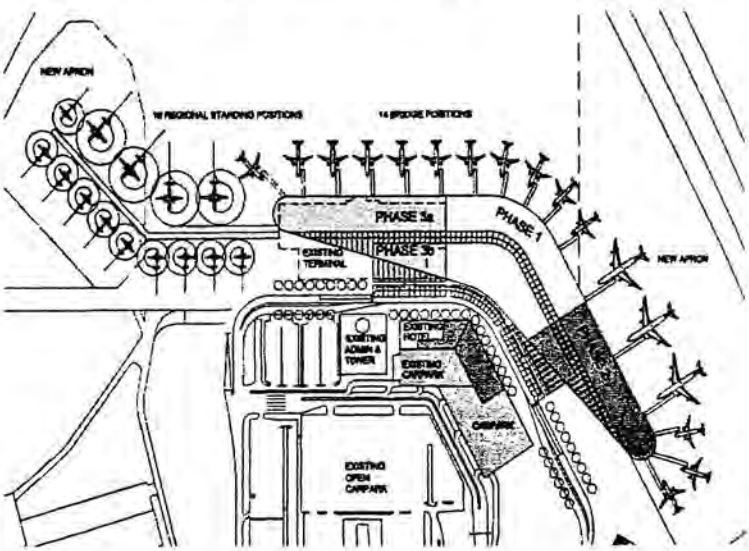


Figure 1: Artistic rendition of the terminal building (courtesy of WAA).

The direct expenditure for each phase depicted above is shown in Figure 2. The expenditures of $135 million, $76 million and $78

million for phases 1, 2 and 3 respectively aggregate to an approximated total direct expenditure of $290 million.

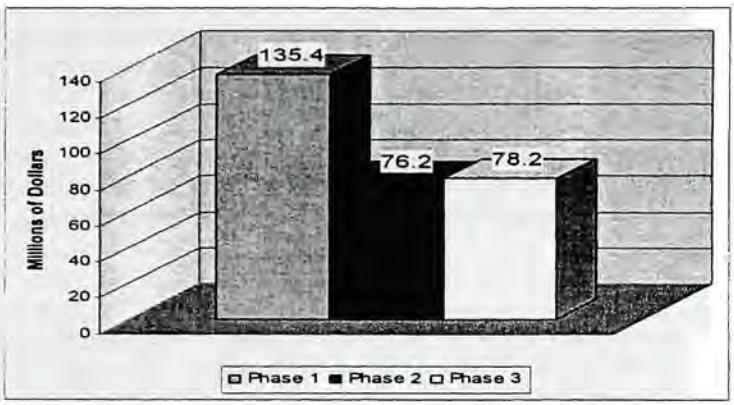


Figure 2: Direct expenditure in each of phases 1 to 3.

The majority of construction occurs in phase 1. These estimates include construction of the new domestic facilities of the airport terminal building (ATB), expansion of bridges and apron areas, and the car park and associated roadwork. Phase 2 consists of the international/ transborder component of the ATB and an apron expansion. The existing terminal building is located on the proposed site for phase 3. Demolition of the old terminal building precedes components 3a and 3b that would provide domestic and regional service.

Methodology

An EIA can be visualized as either an ongoing flow in economic activity (total airport activity), or a surge in the flow of economic activity (contribution to stock of airport infrastructure). An airport terminal construction project that is a contribution to the stock of infrastructure represents the second type of EIA. In a construction

project, the EIA considers only the resources needed to create the structure.

Total economic impact includes direct, indirect and induced effects. The direct effects are a consequence of construction. Firms predominantly contributing to the direct impact are visibly involved with the project. Indirect effects follow from increased (or decreased) demand on suppliers of directly impacted firms. Induced effects refer to a change in consumer spending resulting from the project. Economic multipliers are used to estimate the induced impact.

Multipliers

Economic multipliers measure the ratio of the sum of successive rounds of spending to the original expenditure. In a closed economy, if the marginal propensity to spend were 50%, then $1.00 worth of original spending would lead to the following progression: $1 + $0.50 + $0.25 +...+ $0 = $2.00. In its simplest form the multiplier is the reciprocal of the marginal propensity to save, i.e., $1 \div 0.5 = 2$. Savings extract money from the spending stream and therefore diminishes the value of the multiplier (Khan, Phang and Toh, 1995). In an open economy such simple multipliers cannot be used because of trade leakages.

Strong industry and sectorial linkages in an economy contribute to greater direct, indirect and induced effects and consequently to larger multipliers. Generally, territories with small economies, functioning with a market driven foreign trade regime, have less intra-territorial industry and sectorial linkages and hence have lower multipliers than territories with larger economies. The magnitude of the multiplier is a function of the local value added by the activity. Although project expenditure may be high, if the amount of value added from that activity is small, then the multiplier will be small. The converse also applies.

Economic multipliers for Manitoba were obtained from the Manitoba Bureau of Statistics (MBS). These ratios are derived from the

Manitoba Bureau of Statistics Economic Impact Assessment Model. Multipliers that account for the leakages to imports and exports are defined as intensity ratios. Commodity intensity ratios measure the total economic impact based on the direct purchase of a commodity. The gross value is adjusted by the intensity ratio to determine the net impact that actually contributes to the base of the local economy.

Intensity ratios were used to determine the total economic impact in terms of GDP, labour income (both measured in Canadian dollars), and Manitoba employment (measured in person-years (PY)). The impact on GDP at factor cost represents the net monetary benefit to provincial industries. GDP at factor cost does not include transactions at the intermediate stages of production, taxes or subsidies. The inclusion of intermediate transactions would constitute "double-counting" and the results would be inflated.

Although the project spans many years, no deflation of costs or discounting for time value of money were needed for future years. This is an ex ante economic impact assessment. All costs are order of magnitude estimates based on preliminary designs in year 2000 dollars.

Treatment of Demolition and Residual Value

The existing terminal building has a residual value, but may require additional investment to serve a new use. The literature on economic impact studies offers scant guidance on residual values. The residual value could be deducted as an opportunity cost from the economic impact of the new building. Normally this is not done. Ironically, current methodology counts the demolition of the existing building with the total economic impact of constructing the new terminal and allows nothing for the residual value.

The value of the old terminal building is debatable. The residual value would decline with the delay in demolition, and with the additional investment required for its rehabilitation. In this study, opportunity cost of the old building is entirely omitted from

calculations. Consequently, the net contribution to the base of the Manitoba economy may be overestimated by the unaccounted value lost with demolition of the old building.

Figure 3 shows the location of the existing terminal relative to the proposed terminal building. The coordination of demolition with the phases of construction is also illustrated.

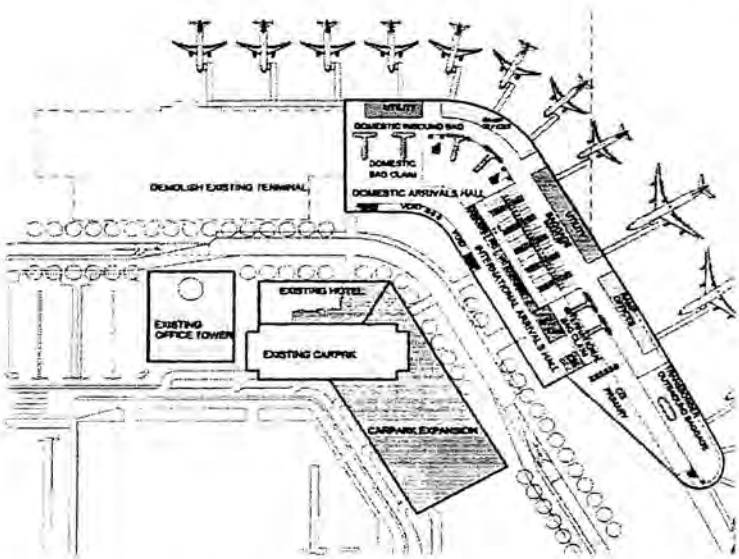


Figure 3: Artistic rendition of the location and planned stage for demolition of the old terminal building (courtesy of WAA).

The demolition of the existing terminal is projected to be undertaken in the final phase of construction. The flexible design enables the airport to extract maximum useful like of this asset. Moreover, it is possible that the final phase could be delayed much longer than anticipated, such as to render the residual value negligible.

Treatment of Tax Collections

The taxes created by a construction project are not an economic impact in the strictest sense. They are simply a transfer of wealth between groups of society. At the same time, taxes are important because they represent a tangible gain to the governments of economic activity, and may help the proponents to obtain other considerations.

Estimation of the federal, provincial and local taxes collected is limited by availability of data. The projected budgets aggregate material and labour costs, as well as costs for various commodities on a functional or task basis. Consequently, a sophisticated treatment is rendered unusable.[i]

Results

Economic Growth, Labour Income and Employment

Table 1 presents the total economic and employment impact of all phases from the proposed project total expenditure of $290 million. The GDP at factor cost (exclusive of indirect taxes and subsidies) as a measure of the net monetary impact to industry is estimated to increase by $222 million. Provincial labour income is estimated to increase by $172 million. The project is estimated to create 4,493 person-years of employment. These effects accrue throughout all phases of the project.

The greatest benefits accrue in phase 1. This phase entails the construction of new domestic facilities and expansion of bridges and apron areas. The estimated impacts are $102 million on provincial GDP at factor cost, $79 million on labour income and more than 2,000 person-years of employment. This represents 46 percent of the project's total economic impact. Phase 2 involves the new U.S. and international facilities and the expansion of bridges and apron areas. Phase 2 yields 26 percent of the total economic impact with a total

contribution of $58 million to provincial GDP at factor cost, $45 million in labour income and nearly 1,200 person-years of employment. During phase 3 the domestic facilities are expanded and regional facilities are created. The provincial GDP at factor cost is estimated to grow by $61 million, labour income by $47 million and employment by more than 1,200 person-years. Phase 3 contributes the final 28 percent of the total economic impact.

Table 1: Manitoba Total Economic Impact of All Phases

Phase	Total Economic Impact of:		
	GDP at Factor Cost ($)[1]	Labour Income ($)[1]	Employment (PY)[2]
1: Domestic	102,472,186	79,386,762	2,076
2: International	58,085,423	44,970,428	1,181
3: Domestic & Regional	60,977,657	47,260,089	1,236
Total[3]	221,535,266	171,617,279	4,493

(1) Year 2000 dollars
(2) Person-years
(3) May not add due to rounding

Table 2 presents the economic impact of phase 1 for various components of the construction. The ATB component contributes $64 million dollars to the Manitoba GDP at factor cost. Labour income of $50 million and 1,300 person-years of employment are created during this stage. This is 63 percent of the total impact of phase 1. Along with the apron component the airside construction accounts for 77 percent of phase 1.

The parkade and roadwork component adds $17 million to the Manitoba economy at factor cost, $13 million in labour income and 335 person-years of employment. The elevated roadway, the new parkade and its associated roadwork constitute 23 percent of phase 1.

Table 2: Manitoba Total Economic Impact of Phase 1			
Component/Stage	Total Economic Impact of:		
	GDP at Factor Cost ($)[1]	Labour Income ($)[1]	Employment (PY)[2]
ATB Component	64,326,467	49,772,906	1,311
Elevated Roadway	6,170,653	4,785,352	126
Apron Component	14,942,716	11,588,104	304
Parkade & Roadwork	17,032,350	13,240,400	335
Sub Total[3]	102,472,186	79,386,762	2,076

(1) Year 2000 dollars
(2) Person-years
(3) May not add due to rounding

Table 3 shows the economic impact on the Manitoba economy from the two components of phase 2. The ATB component adds $48 million to the provincial GDP at factor cost, $37 million in labour income and just under a thousand person-years of employment. That equates to 83 percent of the total economic impact from phase 2. The apron component contributes $10 million to the provincial GDP at factor cost, $8 million in labour income and 200 person-years of employment that is 17 percent of the total economic impact.

Table 3: Manitoba Total Economic Impact of Phase 2			
Component/Stage	Total Economic Impact of:		
	GDP at Factor Cost ($)[1]	Labour Income ($)[1]	Employment (PY)[2]
ATB Component	47,897,567	37,069,724	974
Apron Component	10,187,856	7,900,704	207
Sub Total[3]	58,085,423	44,970,428	1,181

(1) Year 2000 dollars
(2) Person-years
(3) May not add due to rounding

Table 4 displays the economic impact to the Manitoba economy resulting from Stages 3a, 3b, and parkade and roadwork of phase 3.

Table 4: Manitoba Total Economic Impact of Phase 3			
Component/Stage	Total Economic Impact of:		
	GDP at Factor Cost ($)[1]	Labour Income ($)[1]	Employment (PY)[2]
3a	25,096,328	19,446,752	511
3b	28,564,329	22,125,337	581
Parkade & Roadwork	7,317,000	5,688,000	144
Sub Total[3]	60,977,657	47,260,089	1,236

(1) Year 2000 dollars
(2) Person-years
(3) May not add due to rounding

Stages 3a and 3b contribute comparable amounts to the provincial economy with respective additions to the GDP at factor cost of $25 million and $29 million. Labour incomes from these stages are $19 million and $22 million respectively, and additional employment

created is 511 and 581 person-years respectively. These two stages are 88 percent of the impact from phase 3.

Tax Collections

Selected estimates of limited tax collections were made in accordance with the availability of information and industry data. The project direct expenditure was apportioned on the basis of Statistics Canada System of National Accounts (Statistics Canada, 2001a). This series is aggregated at the national level and is not specific to any project. Therefore, estimated tax collections apply at the national level and are inclusive of contributions to the provincial treasury.

Estimates of collected taxes are conservative, because no estimate of total direct taxes was possible from the apportionment of Statistics Canada data. Estimates of direct taxes are limited to aggregation of derived estimates of sales tax and income tax. In other words, estimates of Provincial Sales Tax (PST), Goods and Services Tax (GST) and personal income tax were derived from total material costs and total labour income following the above apportionment.

This procedure accounts for taxes associated with direct and indirect economic activity, but excludes the taxes from induced economic activity. This implies that direct taxes (sales tax and income tax) from expenditure of labour income by employees in subsequent rounds of spending are excluded from the estimated tax collections. Direct taxes are also exclusive of estimates for corporate income taxes. As a result of the issues outlined above, the total taxes collected at all levels of government is significantly underestimated.

Personal income tax calculations are based on the average annual income for the construction industry in Manitoba. At an average annual income of $38,396 (Statistics Canada, 2001b) the effective tax rate is 17.20% (Wolfson and Murphy, 2000). The effective tax rate based on the average income for Manitoba construction workers is the appropriate measure for estimates of net personal income tax from direct economic activity, i.e. first round labour payments.

Labour income and estimates of personal income tax from indirect and induced economic activity may deviate from that of the construction industry. Whereas direct personal income taxes are collected in Manitoba, personal income taxes from indirect and induced economic activity are collected potentially outside of the province to a greater degree of significance. Therefore, a national effective tax rate of 16.4% for all families (Wolfson and Murphy, 2000) may be theoretically more appropriate to estimate net personal income tax from indirect and induced economic activity.

Table 5 shows selected estimates of tax collections.

Table 5: Estimated Tax Collections

Description	Value ($'000)	Percentage of Project (%)[1]
Terminal Renewal Strategy	289,796	100
Indirect Taxes and Subsidies		
Indirect Taxes on Products	5,869	2.03
Indirect Taxes on Production	6,026	2.08
Total Indirect Taxes	11,895	4.10
Subsidies on Products	0	0.00
Subsidies on Production	(158)	(0.05)
Total Subsidies	(158)	(0.05)
Total Net Indirect Taxes (National)	11,737	4.05
Income and Direct Taxes		
Personal Income Tax	16,024	5.53
Other Direct Taxes: PST	12,117	4.18
Other Direct Taxes: GST	12,117	4.18
Estimated Total	40,258	13.89

(1) Totals may not add due to rounding.

No account is given of the following direct taxes: Corporate Income Tax, Tobacco Tax and Manitoba Liquor Control Commission (MLCC) Revenue. Also, indirect tax estimates include indirect taxes and subsidies on products and production, and is assumed to take account of the following indirect taxes: Insurance Corporation Tax, Land Transfer Tax, Corporation Capital Tax, Motive Fuel Tax and the Health and Education Levy.

National total net indirect taxes are estimated at $12 million or 4% of project value. No realistic estimate of corporate taxes is possible.

The effective personal income tax is estimated at $16 million or 6% of total project value. Along with total PST and GST of $24 million (8% of project value) the estimated total income and direct taxes are $40 million or 14% of project value.

The estimated total collection of selected taxes under the constraints and limitations outlined above are $52.5 million. This means for every six dollars spent on this project approximately one dollar goes to government treasuries. This may place the commercialization of airports in a new light. Instead of capital expenditures being a drain on the national treasury, the airport authorities are a significant source of revenues for federal, provincial and municipal treasuries.

Conclusion

The economic impacts from the terminal renewal strategy of Winnipeg International Airport could be expressed in various ways to indicate its relative significance. The Manitoba economy in 2000 (GDP at factor cost) is $26.0 billion (Manitoba Finance, 2001). The new terminal building construction impact is equivalent to a 0.85 percent one-year increase in the provincial GDP at factor cost.

In terms of labour, this project creates employment equal to 29% of the average annual employment in the Manitoba construction sector for the period 1996 to 2000 (Statistics Canada, 2001b), spread over the project's lifetime. Similarly, the 4,493 person-years of

employment are approximately equal to the lifetime careers of 100 workers.

The construction of the new airport terminal can be compared with the impact from expenditure on other projects in other industries and sectors of the economy. Total economic impact of the terminal renewal on GDP at factor cost is estimated at $222 million in year 2000 dollars. This impact on Manitoba GDP is equivalent to expenditure of $317 million on residential construction in Manitoba or 3,170 residential houses at $100,00 each.

This project illustrates some of the theoretical issues that economic impact studies have yet to reconcile. The issue of residual value is interesting because many projects involve such opportunity cost. The treatment of taxes is not well established. Some estimates can be made, but how these are counted, or even whether they should be counted in some manner is undecided. Nevertheless, project proponents are very interested in these transfers.

As with all economic impact studies, no measures of quality are included. Travellers are likely to appreciate the new terminal's amenities more than the old terminal. Local constituents and civic boosters can point with pride to this symbol of their community. Such infrastructure may help to attract other business and economic activity. None of these impacts are measured under current methods of analysis.

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[i] The Manitoba Bureau of Statistics Tax Revenue Assessment Model requires detailed and disaggregated input of material and labour costs.

Airports: A Gateway City Facilitator

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Introduction

The presence of logistics activities around airports is not a new phenomenon. What is new is the degree to which this is now taking place. Distribution centers around Memphis, TN and Louisville, KY take advantage of the fact that these cities are the hub-headquarters for *Federal Express* (FedEx) and *United Parcel Service* (UPS), respectively. Schiphol Airport (Amsterdam), Changi Airport (Singapore), Chek Lap Kok (Hong Kong) and Incheon (near Seoul) are other airports that are beginning to dominate trade and transport activity around them. Logisticians and airport planners have begun to label any large airport and its logistical periphery as an *aerotropolis*.

Railways and seaports were the typical modes of transport that once facilitated the formation of gateway cities. Both of these modes of transport are conditioned by geographical constraints: rail requires flat terrain or extensive infrastructure to build bridges and dig tunnels; and seaports require sufficient water depth and the absence of ice. Railway hubs and competitive seaports both need to be near a major city, in addition to requiring intermodal capabilities such as drayage. Airports, especially those fitting the definition of an *aerotropolis*, tend to be located farther away from the city or cities within its business periphery, relative to other modes of transport, and simply require enough land for the building of runways and terminal space. Of course, the noise factor is a major reason why this tendency is occurring. Finally, because of the factor of speed, an airport in one country may serve as a gateway to many more countries.

Items that tend to be moved by air include goods with high value-to-weight ratios such as: microelectronics, fashion apparel and pharmaceuticals; as well as time-sensitive, or perishable goods such as seafood, and freshly-cut flowers. Off-shoots of an airport gateway include: foreign trade zones, distribution centers, light-manufacturing, railway connections and express trucking lanes. But the major reason for businesses to locate around an airport is the ability to perform just-in-time operations almost around the clock. For example, firms such as *Nike*, *Hewlett-Packard*, and *Pfizer* which are located around Memphis and *Stride Rite*, *Mercedes-Benz*, and *Amgen Pharmaceuticals* which are located around Louisville can have their items loaded on a plane as late as midnight and arrive at their destination in North America by the next business morning. In other words, an order may be placed by a retail outlet when the store is closing and the required item will be delivered before the store re-opens the next day.

This paper discusses the meaning of gateway cities and highlights the role the airport plays in shaping their modern variants. Gateway status was, and still is, a noteworthy recognition of the importance of any city. Many cities in relative proximity of one another are trying to achieve that status. A discussion of the competitive factors affecting the formation of gateway cities is presented within the confines of airport and air carrier activities.

The Gateway Concept

A hub is a necessary though not sufficient condition for the existence of a gateway. A hub is formed in order to take advantage of network economies in that the hub will benefit from economies of scale. Large-scale, indivisible equipment and specialized personnel may be concentrated at the hub so that when all business activity (e.g., airline routing and maintenance/repair) is linked to the hub, average capacity utilization rises and passenger-mile and/or freight-mile costs decline.[1] A hub, then, is formed out of operational necessity while its location is based upon accessibility.

What are the enhancing features of gateways relative to hubs? The gateway is a hub that has achieved a critical mass in terms of economic activity. It is not just a place to be but rather *the* place to be.

In other words, reaching the critical mass means that companies do not have to be enticed to the gateway location by any means other than the advantages that will accrue to them by choosing that location. A gateway is a multifunctional hub where integrated supply chain activity, achieved through logistics support, is the sufficient condition for the hub-to-gateway transformation. One successful business venture leads to the location of others in the area. Not only does supply chain integration occur but spillovers in terms of government-induced infrastructure construction are a natural external benefit. And with enough employment presence comes suburbia and all that it entails (i.e., education and health care systems).

Since a gateway is a special form of a hub the question becomes: what actually facilitates the hub-to-gateway transformation? Agglomeration is merely the evidence of a successful facilitation process. For each type of gateway there is a particular type of business activity that represents its facilitator. From this propulsive industry, inter-industry linkages develop, inducing further economic development benefiting the entire region. For creative gateways it is the co-location of: research and development, production and marketing. Think of Hollywood, CA with its advertising agencies, movie studios, and distributors. Think of Silicon Valley with its education/research institutions and its hardware/software manufacturers. Both of these regions possess domestic as well as global gateway status. For transportation gateways it is the co-location of the transportation mode as well as value-added manufacturing. In other words, the freight is more valuable as a final good if its origin, trans-shipping point, or destination involves the gateway. It is the value-added that suggests the supply chain integration spoken of earlier.

Globalization is manifest through international economic integration and a general decline in transportation and communication costs. The dominance of trade in goods is being challenged by the growth of trade in services. Financial flows distribute wealth in the same way that physical-capital flows once did. And where transportation moved these goods and physical-capital along a physical network, a parallel yet virtual network has been formed to move knowledge in the form of ideas, data and credit. Accessibility to these flows does not require

a massive infrastructure cost in the form of an airport or seaport; all that is required is a personal computer with access to the internet. Where does that leave airports as gateway facilitators? Speed of transport means less reliance on geography so that the role of the *locale* is declining. Furthermore, an increase in both communication and international economic integration mean that there will be a growing demand by shippers for clear and predictable physical trade flows. Speed, clarity and predictability, are the factors upon which contending airports now have to compete. As the next two sections make clear, some of these factors may be beyond the control of the airport authority itself.

Airports and Gateways

Air and ocean vessel carriers are modes of transport that facilitate international trade on a regional and global basis. Of these two, air transport possesses the greater time advantage. And because air transport makes no distinction between land and sea while in-flight it also possesses a wider delivery network. This, in combination with the idea that access to knowledge-trade (i.e., communication, e-business, and e-commerce) is not location-specific, means that a gateway in the modern world can be placed almost anywhere on earth so long as it is facilitated by an airport. By this we mean that it is the trade network that is important; and many possible locales could be chosen as the gateway to that network. Furthermore, the infrastructure cost requirements (both public and private) for an air transport network are the easiest to satisfy in comparison to all other modes. Thus, one would expect gateway cities facilitated by airports to be in either the greatest state of flux or subject to a high degree of *intra*-modal competition.

"While multiple transportation modes will continue to shape metropolitan growth ... major gateway airports are generating spatial concentrations of commercial activities that are leading to a new aviation-linked urban form: the aerotropolis" (Kasarda 2000). Features of the *aerotropolis* can include large manufacturing and distribution facilities (1 million square feet and up), but increasingly support industries where air transportation is also important. Airport related development tends to locate in clusters and spines radiating

from the airport along "aerolanes" (expressways), "aerotrains" (fast rail), and intermodal services (Kasarda 2001).

Listed in table 1 are the top ten airports in the world in terms of metric tonnes of cargo handled during the first half of 2001.[2]

Table 1: Top 10 Cargo Airports (Metric Tonnes)

1. Memphis 1,159,451	2. Los Angeles 1,083,238	3. Hong Kong 983,773	4. Miami 855,782	5. Seoul* 852,801
6. Tokyo NRT 844,795	7. Anchorage# 819,489	8. Frankfurt 803,662	9. New York JFK 780,000	10. Singapore 751,675
* includes the total for Gimpo and Incheon airports # includes transit freight Source: Airports Council International				

All of these airports are in or near metropolitan areas and it is also worth noting that 5 of these are located in the United States while 4 are located in Asia and only 1 is located in Europe. It is also important to point out that these airports are tightly inter-connected to each other in terms carrier routing.[3]

Each country represented in table 1 is a member of a major trade bloc or trade association. All but Germany are members of Asia-Pacific Economic Cooperation (APEC); all of the Asian countries are members of the East Asian Economic Caucus (EAEC); Germany is a member of the European Union (EU); Singapore is a member of the Association of South-East Asian Nations (ASEAN); and the United States is a member of the North American Free Trade Agreement (NAFTA). Further trade integration of the countries is shown in table 2 where each country's merchandise trade (by value) is ranked among the other countries represented.

With the exception of Germany's trade relative to the other countries, and Japan and South Korea's trade with Hong Kong, all of the countries rank each other in the top 15 among their total number of global trade partners. For example, Japan's #5 export destination is Hong Kong while South Korea's #2 import source is Japan. It should also be noted that the numbers shown in table 2 could be even more significant (i.e., lower) if merchandise simply passing through on trans-shipment were considered. Certainly, the numbers for Hong

Kong and Singapore would be the most positively affected in this way.

Table 2: Trade Partner Rankings by Value of Merchandise (1999)

	Partner Ranking											
	USA		HKG		JPN		S.K.		GER		SIN	
USA	-	-	11	14	2	2	5	7	4	8	9	11
HKG	2	3	-	-	3	2	6	5	5	8	7	6
JPN	1	1	5	33	-	-	4	3	6	7	7	15
S.K.	1	1	3	26	2	2	-	-	8	6	6	10
GER	2	2	25	35	12	7	31	24	-	-	32	27
SIN	1	1	3	10	4	2	10	7	11	8	-	-

Calculated from: *Direction of Trade Statistics Yearbook.* (2000). International Monetary Fund.
N.B., the white (shaded) cells indicate the export (import) rank of the country listed in the first column relative to its partner listed in the second row.

Are the airports listed in table 1 part of gateway cities? Are these airports aerotropoli? First consider the city state of Singapore and the *de facto* city state of Hong Kong.[4] *The Economist's* Global Competitiveness Index[5] for 2000 gives Singapore and Hong Kong a #2 and #14 *overall* rating, respectively. When broken down to strictly the government-policy-induced part of the Global Competition Index, Singapore and Hong Kong rate #1 and #2, respectively. And finally, when broken down to international-integration-programs the two countries rate #2 and #9. Clearly, these countries are open for business.

Hong Kong's Chek Lap Kok Airport presents a tremendous opportunity to study the *aerotropolis*. Essentially, Tung Chung New Town, adjacent to the airport, is a 190-acre master-planned development including housing and commercial services to support the airport and is the planned site for Hong Kong Disneyland. On the airport site itself, two major air cargo terminals and a freight

forwarding centre have been developed. The airport also has reserved land for private commercial development, with about 75 acres set aside for logistics activities (Airport Authority Hong Kong, 2002). Similarly, according to Singapore's Master Land Use Plan and Concept Plan 2001, the majority of available land near Changi Airport is reserved for further airport-related industrial and commercial development (Singapore Urban Redevelopment Authority, 2002).

Consider the large cities on the list: Tokyo (the world's largest with 26.4 million people); New York (the 5th largest with 16.6 million people); Los Angeles (the 7th largest with 13.1 million) and Seoul (the 20th largest with 9.9 million). Tokyo is more of a gateway to Japan itself rather than Asia. It is the fact that Japan's financial and knowledge bases are situated in Tokyo--- along with much of its manufacturing base--- that make it a gateway.

As a result of its seaport, New York has been a gateway to North America since the 19th Century. Because of the strong flow of goods through that port—and the requisite flow of financial wealth--- the city established a financial leadership that is still hard to rival. In a modern sense, its cosmopolitan nature has done much to enhance its gateway status. Beyond New York being the headquarters of the United Nations and several multinational corporations, human capital resources in the form of institutions for research and higher learning maintain New York's command and control of much of the world economy. In 1999, $24.5 billion (US) worth of point-of-sale exports[6] were generated in the city of which the largest share (41%) were sent to European destinations (U.S. Department of Commerce). JFK airport, itself, has about 5,000 acres of space to use for further development. Scheduled for opening in November 2002 is a 530,000 square-foot industrial park complex in neighboring Springfield Gardens. Its anchor tenant will be a Japanese-based freight forwarder (*JOC Week*, Feb. 4-10; p. 27).

Los Angeles is also a gateway to North America. The Port of Los Angeles is the highest volume container port in the United States and it, in combination with the Port of Long Beach, would make the city of Los Angeles home to the world's highest volume container port

after Hong Kong and Singapore. The city's proximity to Mexico, with its low-cost labor, in combination with California's high-tech sector up through to the northern part of the state give it a critical role to play in Asia-Pacific trade. Of the city's $23.9 billion (US) in point-of-sale exports for 1999, Asian countries had the largest share (42%) (U.S. Department of Commerce). Although it competes with San Francisco, Seattle and Vancouver, Los Angeles is North America's most significant Pacific gateway. In the diverse five-county region surrounding Los Angeles, LAX Airport is responsible for about one out of every twenty jobs.

Miami is the gateway to the Caribbean and Latin America and is the gateway for the latter two regions to the southern United States itself. As of 1997, the city was 54.4% Hispanic. Of the regions noted, 81% (84%) of all U.S. air cargo exports (imports) travel through Miami (Hansen 2000). Of the $11.9 billion (US) of point-of-sale exports for 1999, 78% were sent to the Caribbean and Latin America (US Department of Commerce). On the import side, Miami has developed as the flower gateway to America. Nearly three-quarters of the American flower market is imported, the majority through Miami International Airport. The spin-off benefits of agglomeration at airports is clearly demonstrated in Miami, where nearly 6,000 people support the airport-dependent fresh cut-flower industry (U.S.D.A. 2002).

Consider Seoul or, more specifically Incheon[7] International Airport, which is about 25 miles west of the city. Incheon, which opened in March, 2001, represents South Korea's attempt to become *the* main cargo gateway for Northeast Asia. Hong Kong's Chek Lap Kok Airport opened in 1998 and its position is, therefore, being challenged. There is generally a limit on the number of locations in a region that can be considered as hubs or gateways, meaning that the Asian air cargo market will likely undergo a degree of spatial discrimination over the next decade. This could also modify the spatial structure of employment and population within the region (Parr 1996). Incheon also relieves the over-capacity at nearby Gimpo Airport which is now relegated to domestic flights. The Port of Incheon, in combination with the airport, has lead government officials to believe that much of northern Asia's logistics and trans-

shipment activity can be attracted to Seoul. The airport is also the chosen site for South Korea's first "free-trade" zone. As with Chek Lap Kok, Incheon is a new development and the airport-related development surrounding it is just beginning to show promise. Officials have incorporated the International Business Center into the land use plan at Incheon, including the development of Media Valley, a global high-tech center. Over 600 companies have expressed their intent to locate in Media Valley. Incheon, like Chek Lap Kok, but unlike most other gateway airports, is essentially a master-planned *aerotropolis*. From Frankfurt, the high-speed German autobahn provides the city and its airport with a link to France, Italy, the Netherlands, Belgium, Switzerland, Austria and Denmark, as well as all other German cities. As well, 15 international railway lines meet at the Frankfurt rail station. In terms of the United States Postal Service's deal with *Consignia* LLP (formerly the British Post Office), the 1 million daily packages bound for Europe will be consolidated at the *Consignia* cargo facility in Frankfurt. Of course, Hahn, Germany's highway to Frankfurt (60 miles to the east), if improved as expected, will allow Frankfurt to offload some surface-logistics operations to Hahn Airport. It is also not clear whether or not Frankfurt can expand its capacity given some concern over the environmental impact of further runway construction. Thus, Hahn may pick up this air cargo over-capacity in a fashion quite different to that of South Korea's Gimpo and Incheon airports.

Consider Memphis and Anchorage. These cities have a place in table 1 due to special circumstances. Memphis earns it place due to it being the corporate headquarters and "superhub" for *Federal Express*. Anchorage's place results from its geographic advantage as a refueling stop for transpacific flights. Of Anchorage's $200 million (US) in point-of-sale exports in 1999, 55% went to NAFTA partners (Canada and Mexico) and 36% went to Asia (US Department of Commerce). Freight on layover and/or in trans-shipment would not be counted in Anchorage as point-of-sale that, therefore, leaves out the vast majority of trade value that passes through the city. Anchorage would be in the #1 spot in table 1 if the measurement were simply landed-freight: the sum of only air cargo in-transit and air cargo unloaded (i.e., air cargo originating at these airports is

excluded). It is the amount of cargo loaded in other cities, as a result of them being major point-of-sale locations, that force Anchorage into a lower position once this other amount is accounted for. At this point, Anchorage is not a gateway city--- though it does have potential as is discussed in the next section.

In terms of 1999 point-of-sale exports, Memphis has a very even distribution of destinations: 29% Europe, 26% NAFTA partners (Canada and Mexico), and 23% Asia. These numbers represent the leverage gained by the firms that are part of the Memphis business area. Of the $3.1 billion (US) in exports, the two largest components are: computers, electronics and scientific instruments (30%) and paper products (23%) (US Department of Commerce). In this regard, and as a result of sheer cargo tonnage passing through its airport, Memphis represents a European and Asian gateway for North American exporters that choose to use FedEx.

Competitive Advantages across Airports

The world today is made up of several advanced economies in both the East and the West; and geography, though still important, is playing a declining role in deciding how gateways are positioned. Airport operations themselves are not uniform in nature across gateway cities because international air cargo operations are the most heavily regulated of all international transportation activities. This section considers the non-geographic sources of comparative advantage an airport may possess.

Within the U.S.-South Korea bilateral air agreement is a provision to use Seoul as a staging point for flights to other cities in the Asia region---- so-called Fifth Freedom flying rights.[8] Basically, under this type of freedom Seoul is used as an intermediate stop or gateway to a final destination. By comparison the U.S.-Hong Kong bilateral under re-negotiation and the Fifth Freedom flying rights into Chek Lap Kok are limited to between 5 and 8 frequencies per week depending on the point(s) chosen beyond Hong Kong. The Hong Kong gateway is under threat as witnessed by FedEx and UPS building distribution centers in mainland China and the Philippines.[9] Furthermore, a construction cost comparison of Incheon's $5 billion (US) to Chek Lap Kok's $20 billion (US) leads some to speculate that Seoul can

likely offer lower landing fees among other incentives to international airlines (*JOC Online*; March 30, 2000).

What complicates matters further is that Hong Kong and mainland China are the same sovereign territory, meaning that foreign carriers flying from Hong Kong to mainland China require concessions beyond Fifth Freedom. For such carriers a move of cargo from Hong Kong to the mainland may be interpreted as cabotage; while just continuing a flight to the mainland after dropping off cargo in Hong Kong is a co-terminalization move.[10] The U.S.-Hong Kong bilateral, for example, makes clear that no mainland China stops are allowed for foreign designated airlines serving Hong Kong. This includes stops for traffic or even non-traffic purposes.

The U.S.-Japan bilateral does, in fact, allow for co-terminalization of *all-cargo* services by one U.S. airline up to seven frequencies per week. The routes are Tokyo, Osaka, or Naha either to Sapporo, Nagoya or Fukuoka. U.S. flights to Asian points beyond Japan are capped at the applicable number of frequencies per week but no more than one flight per day.

On the European front, the concept of the bilateral air agreement itself has been called into question by the European Union's Court of Justice. Until the matter is resolved, further bilaterals will be called off; or the European Union may have to negotiate air agreements as a single trade bloc. To the extent that "open skies" talks will be held off, Frankfurt's position does not appear to be challenged given the fact that a U.S.-Germany open skies agreement has existed since 1996. As well, Sixth (Seventh) Freedom traffic is allowed for passenger-cargo (all-cargo) carriers within the U.S.-Germany bilateral.[11]

Apart from bilateral air agreements, Anchorage's airport unilaterally provides for freedoms in trans-shipping of air cargo. The right to *co-mingle* air cargo was granted by the U.S. Department of Transportation in 1996.[12] Among the reasons why the airport pursued this comparative advantage was in anticipation of: long-range freighters that could simply over-fly Anchorage; and polar routing that would avoid Anchorage altogether. Co-mingling of air cargo allows for a foreign carrier to achieve network economies that are

prohibited by law at other airports. To the extent that air cargo may be transferred on the runway or laid-over within the airport's foreign trade zone, new cargo routings (albeit to 3rd country destinations) may be formed. And to the extent that manufacturing firms would wish to lever off the co-mingling option, Anchorage has the potential for being a gateway to the NAFTA countries.[13] In the other direction, firms might be able to use any excess capacity on any of the several international carriers operating Asia-bound flights through Anchorage.

Conclusions

Economic development cannot take place everywhere consistently. Thus, where there are competing regional gateways--- as is the case in Asia and the U.S.---the growth of one is to the relative decrease in status for another. In this paper, the world's top ten cargo airports were considered in terms of their contribution to their cities' gateway status. In eight of the ten cities, there is a clear case to be made that they are in fact gateways. While Memphis and Anchorage may not be gateways, their airports are all the more important to the cities themselves.

Location near an airport is not crucial for most companies, but many find it advantageous. As more companies make the decision to locate near airports, the role of airports as a necessary component of the gateway is solidified. Once the critical mass is reached, the *aerotropolis* can be self-sustaining. Firms find the *aerotropolis* to be the optimal location because of agglomeration advantages and from shared use of transport infrastructure. In effect, this brings the firm closer to other markets around the world.

Could any of the ten cities discussed be gateways without the presence of their airports? Indeed, several were gateways before airports existed. However, today, there are very few gateway cities without a strong gateway airport. In order to be a strong gateway airport, the proper regulatory environment and the proper infrastructure must exist. To this end, the government that wishes a city to become a gateway must also play the role of facilitator so that private enterprise will indeed select that airport and that city as the location of choice.

As noted by Kasarda (2000), airports have taken over from seaports, canals, railways and freeways to become the new "logistical drivers of development and as primary job and wealth creators".

Endnotes

[1] The argument is limited, of course, to the extent that congestion (as a pecuniary externality) and other negative real externalities occur. And profits are mitigated to the extent that passengers feel a net loss in terms of lost time due to excessive hubbing.

[2] Louisville, the main hub for *United Parcel Service*, is number 11, but would be 10th if the two Korean airports were considered separately.

[3] The only routings that do not exist (according to *OAG Cargo Guide Worldwide*. January 2002) are:

International: Memphis-to-Tokyo; Memphis-to-Seoul; Singapore-to-Memphis; Anchorage-to-Frankfurt and *vice versa* (since Fairbanks, AK is the current Frankfurt connection).

U.S. Domestic: Anchorage-to-Miami and *vice versa*.

[4] Both Singapore and Hong Kong have 100% of the their populations located in urbanized areas. Singapore's population density is the world's 3rd highest with 5,771 people/km^2 while Hong Kong is 2nd with 6,628 people/km^2 (*Pocket World in Figures*, 2001).

[5] "Overall" is the subjective valuation of 259 criteria including: openness of the economy, the role of government, the development of financial markets, the quality of infrastructure, technology, business management, judicial and political institutions, and labor market flexibility.

[6] While there are some exceptions in the data set, point-of-sale exports may be interpreted as being exports whose complete or final stage of production takes place in the metropolitan area cited.

[7] "Inchon" was the original name for the airport but during the period of construction, which began in 1992, the South Korean government instituted new rules requiring the romanizing of Korean names. Similarly, Gimpo Airport was previously known as Kimpo Airport.

[8] Since the bilateral also allows for the U.S. designated-carrier to begin at points behind the U.S., Sixth Freedom is also allowed. For a review of the Eight Freedoms of the Skies see: Button and Stough (2000).

[9] Senior management from both FedEx and UPS have indicated that Guangzhou, Shanghai and Shenzhen will be bases of expansion at the expense of Hong Kong if the *status quo* remains (*Cargo Facts*; p. 1). FedEx and UPS operations in the Philippines are to be expanded at Subic Bay and Clark Air Force Base, respectively. For example, exports from Subic Bay increased from $24 million US to $559 million US in just five years in the late 1990s, spurred by the development of companies such as *Acer*, which operates its largest computer assembly facility there.

[10] *DHL* has a partnership with *Cathay Pacific Airlines* at Chek Lap Kok for the second leg of the former's deliveries to mainland China. What makes the partnership difficult for *DHL* is that their cargo is transported in the bellies of passenger planes— not freighters— and it has to, in effect, charter these planes and bear all operational costs beyond freight haulage (*Cargo Facts*; p. 19). By protecting its market through its influence in Hong Kong politics, *Cathay Pacific* is preventing Chek Lap Kok from providing the time and frequencies of services expected by true air cargo integrators such as *DHL*.

[11] The U.S.-Singapore bilateral is basically identical to the U.S.-Germany bilateral.

[12] For a complete overview of co-mingling as an air cargo routing activity see Prokop (2002). It is also the case that Fairbanks, AK and Honolulu, HA are both covered by the co-mingling provisions. Only Anchorage, however, has been practicing the policy.

[13] This is for basically the same reason why some Japanese television manufacturers do part of the assembly work in the *Maquiladoras* areas of Mexico. As long as a particular amount of value-added is performed in a NAFTA country, the item may enter the other NAFTA countries duty-free.

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Airline Domestic Ownership Requirements: the cases of Canada and Australia

Nations have generally controlled foreign ownership of airlines that operate on domestic routes. While it has long been argued that ownership regulations serve important security and economic purposes, these regulations are often dismissed as protectionist and anachronistic in the current global trading environment.

Recent re-appraisals of foreign ownership by Australia and Canada have led to completely opposite policy directions. The paper examines the different policy motivations in the two countries that led Australia to liberalize while Canada retained the rule, even at the expense of creating a monopoly in its domestic industry.

The Foreign Ownership Issue

Air transport has been almost impervious to the trend toward globalization and trade liberalization that has accelerated in the second half of the 20th century. The root of the problem can be found in the fact that before it matured as a commercial force, aviation had already established its strategic military importance.

The Chicago Convention, which set in place the air transport regime for the post-war period, was arrived at in the context of a protectionist environment and arose from two perceptions. The first was the recognition that, if given free rein, the United States would almost immediately dominate international aviation. Its massive fleet of transports dwarfed the fleets of other countries.

The second was that sentiment in Europe, post-depression and with the war experience of command economies, was that capitalism had failed and that the commanding heights of industry should be

controlled by the state. In these circumstances, it is hardly surprising that the regime drafted in Chicago was rigid and protectionist.

One of the central tenets of the Chicago regime is that a state has the right to license its own air carriers and to place restrictions on the activities of other states' registered aircraft in its airspace. In practice, this means that it can limit the economic opportunities of foreign-registered carriers. Outside of the United States, airlines that operated internationally were generally nationalized, a process that had been underway even before the war.

Canada and Australia

In two of the large Dominions of the British Empire, air transport was transformational. The vast distances and sparse populations in Canada and Australia lent it a nation-building significance.

The two nations were dissimilar, however, in terms of global demography. Australia was then, and remains today, "the end of the line." Australia was isolated by distance from other population centers in the immediate post-war period, particularly those of developed nations that could support significant air transport. The Pacific, on one side, and underdeveloped Southeast Asia, on the other, were hinterlands to be overflown from developed countries.

Canada, on the other hand, benefited briefly from the technical limitations of the day. Because the most important post-war market was clearly the Trans-Atlantic, and aircraft of the day could not fly US-Europe without technical (fuel) stops, Canada's geography gave it a seat at the table, and a power it has never again seen in international aviation.

The ability of small market countries like Australia and Canada to influence a regime dominated by large market countries like the United States and Britain, has always been small. Neither country's decision makers can escape this economic reality, for all of their propensity to broadcast otherwise for domestic consumption.

But ownership requirements for air carriers are, on the surface at least, a purely domestic matter. This was demonstrated in the late 1990s, when the two countries' policy establishments had reason to review the foreign ownership issue.

Canada

The rationale for foreign ownership restriction dates back to the earliest days of commercial aviation in Canada. Where security concerns may have had more resonance on the continent, in Canada, the concerns were purely economic. In the 1930s, the fear that US firms would dominate the infant commercial air industry was sufficient motive to create a foreign ownership restriction. The fact that the US created a foreign ownership restriction of its own has formed the backbone of protectionist sentiment ever since.

Monopolization

Air Canada's sole discernable strategy for more than half a century has been to thwart, by all economic and political means, the development of a worthy competitor in the domestic market. The country, it has argued, cannot support more than one network carrier.

Prior to deregulation, the federal government owned Air Canada. The airline's power within the bureaucracy ensured it a relatively unfettered control of the domestic market. The entrepreneurial aspirations of competitors were viewed as running counter to the national interest.

Air Canada was privatized in the late 1980s and the domestic industry was deregulated. Competitor airlines combined in a rival network that eventually became Canadian Airlines International Limited (CAIL), or were absorbed into Air Canada. A decade-long rivalry began between the western entrepreneurial "blue team" and the entrenched eastern "red team."

The next decade was not kind to the blue team. It entered the Gulf War recession heavily leveraged and was never able to recover despite several restructurings involving infusions of public money, employee concessions and shareholder "haircuts."

In August of 1999, the Minister of Transport announced a suspension of the Competition Act that would allow the airlines to freely discuss mergers or partial sales without incurring Competition Bureau investigation. The invocation of Section 47 was politically controversial, especially since the airlines both testified that they did not ask for it.[1] A few days later, Onex Corporation, a Canadian conglomerate, launched a takeover bid for both airlines, with the intent of merging them. Onex was headed by Gerry Schwartz, a prominent Liberal supporter and closely associated with the Minister.

In the months that followed, the Air Canada-CAIL merger was front-page news.[2] There seemed little doubt that the only way CAIL could survive was to merge with Air Canada. The Minister toyed with increasing the foreign ownership limits, but did not do so. This meant that either the Onex bid or Air Canada's takeover defence, which involved buying Canadian itself, would eventually prevail.

With the exception of the business press, public concern over the resulting monopoly was almost drowned out during the takeover battle by nationalist breast-beating. Business columnists suggested that the minister should allow cabotage to preserve competition. The Minister's silence on the issue was unmistakable, and Air Canada

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[1] The Senate Committee on Transport and Communications later concluded that the action was not necessary because the carriers had had previous discussions on the same issues without the invocation of section 47 (*Airline Industry Restructuring in Canada*). The government may have taken this course because of a finding by the Competition Bureau related to earlier discussions between the airlines. (*No Evidence Found of Collusion Between Canada's Major Airlines*).

[2] Pustay and Kaduck, 2000.

stated that cabotage was acceptable, as long as the US reciprocated.[3] To the general audience, this seemed a fair condition, but there was no prospect of a quick agreement by the US Congress on the matter.

Air Canada's canard was successful in crowding out the real question, which was whether the public would have been better served by a unilateral cabotage, which would have allowed competition in the domestic market. The Competition Commissioner proposed a form of cabotage (somewhat imprecisely called a "modified sixth freedom") over a US hub, but this, too, was rejected.[4]

After months of court battles, spin doctoring and escalation of the bid prices, Onex called off its takeover, leaving the field to Air Canada. As the inevitability of the monopoly outcome became clearer, the Minister of Transport identified key concerns that would have to be addressed in the event of a successful merger. These were first outlined in a policy framework in late October 1999, and later refined.[5] Two overriding principles were noted, safety and bilingualism. Five "key issues" were raised: pricing, fostering competition, Canadian ownership and control, service to small communities and fair treatment of employees.

The five issue areas were sufficiently generic to allow the Minister room to maneuver in a dynamic and politically loaded situation. These were later refined in *A Policy Framework for Airline Restructuring in Canada*, which accompanied the new legislation. A number of issues were also addressed by undertakings from Air Canada, which limited its ability to exercise monopoly power.

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[3] The Minister did not rule out cabotage as an option in the future, once the dominant carrier was "mature enough" to withstand that competition (National Post [hereafter NP] October 29, 1999 C1,C5).

[4] The Competition Commissioner proposed to allow US carriers to serve points in Canada over US hubs to help discipline prices in the Canadian domestic market.

[5] *Minister of Transport Issues Policy Framework for Restructuring of Airline Industry.*

Fate is capricious, however. Air Canada's success spelled the end of any rational argument in favour of foreign ownership restrictions, at least from a consumer standpoint. The year that has followed the Air Canada merger has seen a burst of entrepreneurial activity in the domestic market. An established low-fare airline, WestJet, has expanded eastward and new services have been offered in the eastern domestic market. Consolidation has taken place in the merger of charter carriers Canada 3000 and Royal.

Some policymakers conclude that this activity is evidence of the wisdom of the policy, but questions remain. It seems unlikely that all of the services are viable. The dominant carrier has plans to invade the low-fare market in the west in an attempt to slow down WestJet. The entry of CanJet and Royal into the lucrative Toronto-Ottawa-Montreal triangle probably provides more capacity than the market can absorb in the short run.

Choice is not restricted only in the domestic market. In the international market, the power of *Aeroplan*, Air Canada's frequent flyer plan, will make it increasingly difficult for Canadians to choose anything but the local brand. Frequent flyer miles and lounge access on anything but the Star Alliance are of no benefit on domestic flights. Canada is, effectively, a Star Alliance country.

Political philosophy

The issue of foreign ownership in Canada has been dealt with in most other sectors. The Free Trade Agreement and later the North American Free Trade Agreement (NAFTA) were concluded after a prolonged and nasty debate that pitched socialists, nationalists, heavily protected industry groups and unions against consumer groups, trade theorists and most of the export industries.

The airline industry, for reasons that are not altogether clear, raises strong emotions when foreign ownership is mentioned. It is tempting to think that this is because of the critical historical importance of

aviation, but the reaction is generally not a well-informed one, but rather an instinctive and emotional anti-US sentiment.

Air Canada has manipulated this response throughout its existence. Interestingly, in a country whose major preoccupation for the last 30 years has been Quebec separatism, Air Canada has managed to unite chauvinists from both camps. As a sop to Quebec nationalists, the Mulroney government inserted in the privatization documents the condition that the headquarters must remain in Montreal. Air Canada's private interests are seen as Quebec's economic interests.

Clearly, the Liberal government is motivated by a strong protectionist sentiment among its leadership, but it also realizes that protectionism suits left-wing voters and nationalists in its important Quebec stronghold. It may be that this support will soften with experience of Air Canada dominance, particularly outside Montreal, where price and service level concerns have more resonance than employment in the city. The issue now is whether Canadians in the rest of the country are willing to continue to ignore their economic interests in favour of a purely chauvinistic and protectionist policy.

Australia

Australia's first airlines were established in a pioneering spirit by enthusiastic aviators who struggled to make their operations financially viable. Qantas Airways was formed in 1920 as a purely domestic airline connecting remote inland and northern communities with the rail termini. A decade later it began to link up with Imperial Airways in Singapore and in 1933 it entered into a joint venture with its British partner to bid for the England-Australia mail contract.[6] The new company was known as Qantas Empire Airways Limited.

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[6] Throughout its history, Australia has relied on foreign investment. In the early period, the key contributor was the UK but after World War II, USA, Japan and other countries become important as financiers. See Dwyer et. al. 1991.

The challenge of putting a competitive network together was taken up by Australian National Airways in 1936, but its promoters had a background in shipping and it drew its financial support from this source. But this was an industry dominated by British interests and the question of foreign ownership and control, albeit from the "mother country" began to arise as an important public policy issue.

After World War II, the Australian Labor Party assumed power and it had an agenda to nationalize key industries. It believed that Australia could only support one domestic airline and was reluctant for that airline to be one controlled by a sector it suspected of exploiting its market power. As a consequence, the new Government established the Australian National Airlines Commission in 1945 and began operating as Trans Australia Airlines in 1946.

The Government had no legal power to acquire ANA and its fledgling rivals, so it took the expedient path of giving TAA all of the public sector's business, including the lucrative mail contracts. The intention was that TAA would eventually become the sole domestic airline.[7] At the same time, the Government purchased BOAC's (Imperial's successor) 50 per cent share in Qantas Empire Airways. In 1947, the Government acquired the remaining 50 per cent of the shares. Qantas was to be a flag carrier while TAA would provide domestic services.

Both TAA and Qantas were entrepreneurial airlines that quickly acquired a reputation for success. When a Liberal-National Party coalition government came into office in 1952 with a pro-business agenda, it was faced with an ailing ANA and a profitable TAA enjoying strong public support. Believing that the industry would gravitate to monopoly if left to its own devices, the new government enshrined a policy of limited competition between two airlines – the "two airline policy." Essentially, the TAP ensured that each airline would share equally in the orderly growth of the market.

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[7] Brogden, 1960.

The problem was that all of the other small airlines remained outside this agreement and they simply would not go away easily. Ansett Airlines adopted what might today be described as a "no-frills" strategy and went from success to success. It eventually took over its larger rival, ANA, in 1957 and signed a new Airlines Agreement with the Government before acquiring the remaining significant competitors. Australia's two-airline policy was cemented for approximately four decades.

In 1990, the domestic airline industry was deregulated. Compass Airlines put up a brief show of competition in 1991, and a second new entrant using the same name came and went in 1992. The failures were partly attributable to strategy,[8] but there were concerns that the barriers to entry in the Australian air transport industry were almost insurmountable. One complaint was that Ansett and Australian Airlines[9] controlled the domestic terminals at the major Australian airports and that Compass had been given access to them on very disadvantageous terms. Another problem that the two failed entrants faced was a lack of capital resources.

Eight years later, two new entrants arrived on the scene: Impulse Airlines and Virgin Blue, a wholly owned subsidiary of Virgin Atlantic. Impulse was a regional carrier that started service on the major trunk routes in April 2000. Though majority-owned by Australians, Impulse's foreign backers had a 40 per cent stake in the carrier and included banks and GIC Special Investments (Government of Singapore).

In granting the United Kingdom's Virgin Group approval to establish a new low-cost carrier in Australia, the Assistant Treasurer said: "The government believes it is in the national interest for Australia to have a third major airline. The government has accordingly granted

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[8] Nyathi et. al. 1993

[9] TAA had been renamed as Australian Airlines in the lead-up to deregulation.

Virgin foreign investment approval to establish a new domestic airline in Australia."[10]

A spokesman for Impulse Airlines has raised the issue of foreign ownership in this context in saying that: "We think the Australian public resonate and support any venture that has majority Australian ownership in it." [11]

With four domestic carriers fighting it out for a market that has only a handful of reasonable dense routes, the participants themselves are on record as saying that not all will survive. It is too early to tell whether the question of foreign ownership will play a significant role in the market place, but it has been a relatively easy step in public policy to allow the Virgin Group to set up a wholly owned subsidiary in Australia. To understand why it is necessary to revisit the two major carriers and their counterparts in New Zealand.

When Trans Tasman Empire Airlines (TEAL) was established in 1940, domestic interests were represented by a 20 per cent stake by the Government of New Zealand. Union Air Line held another 19 per cent of the shares. Five years later, UAL was taken over by the Government to form the National Airways Corporation. The remaining shares were held by Australia and the United Kingdom. Australia became the majority owner in 1954, but sold it to the New Zealand Government in 1961. TEAL's name was changed to Air New Zealand in 1965 and it was merged with the National Airways Corporation in 1978.

New Zealand's protectionist policies were reversed in the 1980s under an ambitious and far-reaching agenda of reform. Newmans Airways started in 1985 and gained approval under the *Overseas*

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[10] Statement issued by Assistant Treasurer, the Hon. Rod Kemp, 10th April 2000.

[11] Quote attributed to Mr. Simon Westaway, Corporate Affairs Manager, Impulse Airlines in *Sydney Morning Herald*, 11th June 2000.

Investment Act 1973 to form a consortium with Ansett Transport Industries (ATI) of Australia and Brierley Investments of New Zealand to expand to the main trunk routes. Ansett NZ began operating in July 1987. ATI became Ansett NZ's sole owner in early 1988 upon acquiring Brierley's shares. New Zealand's bold move to allow 100 per cent ownership of one of its domestic airlines was not reciprocated in Australia. It is all the more significant that ATI was itself a subsidiary of the Australian transport conglomerate TNT and the half owner of Ansett Airlines in Australia.

The next major policy change in New Zealand was to privatize Air New Zealand in 1989. The approach taken was to sell 65 per cent of the "Class A" shares to the public with the restriction that New Zealanders must hold them. The Government retained one "Kiwi Share" that had certain rights and privileges attached to preserve ownership and control. The remaining Class B shares could be held by New Zealanders or foreigners. Notably, Brierley Investments purchased 25 per cent of the airline.

Australia and New Zealand signed a "Closer Economic Relations" (CER) trade agreement that excluded aviation.[12] Potential gains to New Zealand appeared very large, but they were not as significant for Australia. Nevertheless, progressive developments in Australia's international aviation policy saw Qantas obtain improved access to the domestic market and a commitment to go ahead with the single aviation market in 1992.

Australia was committed to an agenda of microeconomic reform and pro-competitive policies were under active consideration. There appears to have been a presumption by the Australian Government that Air New Zealand would merge with Ansett Airlines and, in doing so, would emerge as an effective competitor for Qantas.[13] The

[12] This was despite the findings of a joint Australian-New Zealand study demonstrating that there were welfare benefits to be realized under a single aviation market (BTCE & NZ MoT 1991).
[13] Findlay, 1996.

Australian Government had decided to privatize Australian Airlines and Qantas Airways in 1991 as a combined entity. British Airways (BA) emerged the victor in March 1993 after a strong bid from Singapore Airlines had been dismissed. It was not permitted to increase its stake beyond the 25 per cent but other foreign investors could take up to another 24 per cent of the shares. The intention was that Qantas would remain majority-owned by Australians, if only to satisfy the nationality rules under bilateral air services agreements.

Meanwhile, aviation policy had to recognize the legitimate claim of Ansett, and any other would-be airlines, to a share of the international market. New procedures were put into place to allocate routes and capacity entitlements.[14] But Ansett now faced a winner's curse. It could pursue its international ambitions in a booming Australian tourism market, but it had to finance a significant expansion of its fleet with wide-bodied, long-range aircraft. Qantas continued to integrate its domestic and international operations while pursuing marketing and efficiency benefits through its alliance with BA.

Ansett's faltering fortunes led its joint owners, TNT and News Corporation to sell out. News Corporation first attempted to sell its 50 per cent of Ansett to Singapore Airlines in 1993. The negotiations dragged on until late in 1995 when TNT became the more interested party to the sale. However, there were regulatory and policy barriers in both countries. In New Zealand, the Commerce Commission was concerned about any diminution of competition and Ansett New Zealand was Air New Zealand's only significant rival. The government was aware that Qantas had considered entering the NZ domestic market and did not believe that the market could support three carriers.[15] Ansett, though, was reluctant to sell Ansett New Zealand for fear that it might fall into the hands of Qantas in subsequent transactions. The Commerce Commission considered various arrangements and eventually accepted in June 1996 that News

[14] Hooper & Findlay, 1999.
[15] Findlay and Kissling, 1997.

Corporation fully acquire Ansett New Zealand and run it independently of Ansett Airlines as a wholly-owned subsidiary.

In Australia, the problem was that Ansett was now an international carrier and it would become half-owned by Air New Zealand. Besides, the Australian Government had imposed a limit of 25 per cent on any foreign airline's equity in an Australian carrier when it sold Qantas. Eventually, Ansett International was separated from Ansett Australia and 51 per cent of the shares were sold to Australian institutional investors. Air New Zealand purchased TNT's share of Ansett Australia in September 1996 and News Corporation purchased Ansett New Zealand and operated it as a separate entity.

News Corporation eventually decided to leave the airline business altogether. Air New Zealand had, through its earlier purchase into Ansett, gained the right of first refusal on the share held by News Corporation. Late in 1999, Richard Branson made a public statement that he was prepared to bid for Ansett if approached and Singapore Airlines (SIA) made a bid for Ansett Australia in March 1999. Air New Zealand took up its option to buy News Corporation's shares in Ansett in February 2000. Australia's Foreign Investment Review Board approved this subsequently in June 2000, imposing a number of conditions.Ansett NZ was acquired by a consortium of New Zealand investors and it is managed as a franchise of Qantas. The airline changed its name to Qantas New Zealand in June 2000.

During this period, Air New Zealand's ownership also changed. Its investment in Ansett Australia was undertaken for strategic reasons. Singapore Airlines turned its interest to acquiring a share of Air New Zealand, while Qantas offered to buy a stake in the carrier for US$1 billion in April 2000. Some analysts speculated that Qantas was simply trying to thwart any closer tie-up between Ansett, Air New Zealand and SIA, all members of the Star Alliance. Qantas argued that long-term survival demanded that both carriers merge. SIA's stated wish to own 40 per cent of Air New Zealand was rejected by the Government, but it then acquired 8.3 per cent of Air New Zealand's "B" shares in April 2000. Shortly afterwards, Brierley

Investments sold it another 16.7 per cent of Air New Zealand's shares. SIA continues to lobby the New Zealand Government to change the number of class "B" shares, but the Prime Minister, Helen Clark, put the position thus:

> *... the government's ability to negotiate extra traffic rights into other countries would be compromised. The perception would be that Air New Zealand is controlled by the Singapore government.*

The position was further complicated when SIA completed its acquisition of 49 per cent of Virgin Atlantic in March 2000.[16] SIA rejected the option of participating directly in the ownership and management of Virgin Blue in the Australian domestic market, but this further illustrates the difficulty faced by both regulators and airlines in positioning themselves in the limited Australian and New Zealand domestic markets.

Meanwhile, the struggle to consolidate the domestic industry continued in Australia. Late in 2000, Ansett and Qantas were locked into a battle to acquire the controlling interest in Hazelton Airlines, a large regional carrier that previously had been aligned with Ansett. Apart from the feed traffic, what is at stake are landing slots at Sydney's congested airport that Qantas in particular wants for future expansion.[17] Of particular note, Qantas claimed that it was at a disadvantage during this bidding process because it was limited to the extent that it could draw on its foreign partner for an injection of funds. Britain's *Sunday Times* printed a report in December 2000 that BA had been negotiating to lift its investment in Qantas to 49 per cent, but when this was reported in the Australian press as an attempt

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[16] Virgin Atlantic is the holding company for Virgin Atlantic Airways and for Virgin Australia.

[17] The Australian Government decided in December 2000 not to construct a new airport at Badgereys Creek and to make better use of the existing Sydney International Airport for the foreseeable future.

to take over Qantas the report was denied vigorously by BA and Qantas.

What adds spice to these rumours is that the new chief executive of BA previously was the chief executive of Ansett. Air New Zealand also recently appointed a new chief executive. Its choice was the former Deputy Chief Executive Officer and Chief Financial Officer of Qantas, Gary Toomey. Clearly the Australian and New Zealand airline industries are going through a particularly dynamic period. The Governments on both sides of the Tasman Sea have, in the past, modified their policies in the face of compelling market realities. Both governments want some competition and have been prepared to compromise on the question of foreign ownership of their domestic airlines when necessary. The complicating issue is the increasing levels of integration and cross-ownership with international airlines from outside the two countries.

Observations

Much of the political discourse over foreign ownership restrictions is purely chauvinist in nature. Powerful forces within countries, including organized labour, tend to reinforce these tendencies to protect their economic interests, as they perceive them. Within countries, well-organized lobbies compete with the somewhat more diffuse benefits to consumers. It will be interesting to see whether Canadians, who have traditionally supported airline protectionism, will remain as sanguine as their experience with a virtual monopoly broadens.

The presence of a larger economy in close proximity clearly influences policy in Canada more immediately than Australia. Canadian policy debates are often dominated by considerations of the relationship with the United States. Canadian politicians are constrained to options that can be depicted as favouring Canadian interests over those of the US. This is the case even if the benefits to

Canada of either agreement outweigh the status quo.[18] To some extent, New Zealand's position parallels that of Canada, but New Zealand has been committed to extensive reforms of its domestic economy.

It is generally accepted that consumers benefit from increased competition. This was the motivation for domestic deregulation of the airline industries in most countries. In Canada, deregulation led to consolidation and monopoly power greater than Air Canada had enjoyed under regulation, but there is substantial debate over whether this was a necessary outcome, based on market structure, or a normal failure of a company based on bad business decisions. For policy makers to take the critical step toward internationalizing the Canadian industry, it will be necessary that they believe there is a good chance that increased competition will actually appear and that it will be broadly based, providing service to small cities and disadvantaged regions, rather than being restricted to the top city pairs.

In Australia, the merger of the government's domestic airline and its national carrier prior to privatization destabilized the competitive balance with the existing domestic rival. Although the market has proven to be contestable, it is questionable that new entrants can survive. The debate will continue, but international consolidation is also occurring, through acquisition or alliance.

Foreign ownership restrictions appear, superficially, to be a domestic decision. In practice, however, the protectionist Chicago-Bermuda regime tempers these decisions to a large extent. The ability of a country to negotiate bilateral rights is strongly related to the "national" character of the airlines that will utilize them. This is certainly the case in Australia and New Zealand. Both countries have been prepared to allow foreign airlines to hold a 100 per cent share of a domestic carrier, but problems arise with foreign equity for the international operators. The situation is exacerbated when one of the major foreign airlines interested in investing in the Australian and

[18] This dynamic is explored in Kaduck, 1996.

New Zealand airline industry is perceived as being majority-owned by a foreign government.

Government bureaucracies are required to bargain for the interests of domestic carriers, and it is not always clear that they separate the benefits derived for the carrier from the national interest.

The transactions required by the Chicago-Bermuda regime form the basis for decisions, but the transition path to liberalization is also critical. There is a natural resistance to unilateral liberalization among negotiators because such actions are not "counted" in future liberalization efforts. Air Canada made use of this form of argument when it suggested that cabotage was acceptable as long as the US offered the same rights.

The persistence of the Chicago-Bermuda regime, with its attendant foreign ownership restrictions, is remarkable in a globalized free trade economy. Even in large countries where aviation plays a key role – and even if the alternative to liberalization is monopoly power – a variety of domestic political forces continue to reinforce it.

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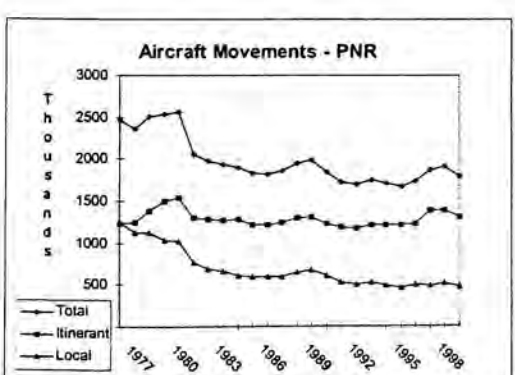
A Survey of Aviation Trends in the Prairie and Northern Region

Geoffrey Horner[i], Transport Canada, and Barry E. Prentice, Director, Transport Institute, University of Manitoba

The Prairie & Northern Region (PNR) encompasses the three Prairie Provinces and the three northern Territories. This survey analyses the regional performance of aviation, the air carrier industry and passenger flows. Subsequently, the economic trends and conditions affecting the PNR air market are examined. Much of the downturn in the aviation industry during 2001 has been attributed to the terrorists' attacks in September and subsequent consumer reaction. While data are still fragmentary, the impact of this attack is placed in context in the final section.

Regional Aviation Profile

Aircraft activity is the sum of itinerant and local movements. Loosely defined, local movements have the same origin and destination, while itinerant movements have different origins and destinations.



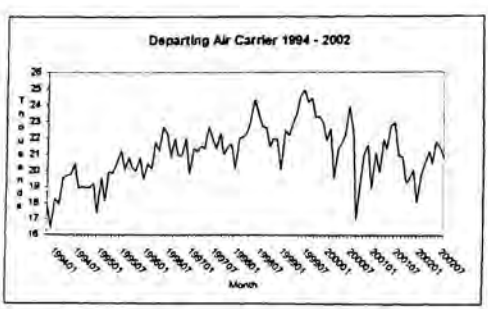
Since 1981, total aircraft movements have trended down due largely to lower activity in the local movements sector. This reflects a fall off in recreational flying and in flight school training.

Competition by the air carriers drove the activity of the itinerant sector up to 139,000 movements during the 1995-1999 period. This is the third highest level of activity since 1977. In 2000, despite a robust Prairie economy, the five-year rally ended. Central to this retrenchment was the take-over of Canadian Airlines by Air Canada producing a coordinated flight schedule that eliminated many duplicate city-pair flights.

PNR Air Carrier Frequency

The PNR monthly departing air carrier fleet since January 1994 was compiled from data listed in the Official Airline Guide. This exercise generates a theoretical level of service provided by air carriers to the traveling public. Cancellations due to inclement weather and mechanical problems cannot be incorporated into the results. Some prominent regional items are:

- The consolidation of Air Canada and Canadian Airlines in the summer of 2000 produced 25.5 percent less air carrier departures from September 2000 to October 2000; and
- The departure schedule is marginally lower during first nine months of the 2002 compared to 2001, reflecting Canada 3000's withdrawal from operations.

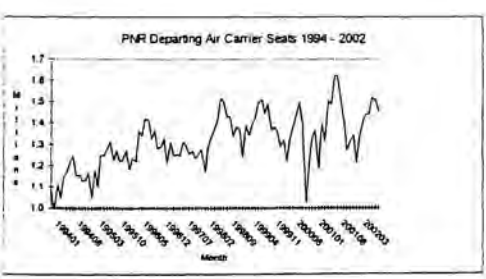


With respect to the latter item, other air carriers may increase their schedule to accommodate unfilled demand. As a result, the 2002 flight schedule may be understated.

Major Airline Departure Frequency



Throughout the region air carrier services provided by the major airlines are illustrated in the monthly Departing Air Carrier Chart. By the summer of 1999, the total departing air carrier flights peaked at 25,000. Historically, Canadian Airlines had been the dominant carrier in PNR. By July 2000, Canadian Airlines increased its frequency to record levels. At the same time, Air Canada had reduced its frequency to 3,500 departures. In the latter half of 2000, total air carrier services operating in western Canada had fallen below 17,000. Air Canada's service levels in 2001 were slightly above Canadian Airlines' historical frequency. Expectations for the summer of 2002 call for 21,500 total departures with Air Canada's schedule posting almost 10,000 departures.

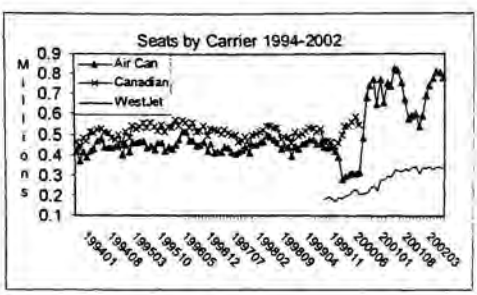


The total monthly departing air carrier seats are illustrated in the Departing Air Carrier Seats Chart. The October 2000 departing seats are the lowest since 1994; a result of the Air

Canada-Canadian Airlines schedule integration. The schedule for the first nine months of 2002 (September) is 13 percent less than the same period in 2001.

PNR Departing Seats By Air Carrier

A profile of the monthly Seats by Carrier is illustrated from January 1994 to September 2002.



To September 2001, Canadian Airlines provided more seats than Air Canada. At the height of the competition between them, 1.2 to 1.4 million seats were offered during peak periods. In 2001 and into 2002, peak departing seats are rarely above 950,000. Comparing the first nine months of 2002 to 2001, Air Canada's schedule indicates a 7.8 percent reduction in departing seats while WestJet increases by 2.2 percent.

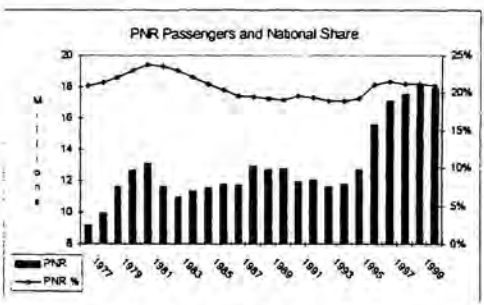
In 1994, aircraft operating in PNR had an average of 60 seats. In the first half of 2001, the monthly average air carrier seats ranged from 67 to 69 seats. This increase reflects Calgary International Airport's ability to attract transborder and international flights. The first nine months of 2002 generates a 70-seat average.

PNR Passengers

The majority of the region's passenger traffic (69 percent) takes place in Alberta. With the fastest growing population and the most

dynamic economy Alberta's share is likely to grow larger. In 2000, Alberta accounted for 57.2 percent of the PNR population and 66 percent of the nominal GDP in the PNR. Calgary International Airport is the dominant hub of the region with 45 percent of PNR passenger traffic.

The large run-up starting in 1995 is attributed to the launch of low cost carriers such as Greyhound and then WestJet in 1996. Even with this activity, the share of the national market has not appreciated and has been stable in the 21 percent range over the past five years as illustrated in the right side scale.



Passenger flows experienced sharp reductions during the recessions of 1980-81 and 1990-92. A minor passenger reduction is noted in 2000, but passenger flows in PNR could fall from 1.5 to 2 million by 2002, considering the effects of the previous recessions. A recovery in the US economy could offset some of the losses in this forecast, but the prospect of renewed growth remains uncertain.

Economic Trends and Conditions

Consumer demand for air transport is sensitive to changes in prices, incomes and quality. This varies amongst individuals and by the reasons for travel. Generally, leisure travelers are more affected by price changes than business travelers. Overall, the level of demand rises and falls with the underlying tempo of the economy.

Aggregate Demand

Throughout 2001, solid economic growth on the Prairies moderated largely as a result of slowing US consumption. Despite the retrenching regional economy, PNR outperformed the nation that has been hard pressed to skirt the recession. Canada posted its ninth consecutive year of growth at 1.5 percent while the PNR economy fared better at 1.8 percent.

The fundamentals of maintaining the Canadian economy were instituted as the year progressed. The Bank of Canada discounted the prime rate 275 basis points to allay business and consumer confidence issues. The US Federal Reserve cut its lending rate eleven times in 2001 to 1.75 percent. This action reflects the US central bank's continuing concern over the overly sluggish state of their domestic economy. Such rates, coupled with the low Canadian dollar, bode well for the Prairie economy with its export based manufacturing industrial base. Barring any implosion of the financial markets or other catastrophic event, the economy should rebound by mid 2002 to traditional levels.

Manitoba and Saskatchewan were less influenced by the continental slowdown because of the dominant position of agriculture and food processing in their economies. Nevertheless, a sharp economic deceleration has materialized, particularly in Saskatchewan where crop production was truncated by drought. Manitoba's export oriented manufacturing sector was curtailed while agriculture maintained its pace. Alberta was able to sustain several price shocks on the energy front. With the US favouring North American oil stocks, investments in the Athabasca Oilsands have been maintained in the face of lower world prices for oil. Despite Alberta's enviable fiscal status, some selected spending cuts have been targeted to maintain their aggressive debt reduction program.

The North presents a mixed economic picture with Yukon experiencing royalty revenue shortfalls, as metal prices remain soft. A critical factor in 2002 will be the final decision of the route of the

pipeline currently favouring the Alaska Highway route. The Northwest Territories with the diamond industry in full flight, sports an exploding manufacturing sector with annualized increases over 150 percent. Nunavut still seeks some resolution to its fiscal constraints but has the prospect of several diamond mines coming on line this decade. The discovery of at least six new diamond deposits in the Kitikmeot region of Nunavut is creating a heightened interest in the exploration industry. The deposits have been found in a cluster of volcanic kimberlite formations, called pipes, southeast of the Arctic coast community of Kugluktuk.

Airline Costs

Fuel prices are expected to remain well below the 2000 level throughout 2002. The global economic slowdown is creating a surplus supply that will inhibit any price increases, save a concerted effort of the oil producers to cut back exports. Despite attempts to gain a coordinated reduction, the oil exporters have yet to tighten supplies in a significant manner.

Globally, aviation fuel represents 8 percent of total demand. With a reduced air carrier profile, a North American surplus in the range of 11-12 percent (nearly 1 percent of global supply) is available. Consequently, fuel prices are unlikely to be the source of fare increases in the near future.

The airline industry in Canada remains unsettled in the aftermath of September 11th characterized by the demise of Canada 3000. Even with an 80 percent market share, Air Canada is not invulnerable. After losing over $1 billion during 2001, the shareholder equity is negative. In late December 2001, Air Canada announced a sale-lease-back agreement with GE Capital Aviation Services Inc. for $Can 565 million.[ii]

The end of the "no involuntary layoff" condition of the merger ended in 2002. Air Canada announced 10,000 job cuts in late 2001, but will likely end up with more.

The ability of Air Canada to raise fares is limited for both leisure and business travelers. Discount operators, like WestJet, are putting a ceiling on leisure traffic ticket prices, as well as eating into business traffic where their flights are frequent. Air Canada has responded with its Tango brand to halt the growth of discount competitors. Charitably, Tango cannot be expected to add much to Air Canada's profits, but it does help to keep passenger numbers from falling further.

In business travel, a new competitive threat is forming from time-share private jet. For various reasons, including the requirement for a regulatory framework, the time-share option is undeveloped in PNR. However, two cases of corporate time-share turbo-prop aircraft have operated in Calgary and Edmonton. When the regulatory processes are complete, expectations that this niche market will expand to meet corporate demand. At this time, the scheduled carriers are unlikely to feel much market share loss, but this phenomenon can only grow if business ticket prices increase.

New Security and Safety Measures

In the December 10th, 2001 Budget Address, the federal government announced a five year $7.7 billion program to counter terrorism. Among the measures, an agency will be established to assume security operations at airports. The cost of this operation was estimated at $2.2 billion (i.e. the purchase of explosive detection equipment, training, air marshals and staffing of security posts, one time costs for aircraft modifications (e.g. cockpit reinforcement and other associated costs).

A ticket surcharge of $12 per one-way trip for all air travel conducted through airports with security facilities will be implemented by April

2002 to pay for additional security. This could have a significant impact on air traffic in short haul markets. For example, the discount airfare between Calgary and Edmonton is under $50. The new security charge is equal to a 20 percent fare increase. Ultimately, this charge will make the airlines less competitive with luxury high-speed inter-city buses, or private automobiles. The $24 security charge (round-trip) is reported to increase average airfares by 5.9 percent for Air Canada and 15 percent for WestJet. Assuming greater price elasticity amongst WestJet's leisure travelers, the quantity of travelers could fall by more than 15 percent, while Air Canada would experience at least a six percent loss.

The magnitude of the air security charge is not generally recognized. For the purposes of comparison, the charge to travelers originating at the Winnipeg International Airport will be equal to half the annual operating costs of this airport. On the other side of this equation, the airlines will no longer be responsible for providing passenger screening. The benefits are unlikely to be passed on to consumers, but may hold down general fare increases.

Insurance Coverage

Insurance premiums are expected to surge in the aftermath of September 11th. Some evidence of this has been seen with passengers paying a one-way $3 surcharge by some airlines. The airports are also likely to face higher insurance costs that will indirectly be passed on to consumers.

Trip Substitution (Modal and Telecommunication)

A decline in the demand for air travel has already occurred. Whether or not it is a temporary change is uncertain. First, the "aircraft fear factor" has been heightened. Under normal conditions, this would abate, however, a prolonged military action could extend this "anxiety" through 2002 and beyond. Second, the longer waiting

times due to enhanced security measures can transfer passengers back to the surface modes especially on the short to medium haul trips.

The use of video conferencing to replace air travel is difficult to quantify. Anecdotally, more video conferencing is occurring, but cost and quality is still an issue. A greater threat to the airlines is Internet based conferencing. As the bandwidth keeps expanding, low cost and convenient video conferencing may soon be a reality.

Nav Canada

Air navigation fees are an additional cost faced by air travelers that is outside the purview of the airlines. Nav Canada provides these services on a not for profit basis, but their charges are very sensitive to air traffic volumes. Most of their costs are fixed.

Nav Canada is facing a $145 million shortfall on revenues of $850 million in 2001/02, largely attributed to September 11th. Nav Canada expects to compensate by:

- Drawing down from the $30 million reserve;
- Implementing higher efficiencies; and
- Posting a 6 percent fee increase as of mid-October.

Recently, Nav Canada announced its interim financial results for the three months ending November 30, 2001. The results reflect reductions in air traffic as a result of the September 11th terrorist attacks and the decline in the economy. Revenues for the first quarter were $246 million with total operating expenses for the period at $185 million, including salaries and benefits of $126 million. Revenue over expenses (profit) was $11 million.

Economic Downturn Versus Terrorism

In the first half of 2001, and with a slowing economy, the aviation industry was struggling. This latter half of 2000 had been reduced by the Air Canada-Canadian Airlines consolidation. In August 2001, PNR total aircraft movements responded with a 6.9 percent jump and 2.9 percent nationally compared to the same period in the previous year. September 11th temporarily halted aviation and subsequently reduced demand. A comparison of September 2000 to September 2001 identifies total movements as declining by 6.4 percent in PNR and 9.8 percent nationally.

Much media attention was given to the terrorist attacks of September reducing air demand. Without diminishing the tragedy, the reduced demands for air services in PNR were well entrenched before September. The comparison of preliminary total aircraft movements at PNR sites with air traffic control[iii] illustrates the position prior to September and subsequent activity.

	May	Jun	Jul	Aug	Sep	Oct	Nov
2000	107,204	110,797	112,175	104,834	98,747	107,689	91,302
2001	102,076	106,886	112,579	112,082	92,458	97,812	89,519
Percentage	-4.8%	-3.5%	0.4%	6.9%	-6.4%	-9.2%	-2.0%

The traffic declines in September and October are larger than occurred in the spring months and are consistent with the response to September 11th. November 2001 appears to be tracking close to previous months consistent with an economic slowdown. If this trend continues the impact of the terrorist attack could be short lived in the PNR.

Observations

The PNR is a well-established aviation market that is exposed to the vagaries of national and international economic forces. Aviation is

very sensitive to macroeconomic growth and this is evident in the tracking of passenger numbers with periods of contraction and expansion. The last five years have been more dynamic for many reasons. New discount airlines emerged, while the large full service airlines merged and streamlined, and several carriers have entered and exited the industry.

The future of the aviation industry remains uncertain. Direct costs, like fuel and financing rates are falling, but higher charges for navigation, insurance rates and new security fees are likely to offset any fare reductions for passengers. On balance, Canada is too reliant on the US economy to track an independent path, but the PNR appears to be somewhat more independent because of its resource base.

This survey raises some interesting topics for further research. The competitive challenges of "fractional" corporate jet ownership and video conferencing are only beginning to appear. Much will depend on their costs, convenience and effectiveness as substitutes for scheduled air passenger services.

The role of Alberta in shaping the aviation industry in PNR is another interesting subject. Alberta has the fastest growing and youngest population amongst the Prairie Provinces, and its economy is twice as large as Saskatchewan and Manitoba combined. Calgary has already emerged as the dominant airport hub in the PNR, and its influence can only grow. Will Calgary draw traffic away from other airports in the PNR, or siphon traffic from larger gateways, like Vancouver and Toronto, or both?

The surge of air travel in the PNR during the last half of the 1990s coincided with the emergence of discount airlines. Whether the change in quantity demanded reflects a movement along the demand curve (a price response), or simply a demand shift caused by the growing economy (an income response) is likely to become evident in this decade.

[i] The views expressed are those of the author and not necessarily those of Transport Canada.

[ii] The transaction involves 16 A-320's and one A-319. Additionally, the leasing of six new A-319/A-320 aircraft in 2003 and 2004 will permit the sale of six older aircraft with an average age of 12 years.

[iii] PNR airports with towers are: Calgary International, Calgary/Springbank, Edmonton City Centre, Edmonton International, Edmonton Villeneuve, Regina, Saskatoon, Whitehorse, Winnipeg International, Winnipeg/St. Andrews and Yellowknife.

ICT, B2B, B2C, EDI etc. – Making Sense of the E-Business Alphabet in Transportation

Greg Peterson, Science, Innovation and Electronic Information Division, Statistics Canada
Gord Baldwin, Transportation Division, Statistics Canada

1. Introduction

In the late 1990's, electronic commerce and the use of information and communications technologies (ICTs) was seen as a means of reaching new customers at little cost. This reduction in entry barriers was to create new opportunities for small and medium sized businesses, in particular, to become a competitive force in the global marketplace. With the burst of the dot-com bubble, focus has shifted from the use of ICTs to sell goods and services to the use of ICTs to reduce costs, including managing more effectively their supply chains.

This dot-com shakeout saw a reduction in the percentage of Canadian businesses selling on the Internet, from 10% in 1999 to 6% in 2000. Despite this decline, the value of sales over the Internet advanced by 73% over the same period. Electronic commerce continues to occur, albeit from fewer, larger players.[1]

However businesses use ICTs, the transportation sector will be affected. As businesses better manage their supply chains, they will look to their transportation service providers to provide more integrated logistics solutions (i.e. information on delivery status). Electronic commerce, particularly in the Business-to-Consumer (B-C) market will change the way in which goods are distributed.

In addition to making their supply chains more efficient, the availability of broadband Internet access also permits the development and deployment of digital products, reducing the need for music, videos and published text to be transported on physical media.

The transportation sector is also uniquely positioned to benefit from increasing use of ICTs, both in terms of making their own operations more efficient, as well as to sell their products over the Internet.

The Canada Transportation Act Review (CTAR) suggests four ways in which e-business can have an impact on transportation services[2]. First, the shift from conventional to electronic products will reduce the requirement for transportation services. Second, the adoption of efficient logistics management practices, permitted by the use of ICTs, by the users of transportation services will have an impact on the distribution patterns. Third, businesses in the transportation sector can use ICTs to make themselves more efficient. Finally, these same businesses can use electronic networks to sell their services, thus expanding their market.

This paper suggests how the transportation sector may be affected by the increased use of ICTs. It then goes through each of these potential impacts and, using data from Statistics Canada's Survey of Electronic Commerce and Technology (SECT), shows how real the threat or opportunity may be at the present time.

2. E-business and logistics

Electronic business practices include those that involve the movement of information over electronic networks that permit a business to operate more effectively. Of particular interest in this paper is the ways in which these practices are used to organize logistics functions.[3]

With respect to inbound logistics, the Internet offers the potential to better manage scheduling, shipping, and warehousing; and demand

forecasting and planning – all in real time and available across the enterprise, as well as to suppliers.

In terms of company operations, the Internet offers the ability to exchange information within the enterprise. For instance, production units could be linked to sales units to reliably promise delivery based on real-time information.

Finally, in terms of outbound logistics, orders can be processed regardless from where the order is placed (end customers, sales personnel, other marketing channels). Also orders can be automated. Product development and delivery status can be made available to customers. More advanced features would include integration with customer forecast systems and a more integrated management of information flows to and from the customer.

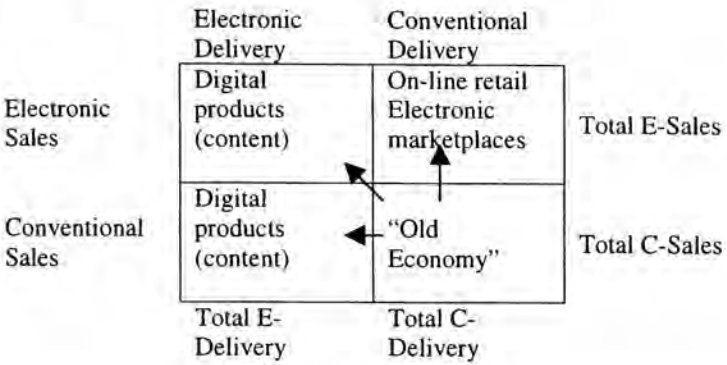
Before examining how ICTs are being used by Canadian business, it is useful to look at how these technologies may have an impact on logistics.

2.1 Conventional vs. digital products

In recent years, much of the preoccupation on e-business was the development of electronic commerce and the readiness of businesses to participate in this activity. With new technological advances, such as applications of broadband, attention is shifting to the electronic delivery of products.

Figure 1 illustrates the difference between electronic commerce and electronic products. Electronic commerce is in the first row. These are products that are sold over computer networks, regardless of the means of delivery (electronic vs. conventional). There is an increasing emphasis on the first column; the value of products delivered over the Internet, regardless of the means of sales. This illustrates the potential change from "old economy" conventional product, conventional sales to electronic product, electronic delivery or both[4].

Figure 1: Electronic (E-) and Conventional (C-) Sales and Delivery



The shift from conventional product raises the potential impact of what the CTAR calls the "dematerialization" of commodities on the transportation sector. Will the transportation sector be adversely affected with the increasing use of electronic networks to deliver digital products?

2.2 B-B vs. B-C

While much attention has focused on business to consumer (B-C) transactions over the Internet, they represented only one-fifth of Internet sales in 2000.[5] The solutions provided by transportation service providers are different depending on the market. For B-C transactions, for instance, the delivery through the "last mile" becomes important. Instead of moving large quantities of materials from one place to another, the transportation of goods to consumers usually involves the movement of small packages to more widely dispersed areas. The result will be a "fragmentation of freight consignments, particularly at the level of urban distribution."[6] The distribution of many small shipments may be good news for the

courier portion of the transportation sector. Operating revenue of businesses in the Canadian couriers and local messengers industry increased in 1999 to $4.6 billion. "This represents consecutive annual increases of 9% from 1997 to 1999. By comparison, the overall Canadian economy rose in a range of 3% to 5% over the same periods."[7]

In addition the industrial makeup of B-C vendors is different from B-B sellers. Not surprisingly, according to the Survey of Electronic Commerce and Technology, the most important industry in the B-C market is retail (30% share) followed by wholesale trade (12%), transportation (12%) and accommodation and food services (9%). By contrast in the B-B market, the largest share is held by manufacturing (22%), followed by transportation (14%), wholesale trade (13%) and retail trade (8%). It is important to note two things. First, the transportation sector has a significant portion of both the B-B and B-C markets. Also, the impact to transportation will differ depending on the industry they serve.

2.3 Distribution systems

ICTs are enabling transportation companies to move from suppliers of transportation services to providers of complete logistical support. Here, logistics extends beyond the movement of goods to the management of a complete supply chain from ordering to final delivery, including the handling of information.[8]

In order for this to happen, there should be a corresponding increase in the use of ICTs, more intensive use of these technologies and more investments in ICT commodities.

The service requirements that have to be managed by the transportation service provider will vary depending not only upon the class of customer as discussed above, but also on the scope of operations. Businesses offering products or services on a strictly local service will focus exclusively on "last mile" solutions. Those that are global in scope will additionally be concerned with global

distribution, customs, taxes and standards. This is depicted in Figure 2[9].

Figure 2: Increasing complexity of scope

Service problems to be solved	Last mile, local logistics and transportation network	National logistics and transportation network	World logistics and transportation network	Customs, taxes and standards
Local service	X			
National service	X	X		
Global service	X	X	X	X

Hence, the logistics solutions being sought by Canadian businesses will not be homogeneous across industries but will depend upon, among other things, their market (B-B and B-C) and the scope of their operation. Similarly, the impact of e-business practices will not be homogeneous among transportation carriers.

Falling out of this are two broad issues. First, are the main transportation users capable of engaging in these activities? Second, how is the transportation industry equipped to become partners in this activity?

3. The impact of e-business on transportation

3.1 Digital products

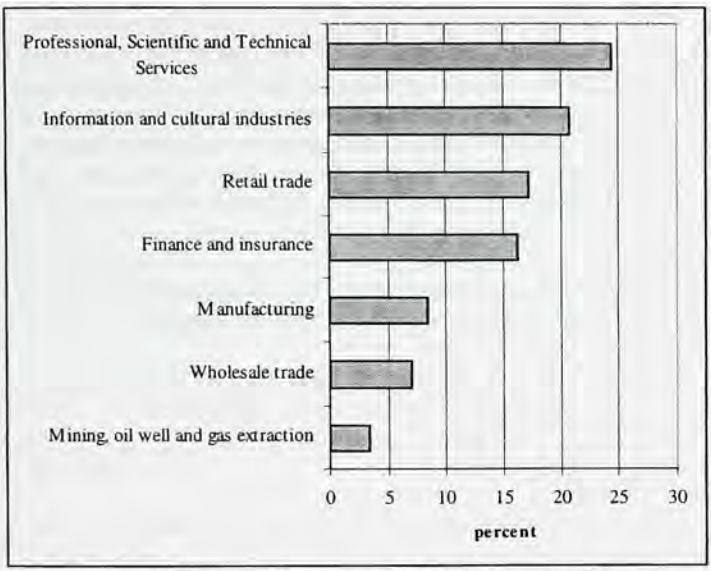
Digital products, refer to the goods and services that can be ordered and delivered over the Internet. These include products such as: music, videos, games, computer software, online newspapers and consulting services. As defined in SECT, a digital product could also include downloadable documentation. These services are offered by a wide variety of industries. The issue for transportation service providers is: do they really matter? The percentage of Canadian enterprises offering digital products over the Internet is depicted in Figure 3.

Overall, 3% of private sector enterprises offered digital products on their web sites. These businesses represented 13% of gross business income. Service industries were most likely to offer electronic products. The proportion of economic activity attributable to enterprises offering digital products[10] was higher in these same industries.

There is no evidence that among goods producing or distribution industries that the availability of digital products is widespread.

Among industries that make heavy use of transportation services (i.e. mining, manufacturing, wholesale), comparatively few offered digital products. The impact on transportation of digital products has so far been negligible. This is especially true given that the definition of digital product in SECT is very broad. The percentages above therefore present an upper bound on the percentage of firms offering products that are substitutes for physical products that are distributed by conventional means.

Figure 3: Percentage of enterprises offering digital products for selected industries



Source: Survey of Electronic Commerce and Technology, 2000

3.2 Improved supply chain management

We have outlined above how ICT use enables businesses to adopt more integrative transportation solutions.

SECT does not identify if these activities are taking place, but it is possible to examine which industries are using ICTs that would be required if they were to adopt some of the practices outlined above. Examples of these include: selling over the Internet; purchasing over the Internet; use of EDI, use of an Extranet; and using the Internet to access databases of customers and suppliers.

Sales and purchases over the Internet, particularly in the context of B-B transactions may allow businesses to reduce their transaction costs

and to reduce their inventory levels (and hence their inventory carrying costs). In order for this to happen, transportation providers must ensure that goods move to the right place at the right time.

The use of EDI over a proprietary network offers the similar benefits to their users. In addition to sales and purchases, other information that could move along electronic networks include: order status, demand forecasts, inventories (i.e. continuous replenishment) and client information (i.e. CRM). These later applications require businesses to access the databases of their customers and their suppliers.

Table 1: Percentage of economic activity attributable to businesses engaged in selected e-business practices

	Purchasing over the Internet	Selling over the Internet	EDI not on the Internet	Extranet
Forestry, logging	10	1	10	2
Mining and oil & gas extraction	33	1	62	34
Manufacturing	45	18	62	45
Wholesale trade	24	41	64	40
Retail Trade	32	20	37	25

Source: Survey of Electronic Commerce and Technology, 2000

Table 1 shows the percentage of economic activity attributable to enterprises that use selected ICTs. These percentages represent the percentage of gross business income in a particular industry attributable to those enterprises using a particular ICT. This variable is more relevant than the number of businesses engaged in this activity. It indicates that the proportion of the market in selected industries attributable to businesses engaged in these activities, both basic connectivity as well as more advanced practices, is important.

Businesses involved in these activities account for a significant proportion of gross business income and are therefore important.

While we have no direct evidence that their applications of ICTs are to improve their logistics management practices, information is flowing along networks. If business enterprises are becoming more likely engaged in these e-business practices, then transportation service providers that use these technologies will benefit.

Just as important as indicators of ICT use are measures of information flowing through these networks. While the 2000 SECT contains limited information on how these technologies are being used, the respondents are asked if they use the Internet to obtain information from their suppliers' and customers' databases.

Again, we see that for industries that are heavy users of transportation services, businesses that use the Internet to access databases of suppliers and customers is significant in terms of the GBI attributable to that industry.

Table 2: Percentage of economic activity attributable to businesses accessing databases of suppliers and customers

	Accessing databases of customers	Accessing databases of suppliers
Forestry, logging	42	52
Mining and oil & gas extraction	24	58
Manufacturing	44	55
Wholesale trade	34	59
Retail Trade	25	44

Source: Survey of Electronic Commerce and Technology, 2000

3.3 E-business readiness in transportation

Business enterprises that use ICTs that can support more advanced e-business practices account for a significant proportion of economic activity. Just as these businesses can use ICTs to reduce operating costs, so can enterprises in the transportation sector. Indeed, adoption of these technologies may become increasingly important to plug themselves within their customers' supply chains.

From SECT, overall, in the transportation sector, nearly one in five enterprises used the Internet in 2000. A much smaller percentage (13%) had a web site. Similarly, only a small percentage of the enterprises had adopted more advanced e-business technologies. These included the ownership of Extranets (4%), Intranets (7%) and EDI over proprietary networks (7%). Additionally, 15% of these enterprises purchased goods or services over the Internet.

Table 3: Percentage of enterprises using selected ICTs

Mode	Internet	Web site	Extranet	Internet Purchase	EDI
Air	93	73	1	28	5
Rail	90	70	26	20	32
Marine	87	79	28	9	29
Truck	53	6	3	12	4
All tspt.	58	13	4	15	7

Source: Survey of Electronic Commerce and Technology, 2000

While these percentages are small, the businesses that used these technologies are not. For instance, the enterprises with EDI over proprietary networks accounted for 46% of economic activity. Similarly businesses using Extranets accounted for 33% and Intranets 58%. The implication of all of this is that it is the larger businesses engaging in the use of these technologies. Smaller businesses may find it increasingly difficult to fit into the value chains of their larger clients.

There is significant variation within the transportation sector. Table 3 shows the penetration rate for various ICTs for selected industries in the transportation sector (air, rail, marine, and truck). We see here that air, rail and marine transportation enterprises are more likely to be engaged in e-businesses practices.

3.4 Electronic commerce in the transportation sector

Businesses in the transportation sector have a significant share of the total e-commerce market in Canada. Internet sales in the transportation sector rose to $990.2 million in 2000 from $164.3 million in 1999[11]. Over one-third of these sales were by the air transportation industry.

Only a small percentage of the transportation sector sold over the Internet in 2000 (2%). These enterprises, however, accounted for 23% of gross business income. It is the larger businesses engaged in this activity.

The air transportation industry is the best equipped to sell over the Internet. Nearly one-third of these enterprises (30%) sold online. These businesses accounted for 88% of gross business income. In the business to consumer market, air transport sales over the Internet amounted to almost three-fifths of B-C transactions in the sector. Air Canada credited the greater than 80% Internet booking of its low-cost Tango service as one method to maintain lower costs and lower fares.[12]

A significant proportion of Internet sales in the air industry was for export. E-commerce sales by this industry accounted for about one-fifth of all e-exports for all products and services.

Most other industries in the transportation sector were not as active in the e-commerce market.

4. Conclusion

The adoption of e-business practices by Canadian businesses offer tremendous potential to improve the way they do business. This, in turn will have an impact on the transportation sector. This paper examined how these practices may impact on the transportation sector in terms of the dematerialization of physical products, the use of ICTs by both users and providers of transportation services and electronic commerce in the transportation sector.

Industries that are making digital products available over the Internet are not significant users of the Internet. Manufacturers and wholesalers are less likely to offer digital products than information and cultural industries and professional, scientific and technical services.

Canadian businesses are using e-business enabling technologies. The percentage of gross business income accounted for by businesses that use the Internet to buy and sell products as well as EDI over proprietary networks is significant.

The take-up of these technologies by the transportation sector has not been as swift. Nor has the adoption of these technologies been uniform across all modes. The reticence to embrace their use may make it more difficult for transportation service providers to integrate themselves into the supply chains of their more important customers.

The transportation sector, however, holds a significant share of the electronic commerce market, both in sales to consumers and to businesses. This is particularly true in the air transportation industry.

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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Innovation and Growth : two Success Factors for Logistics Third Parties

Executive Summary

Our subject is to show why Logistics Third Parties are developing Efforts of Innovation. In that way, they are facing a need of huge investments. Growth and alliances appear more and more necessary.

The paper discusses many results of a mail survey among French Logistics Service Providers. First, an analysis of reliability through a factor Analysis has been conducted. Then many tests about two propositions have been made :
Proposition 1: The Technological Potential of the logistics service provider is correlated with the duration of the relationship with the customers.

Proposition 2: The Technological Potential of the logistics service provider is correlated with the degree of involvement in a relation of joint flow management.

The main result is that the technological potential of logistics service providers provides competitiveness for the relationships and moreover for the whole Supply Chain. To be innovative can be viewed as a yardstick of the provider's autonomy and capacity to joint flows management. Innovation and Technological potential thus emerge more and more as a strategic trajectory of pertinent differentiation for the logistics service providers.

Innovation and Growth : two Success Factors for Logistics Third Parties

Christopher (1997) notes that the challenge of the contemporary firm lies in enhancing the technological potential, a lever that reduces time frames and enhances the reliability of logistics. The objective of this article is to show that in a highly competitive context characterized by time compression, technological potential becomes a key variable and a primordial means of differentiation for logistics service providers. Technological potential consists in the capacity to implement new organizational and technical solutions in order to improve flows management. Two propositions on the relationship-related consequences will be tested. The analysis of interorganizational relationships in terms of the technological potential and thus innovation has enriched classical models of power that essentially examine firm's arbitrations along the conflict-partnership continuum (Rosenbloom, 1999). Our objective is to build on the idea of Alter (1999), who concluded that technological potential, an indicator of an organization's innovation capacity, is a superior structuring source of power for logistics service providers' strategies. This approach can be viewed as part of the analysis of the role of innovation in contractual theories and consequently in the Williamson paradigm (Williamson, 1985) about market and hierarchy.

From 1970 to the present, the company has passed from the era of domination strategies by cost to differentiation strategies by customer service. To be able to offer growing levels of personalization, production and distribution companies have accepted fragmentation of order size and a greater diversity of flows. The number of references, specifications and delivery dates has tended to inflate. The generalization of Just-in-time organizations is a managerial response to that principle of "customer is the king." Simultaneously, some

have begun to question the pertinence of the notion of customer service as a guiding principle of logistics organization. Effort should be exerted only for services "perceivable" by the customer; all other expenses are translated by erosion of competitiveness, even by effects contrary to the perception of quality by the customer. Aurifeille (1997) cites the example of the semi-fresh produce sector, where attempts at logistics innovation consisting in lengthening the duration of product validity have been interpreted by the consumer as a sign of the declining intrinsic quality of the merchandise. Insufficiency in the perception of motivations and expectations of final demand have resulted in losses of market share. Yet customer sensitivity of logistics is poorly understood. Christopher (1997) observed that the consumer has become time-sensitive. Many practitioners now refer to the concept of a "gap in procurement time," defined as the difference between the time it takes to deliver the product and the time the customer is prepared to wait. When a customer places an order, the commitment to delivery time becomes important. Delivery time has become a discriminating product attribute, one that influences the consumer's mood and loyalty in particular. Customers must contend with fast-paced product innovation that reinforces the risks of obsolescence of the merchandise purchased. Companies involved in Supply chains react by implementing flows management through time frames. One example of such control is the ability to quantify the impact the each option or variant of a product on delivery time. Customers can thus adapt their demand if they want a product delivered more quickly. Preeminence placed on mastery of time frames is also stimulated by the trend toward unification of national markets and the creation of diffuse trade zones that have to be served with homogeneous quality.

In this context, subcontracting of distribution to providers able to consolidate diffuse tight flows and to thus cushion the effects of volatility of demand spontaneously become a worthwhile organization solution, and an opportunity for "capable" logistics service providers. Given the skills that they must control, these providers become the prescribers of logistics solutions that enable customers to access control over all the logistics organization.

We postulate that the leadership of logistics service providers lies in their capacity to innovate in the area of joint flows management. Specifically, providers must maintain very close ties to technologies, particularly information technology. This relationship is invariably reinforced as the trend toward reduction of cycle times along the supply chain becomes more pronounced.

1 – Logistics activities, a vector of diffusion of information technologies

What is the theoretical value of the technological potential and technological advantage in logistics management models? Is the growth of logistics a catalyst for the development of information technologies or vice versa? Zaheer and Dirks (1999) posit that information technologies are most often considered as a resource of the firm, i.e. a source of competitive advantage. They are a tool for control and management of internal and external resources. These technologies are sometimes called *economizing* with regard to management and human resources costs (Fabbe-Costes and Colin, 1995), particularly given that they automate and lower the costs of supervision and information processing. With the contract technologies, they constitute an essential aspect of the relationship with external partners. Their development affects the nature of interorganizational relations. They foster the development of cooperative forms of relationships, in particular partnerships and alliances, because information management in real time and efficiency of co-ordination of various production assets are relying to a decreasing extent on geographical proximity and centralized structures. The legal and organizational limits of the firm are tending to dematerialize and disaggregate. The concept of quasi-integration captures the idea of the enlargement the boundaries of the organization, engendered by improved levels and control of co-ordination mechanisms. In the third-party logistics sector, thanks to technological developments and standardization efforts, real-time

information exchange has become omnipresent in routine management and follow-up of operations.

The technological advantage is often discussed and questioned given the effect of the rapid diffusion of innovations, especially in the services sector, where protection and patents are difficult to implement. Commonplace innovation effectively dilutes the role of technology as a competitive advantage. The speed with which innovations spread is a threat to the most innovative logistics service providers, who have developed a number of applications and processes internally. For example, the high speed of diffusion and multiplication of applications produced and sold by computer suppliers, which improve and nurture the permanent renewal of information systems, confers a potentially short lifespan on computer-based innovations. Thus, the development of innovations can quickly negate some of the benefits achieved, by making obsolete equipment that ultimately becomes a disadvantage. Owing to the speed of obsolescence of advantages derived from innovation and technological developments, companies may prefer subcontracting solutions rather than internalizing operations that necessitate technological investments. Without constituting an end in itself, technology offers competitive advantages and serves as a catalyst of change in an organization. In the logistics sphere, information technologies are a lever for improving reactivity. They are tools that allow companies to differentiate while converging toward customer satisfaction.

Logistics service providers seems to be critical vectors of generalization of logistical innovation among shippers. Paradoxically, the level of computer use remains low in the transportation sector, suggesting that penetration of information systems follows the hierarchy of the physical distribution sector: large companies are the primary beneficiaries. Simple owner-operators are poorly equipped whereas large logistics service providers use powerful information systems acquired through significant investment. Mastery of these means, at a cost inaccessible for small

financially fragile competitors, lends additional credibility to large operators. This mastery enables the main providers to position themselves in traditionally internalized activities such as global management of supply chains and warehouse networks. As Paché (1996) noted, technological innovation is also a vector of emancipation for truckers who aspire to rise from their status of simple subcontractors.

2 – Acceleration of cycles and the growing role of technological potential

The end of the 20th century is characterized by the onset of the phenomenal development and innovation in the electronic processors and microcircuits industry. In the space of a few years, calculation speeds and data storage capacity have increased exponentially. On a wider scale, in many industries engineering and testing is fully digitalized and data has become immediately transmissible in large quantities along the chains of partners, suppliers and subcontractors. A major consequence of this is that technology, by accelerating the data preparation and transmission times, has increased the reaction speed to market needs. The duration of cycles has decreased significantly along two axes: new product development and distribution. Christopher (1997) shows that products' life cycles have contracted, particularly in sectors that rely on high technology. In the French automobile sector, the duration of vehicle development was approximately 18 months in the mid-'90s. Manufacturers now aim to reduce this period to less than 12 months by 2001 or 2002. Concerning distribution, delivery times between the date of the order and the date the product is made available have also been substantially reduced. This contraction is a strategic success factor of products. Beginning in the early 1990s, La Londe and Masters (1994) predicted the compression of cycle times through generalization of cross-docking, just-in-time and high reactivity. Today these approaches are grounded in the use of scanning, standard bar codes and standardized E.D.I. techniques between the principal partners. Incompressible limits seem to have been reached, such as maximum

speed for trucks, thus precluding the possibility of reducing delivery time frames. Strategies based on just-in-time may have attained maturity. The foundations of progress now consist primarily in reactivity and supplier involvement in automatic inventory replenishment. The capacity to produce real-time logistics information such as liquidation of merchandise at the stores constitutes a new technological objective for partners of the supply chain. In the new context of globalization and wholesale reduction of time frames, efficiency in logistics necessitates advanced information management and communication systems.

The contraction of cycle times is thus associated with stimulation of innovation. The cost of putting in place new techniques and processes nonetheless remains high: designing specific software, implementing adapted maintenance mechanisms, developing systems to convert incompatible languages, etc. The need to significantly increase the capacity for innovation is a problem that companies can resolve by soliciting input from suppliers and customers. Innovation networks are built to enhance the potential and speed of development of technological projects. New trajectories arising from subcontracting policies in the automobile production sector meet this need (Sauvage and Nahon, 2000). Policies of competitiveness and systematic reassessment of suppliers, whose responsibilities are voluntarily limited, seem to run counter to the search for innovative partners. In this type of model, the Purchasing function controls the selection of suppliers of goods and services based on order books established by the functions that use them (logistics, production, maintenance, etc.). Inversely, the partnership model operates with a limited number of suppliers involved in the most upstream activities (design, engineering, packaging, product development). This model is also not the best adapted to developing reactivity and the innovation capacity of understimulated partners, which are firmly rooted in the organization. Attempts to reconcile these two extremes in the automobile industry have been quite intriguing. This sector apparently favors healthy emulation while encouraging innovation and permanent progress. This "soft" stimulation by the market

purportedly allows some manufacturers to benefit from improved reactivity in terms of technological progress.

The reduction of cycle times and the growing sensitivity of supply chains to time frames call for a two-pronged modification of the outsourcing approach. First, these phenomena render conflict-based sub-contracting relationships founded on exploitation of advantageous power relations poorly adapted or at least paradoxical. Moreover, reduction of cycle times assumes close collaboration with suppliers that can ease the cost of the innovation process. Suppliers selected must be managerial, innovative and reactive. However, they must also be autonomous, to be able to keep abreast of best practices and international expertise. The quasi-integration model (total partnership), owing to its static nature, is not necessarily suitable, particularly because it can hamper permanent progress. The new scales of cycle times call for a dynamic management model, in which the supplier pool evolves according to the principles of healthy emulation.

How does one explain the correlation between the relationship model selected and the technological potential? Logics of power and the quest for a competitive advantage through costs triggers opposition forces and defensive behaviors, whether it be the fight against entrenchment of the "other" in the relationship or the manipulation of dependency factors (Sauvage and Nahon, 2000). Among sub-contractors in the automobile industry, this reaction to power and the pressures of the dominant actor are manifested by segmentation of the customers. The best customers benefit from preferred treatment and assignment of qualified, involved and creative teams. In contrast, teams of lesser value are assigned to less important customers.

Furthermore, the nature of the relationship model adopted appears to be correlated with the technology approach adopted by suppliers and providers. Specifically, we have formulated two propositions related to the third-party logistics sphere:

Proposition 1: The technological potential of the logistics service provider is correlated with the duration of the relationship with the customers.
Proposition 2: The technological potential of the logistics service provider is correlated with the degree of involvement in a relation of joint flow management

3 - Variables studies, methodology and results

The technological potential includes several components.
First, there is the capacity of adaptation and insertion in the information system of the partner : the advantages of EDI, particularly with regard to reducing delivery times. The capacity to connect to customers' systems allows synchronization of operations and real-time management of contingencies. Implementation of these systems is generally costly in terms of competencies, logistics expertise, information systems and marketing.
The capacity to produce certification procedures, sometimes referred to as quality assurance, also appears essential. It contributes to the creation or maintenance of a feeling of confidence between the customer and the provider (Lamprecht, 1995). The use of I.S.O. 9000 assurance certificates allows logistics service providers to reinforce their credibility, particularly in response to calls for tender.
The nature of the array of services offered is another indicator of the technological advancement of the provider. The combination of a high number of new logistics activities is a source of complexity to which the operator responds through advanced processes of coordination, planning and information (Van de Ven, 1976) The number of activities to coordinate was operationalized by the creation of a score ranging from 0 to 7, obtained from the aggregation of Boolean responses related to 7 activities considered innovative.

Concerning the nature of the relationship, two aspects were studied: the duration of the relationship and involvement in joint flow management. Christopher (1997) postulated that above all, joint management, in a perspective of downstream customer satisfaction,

must encompass the critical elements of delivery: punctuality, reliability and quality (absence of errors and shortfalls). Sauvage (1997) found that the critical operational objective assigned to the logistics service provider by the majority of shippers improves the punctuality of delivery. Consequently, to study the effort required to guarantee the punctuality of delivery, two types of effort have been retained: monitoring of procurement (if the input merchandise is not received in time, stock out and delivery delays may occur) and planning of time frames (if the customer does not communicate the planning of deliveries sufficiently in advance, the provider cannot organize its routes, or cannot deliver at the specified time). We have also measured the effort of formalization of operational procedures. Daugherty *et al* (1992) demonstrated the influence of the formalization of third-party logistics on performance and monitoring capacities. Responses were measured based on a seven-point Likert scale.

The consequences of the technological potential on the nature of the relationship with the customer was evaluated by means of a questionnaire mailed to a population of logistics service providers. After we inventoried logistics service providers, 1081 sites were identified. The mail questionnaire was sent in 1997 to the managers of these 1081 sites. The usable response rate was 9.15%.

Results

There are formidable doubts as to the pertinence and operationalization of constructs inspired by the theory, at least with regard to the domain of applied research. To structure the information collected, we performed Principal Component Analysis to elucidate the principal dimensions of the constructs. The information contained in the various items is summarized. Principal Component Analysis (PCA) was then performed on standardized variables (centered and reduced) given the existence of different measurement scales. Because the research was conducted in a new area of experimentation, we observed the rule proposed by Ford *et al*

(1986) : the loading, which underpins the correlation to the factor axis, or the percentage of variance explained by the most strongly correlated factor axis, must be greater than 0.4. We were thus able to conserve all the items. For explanatory variables presumed to measure the same construct, we also performed an analysis of their internal coherency by Cronbach's alpha (α). For constructs that rely on exploratory measures, Cronbach's α can only be greater than 0.5 (Perrien *et al*, 1984).

Statistical analysis of the technological potential reveals that only one dimension encompasses 53.5% of the information (Figure 1). This factor axis is interpreted as the technological effort of the provider, intended to satisfy the customer. Analysis of the nature of the relationship reveals that two principal components cover 76.4% of the information. These two dimensions are interpreted as duration of the relationship and involvement in joint management of logistics activities.

Figure 1: Structure of constructs

% of variance Explained	Explanatory variables	Cronbach's α (loadings)
Technological potential		$\alpha = 0.57$
53.5% of variance is explained by a single factor	Nature of services provided	(0.74)
	ISO 9000 certification effort	(0.75)
	Information exchange technology	(0.69)
Nature of relationship		$\alpha = 0.73$
76.42% of variance is explained by two dimensions interpreted as: -involvement in joint management of logistics -duration of relationship with shipper	-involvement in co-control	
	control and planning of time	(0.94)
	Management of supply flows	(0.93)
	formalization of dysfunction management procedures	(0.51)
	-duration of relationship	(0.94)

Figure 2: Results of hypothesis test

Dimensions of nature of relationship	β coefficient	t test	R ; R^2 F value observed
Duration of relationship with shipper	**n.a.**	**n.a.**	**n.a.**
Involvement in joint management of logistics	**0.45**	**4.04 significant at 0.0001**	**0.21 ; 0.19 F = 9.0 sign. at 0.0001**

The proposition that the nature of the relationship model adopted is correlated with the technology relation maintained by the logistics service providers can be partially accepted. The technological potential of the provider influences its degree of involvement in a relationship of joint flow management.
The correlation with the duration of the relationship cannot be retained. Technological potential is a necessary but insufficient condition for the continuity of the relationship. The main obstacle remains behavioral. The ideal of perfect reactivity to the customers' requirements clashes with power cultures and supplier-customer logics with varying degrees of conflict, which are much stronger than the attraction of a rewarding technological collaboration. This would explain the absence of a correlation.
Another possibility is that an endless quest for very intense technological collaboration contributes to the instability of relationships. Baldwin and Clark's (1997) work on modular production advocate this point of view. Modularity consists of creating a process or complex product based on subsystems designed independently but functioning together.

The statistical results indicate a trend toward modular production in the French third-party logistics sector. The providers that present considerable technological potential are highly involved in managing logistics without being assured of the continuity of their relationship. The items used support this interpretation. Certification thus represents a methodological guide, a collection of standardized

procedures according to a rigorous order book, that allow reproduction and coordination of logistics with a "routine" level of performance, regardless of the customer. Modularity requires powerful information systems between partners to be able to connect all the teams that work in the network with management of "modern" logistics (La Londe and Powers, 1993). Our results suggest that the information technologies used are highly personalized: 56 out of 99 sites have introduced a dedicated line, i.e. a non-standardized communication support that is not usable with another customer. The scope of the phenomenon suggests strong specificity in information systems between logistics service providers and their customers. Indeed, E.D.I. technology is often coupled with a dedicated line, which implies that the standards and formats of standardized communication seem insufficient for some aspects of the logistics service provider-customer relationship.

Conclusion

The development of technological potential constitutes a crucial strategic orientation for logistics service providers. The functional status of the provider is evolving from that of an executing subcontractor to that of a joint managing partner in the organization and management of flows. The logistics service provider is gradually taking on the role of key interface in the functioning of information systems, for one central reason: it is best positioned to manage contingencies in the industrial and distributor markets. To quote Alter (1999), it "profits" from the uncertainties of its customers. Its development logic is thus opportunistic, necessarily founded on logistical information and mastery of new technologies. These attributes are indispensable to guarantee reactivity to unforeseen events and continuous adaptation to changing constraints. According to Mason-Jones and Towill (1999), the performance of a supply chain now depends on the capacity of its members to move the decoupling point of information--the point where forecasts and real time data are compiled--as far upstream as possible. The authors use a series of

simulations to illustrate that this capacity can optimize the advantages obtained both from standardized production and from reactivity and production on demand. The technological potential and the management capacities it promises represent a yardstick of the provider's capacity to adapt to market requirements. This capacity thus emerges as a strategic trajectory of pertinent differentiation for the providers.

In contrast, the entrenchment in behaviors of simple executors engenders static organizational forms founded on leadership and power. Subcontractors remain guardians of solutions imposed by their shippers. This subordination exerts an inhibiting effect on development of technological potential. In the automobile industry, Langlet (1999) observes that automobile manufacturers currently regret the absence of prescribing and expert subcontractors. Relationships and services provided are overly dedicated and specific. Economy of scope, competencies and expertise remain difficult. In contrast, the multispecialization of operators would be an interesting strategy that is worth developing. For the SME/SMI fabric, multispecialization of providers seems indispensable to enhance the efficiency of outsourcing of heterogeneous and diffuse volumes. For the large business market, multispecialization offers another advantage: companies can let the customer profit from updating of processes and technologies, along with capitalization of experiences with different shippers. It also favors improvement of processes and reduction of cycle times.

The innovation approach for logistics outsourcing has given rise to strategic perspectives that run counter to traditional viewpoints. We consider the size of the provider as a success factor on the logistics market. "*Small is beautiful,*" dictated by the analysis of the exercise of power in the provider-customer relationship, is increasingly deviating from the new logistic challenges founded on innovation and joint flow management. According to Lieb and Randall (1996)'s investigation of 92 American industrial corporations, the growing weight of logistics investment required to take back the customer's

specific logistics assets and the use of new technology presumes the accumulation of sufficient financial power. Repeated innovation constrains the provider to attain sufficient size to benefit from the changes. Van Laarhoven *et al* 's (2000) conclusions on the evolution of logistics service providers between 1993 and 1998 corroborate this viewpoint: despite efforts to enhance sophistication and consequent diversification, providers have not always succeeded in becoming autonomous and co-responsible partners, which could attest to their insufficient capitalistic credibility.

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The Application of Option Modeling to Rail Abandonment Policy Decisions in Canada

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Introduction

The rail industry in Canada has been regulated in one form or another since 1897. These regulations extended to actual service decisions, including oversight over additions or removal of physical rail track. Since just after the Second World War, Canadian railways have argued that their rail systems were vastly overbuilt considering the nature of settlement patterns in much of the country, especially in the West. To achieve further economies of density, the railways maintained that they should be freely permitted to stop using any rail line they found to be uneconomic.

While liberalization in the Canadian rail industry began in 1967 with the passage of the first National Transportation Act (NTA), the passage of the Canada Transportation Act (CTA) in 1987 meant that Canadian Class I railroads were finally given increased freedom to abandon unprofitable branch lines in order to consolidate their network operations. From 1984 to 1996 the total mileage of branch lines fell about 14 percent, most of this decline occurring after the enactment of the NTA in 1987.

Abandonment freedoms were extended in amendments to the Act in 1995. Since 1996, each Class I railway in Canada has increasingly pursued a policy of rail line abandonment across the country, often drawing public ire at the speed and finality of their line abandonments (Estey, 1998). In just one year after the passage of the CTA up to 1997, grain dependent branch line mileage in the Western prairies fell by about 18 percent (Transport Canada, 1999).

Complicating the process are accusations that the railways have behaved in a manner so as to make it difficult for affected parties to put together any opposition to proposed abandonments. The Estey review of 1998 made public some of the feelings held, especially in western Canada, that the railways were not following "the spirit" of the abandonment rules. Furthermore, several of the latest abandonment hearings were controversial. The recent release of the regulatory report on the future of Canadian rail transportation offered suggestions for change, but has left the basic rail abandonment provisions intact (Government of Canada, 2001).

While the details of Canadian abandonment regulations are controversial, the policy is not without direct cost to the railways. Aside from the need to make public notice well in advance (3 years in some cases) of those branch lines under consideration for abandonment, an abandoned branch line can be judged to be "grain dependent". If this occurs, the railways also pay direct compensation costs to communities affected by the loss of rail service. Thus far, these payments have been limited to lines located in Western Canada. As of the present, the grain dependent branch line abandonment fee is set at $10,000 per mile or roughly $6,000 per kilometer of abandoned rail line (Estey, 1998).

In this paper, we examine the methodology used by the Canadian Transportation Agency (CTA) to evaluate rail abandonment decisions. The specified evaluation criterion is standard cost-benefit analysis (CBA). While well proven as a decision management tool, modern financial pricing models have been constructed to improve upon CBA by incorporating explicit valuation of risk into the analysis. Given the cost of rail line construction today, for many jurisdictions abandonment is basically a decision that will last in perpetuity. It is our feeling that by applying real options modeling to the rail abandonment decision framework, the decision process will become more transparent and will be better able to incorporate any potential future uses of track scheduled for abandonment.

The case study: The Uxbridge subdivision near Toronto

To frame this analysis, we will examine a standing decision to abandon the operations of a segment of the Uxbridge Subdivision of rail track near Toronto, Canada. Extensive details of the case are contained in Decision # 299-R-1993 (CTA, 2001). This Canadian National (CN) subdivision connected the town of Lindsay, Ontario, to rail track leading into the city of Toronto. The track distance under abandonment consideration was only 1.43 miles, but removing the segment would cut off the rest of the subdivision towards the town of Lindsay from using rail service into Toronto.

We have chosen this case for several reasons. Firstly, because the decision was made almost a decade ago, it is now relatively uncontroversial. Secondly, the recently released CTA review of Canadian transportation policy makes explicit reference for a need to improve the abandonment review process in the context of urban transit. Lastly, since the segment was not classified as a grain dependent branch line, Canadian National incurred no additional regulatory fee (i.e. C$6,000 per kilometer) to abandon the segment.

Under what set of circumstances is the decision to permit CN to exercise its option to abandon the track and collect the salvage value the correct decision? Under what set of circumstances would it have been preferable not to allow CN to abandon the track? The latter might well correspond to a situation in which CN itself would concur that continuing the maintain the segment of track was preferable to abandoning the track.

Implementing an option framework in the context of rail line abandonment

The decision to abandon can be broken down into a set of basic elements. If the railway abandons the segment, then it no longer incurs annual maintenance costs and will be able to sell the track components (land, materials) for salvage value. If the railway does not abandon the track, then it forgoes any salvage value, incurs the maintenance costs and collects revenue from its own operations along the track. In addition, any third party operators (like a commuter rail

operator) will give the railway additional revenue through an access fee. This lease-like situation is quite common in transactions between freight railways and passenger railways, including VIA in Canada and Amtrak in the U.S. (Bonsor, 1995).

In a series of rulings culminating in decision #299-R-1993, Canadian National testified that from 1989 through 1991, there was no revenue freight traffic passing along the subdivision. But given its location near the Toronto metropolitan area, the Uxbridge subdivision clearly offered potential for use by the Government of Ontario (GO) transit system as a commuter line to connect commuters from Lindsay (and beyond) to the Toronto area. If this commuter rail potential were sufficiently likely and the revenue generated for CN sufficiently high, CN would have an incentive not to abandon this segment of track. Re-stated in the language of real options theory, CN owns a put option; this put option will be in-the-money if the revenues associated with keeping the track open are sufficiently low. Rather than the existing reliance on cost-benefit analysis (CBA), we argue that the decision to abandon track segments can be vastly improved for all parties if it is considered in a real options framework.

Several key factors influence the value of a call or put option. The most important of these is the strike price of the option. Other things equal, a higher strike price lowers the value of a call option and increases the value of a put option. In the case of an abandonment option for the railway (put option), the strike price is not merely the savings associated with avoidance of maintenance costs, but also the opportunity cost associated with the salvage value that would be collected if the option were exercised. The decision to exercise a put option is based on a comparison of the strike price of the option and the value of the asset underlying the option at maturity of the option, assuming for now that the option is European rather than American.[1] At maturity, if the value of the underlying asset is sufficiently high, the put option holder will choose not to exercise, and so will sell the

[1] A European option can be exercised only on the expiration date of the option. American options can be exercised any time before the expiration date.

asset on the spot market rather than at the exercise price of the put option held. With rail line abandonment options, if the revenue associated with keeping the track operational is sufficiently high, CN will not exercise its right to abandon and will keep the rail segment operational. The value of the underlying asset, the track maintained as a going concern, would have to be high enough to cover both the maintenance costs and the salvage value foregone.

The second factor influencing the value of an option is the price of the underlying asset itself. Other things equal, the higher the value of the underlying, the more likely a call option holder is to exercise and the less likely a put option holder is to exercise. Obviously, the higher the revenue from keeping the rail segment open, the less likely CN is to abandon the line. If this real option were European and the abandonment decision could not be made either before or after the exercise date, then the decision on that date would hinge on the revenue from keeping the line open. Since the value of exercising a put option is finitely high (i.e. unlimited profit is not possible since the maximum payoff is reached when the price of the underlying is zero), early exercise via an American option is entirely possible if the option is sufficiently deep in-the-money.

Suppose instead that we considered not the actual revenue at the time of the decision, but the present value of the probable stream of future revenues. In Canada, users of mainline rail are bound by confidentiality agreements to keep the terms of their access confidential. But using other sources of information, we can estimate the potential access fee revenues that CN could collect from GO commuter traffic on the subdivision.

We employ an access fee methodology suggested in Carlson et al. (2001) for Canadian rail. This allows us to perform sensitivity analyses to examine what level of traffic is needed on the subdivision to cover CN's direct cost of maintaining the line. See Table 1. From the table we can see that considerable commuter rail service is necessary (12 trains; 6 morning /6 evening trains) to simply cover the maintenance costs of the subdivision. Furthermore, if it were possible

to make a probability statement regarding the likelihood of the GO commuter traffic ever existing on this line, then we would be able to calculate the present value of the expected future revenues. But that type of computation is beyond the scope of the present study.

However, we know that on average, access fees can be reasonably approximated by flat fees computed on a per unit transported basis. In reality, rail access fees for passenger rail operators in Canada take a variety of forms (GO, private communication), but all are similar in spirit to the type computed for Table 1. More importantly, Table 1 illustrates that there is likely only minimal variation in the access revenue under existing access fee arrangements for the host railway if a commuter line materialized utilizing the subdivision track.

Table 1. Yearly revenues available to Canadian National from a commuter line on Uxbridge Subdivision using an access fee per car mile of 60 cents (total includes reduced weekend service revenues)

Number of commuter train runs per weekday	Number of cars/train	Total yearly access fee revenues	Yearly costs on Uxbridge subdivision as estimated by CN (listed in the CTA decision)	
4	8	$9,307	1989	$17,003
8	8	$16,473	1990	$14,185
12	12	$34,388	1991	$31,131

Source: Carlson et al. (2001) and author's calculations

Our discussion of the nature of access fees for the use of rail track by passenger rail in Canada highlights the importance of the next factor affecting the value of options. This is the volatility of the price or return on the asset underlying the option. If there is a high degree of risk or uncertainty associated with the asset underlying the option, then the option, either a put or a call, is more valuable. Options give their holders the opportunity to reap profit from price movements in one particular direction. For a call option holder, the rewards are higher the higher the price of the underlying asset on the maturity

date of the option, and, if the price falls below the exercise price, the option holder loses only the initial investment in the option itself. Put options provide basic insurance. The put option holder reaps profit in the event of downward price movement in the underlying asset, i.e. the holder has the right to sell the asset for a fixed price even though the actual market value of that asset is now well below that fixed price. A high degree of risk or uncertainty associated with future revenues from the Uxbridge subdivision makes the option to abandon the line potentially valuable to CN.

The information contained in Decision No. 299-R-1993 implies that the revenue uncertainty for CN is not high at all. Rather it is almost certain there will be no viable GO commuter line using the subdivision and no other source of revenue for CN is available on the line in the foreseeable future. The notion of flexibility in decision making has value when there is a high degree of uncertainty associated with the decision to be made. This is analogous to increased volatility in the underlying asset increasing the value of an option.

The volatility or uncertainty associated with the revenues on the Uxbridge subdivision segment of track relate to the probability of the GO commuter line becoming a reality and to the revenue to CN associated with that commuter line. We assume the probability of future revenue-generating traffic along this segment of track other than from commuter traffic is remote. Otherwise, we presume that CN would have referred to it in the decision and would not be so eager to abandon the segment. Flat or near-flat track access fee structures do not translate into potentially volatile revenues. If the uncertainty associated with the revenue on this line were more variable, the option aspect of the abandonment would be more valuable.

In the CTA decision, the relevant uncertainty is whether or not the GO commuter line would ever materialize. Consider the following scenario: if the passenger rail access fee were permitted to vary with the actual passenger traffic and not just on rail car movement, then a

different outcome for the abandonment decision using an options framework might have materialized. For example, from 1997-1998 the average percentage increase in the number of passengers using all GO trains was 5.8 percent, from a high of 20 percent on the Bradford line down to 3.3 percent on the Lakeshore East line (Government of Ontario, 1998). This variation or volatility is an ideal framework in which to use a real options approach to hedge risk. If the access fee computed for a GO commuter line were proportional to the number of passengers, then revenue variability would increase and the decision to abandon the line by CN would be more closely tied to the same factors that interest the proponents campaigning to keep the line open.

The fourth factor influencing the value of an option is its time to maturity. Other things equal, the longer the time to maturity, the more valuable the option is. Intuitively, in our context, the longer away the time until a definitive decision regarding abandonment can be made, the more valuable the flexibility in that decision making will be. In the real or financial option context, time allows the option to move more fully in-the-money or more definitely out-of-the-money. In context of the rail abandonment decision, or any other real option decision, a longer time horizon allows us to collect and analyze relevant facts and make a more fully informed decision.

The final factor is the existence of cash flows emanating from the underlying asset.[2] This only influences the exercise decision in the case of American options. In the real option case, an option written on an asset that pays dividends may alter the exercise decision depending on the magnitude and timing of the dividends. If the call option holder exercises early, he takes possession of the underlying asset and becomes entitled to receive its cash flows. The longer he waits to make an exercise decision, the longer he forgoes the associated

[2] Another factor to consider for options analysis is not crucial to the analysis in this paper. It relates to the prevailing interest rate over the remaining maturity of the option. This determines the present value of the opportunity cost associated with paying out the exercise price (in the case of a call option) and collecting the exercise price (in the case of a put option).

cash flows. The longer CN waited to make a decision regarding abandoning the Uxbridge line, the longer CN could collect any revenue generated from the operation of the track. In this case, the latter was not a consideration since there was no actual revenue generated by the line and GO commuter traffic was the only potential source of revenue in the foreseeable future.

Additional considerations

The following considerations have no bearing on the decision to abandon, but they do relate to this issue and might well be worth including in the analysis from the point of view of the regulator granting the right to abandon. Suppose, as actually occurred, that CN was permitted to abandon the segment of track such that it is removed and sold. Then if a commuter line to Lindsay become desirable in the future, the cost associated with implementing such a line would inflate to include the reconstruction of the line. In addition to rebuilding the segment of track, GO or the relevant municipality (or some combination) would also have to re-purchase the right-of-way. This would be true of virtually all of these cases across Canada.

Government intervention through the existing legislation could encourage the use of appropriate financial instruments when a municipality desires to purchase rail right-of-way, but is uncertain about future use. In fact, such a policy would not be a large deviation from the present abandonment legislation allowing municipalities to purchase track outright from railways for salvage value. In the case examined here, the municipality of Lindsay was certainly interested in the future possibility of having a GO commuter line running to Toronto. In essence, the Canadian Transportation Act could permit municipalities like Lindsay to purchase a call option on the relevant rail line to be abandoned. In this manner, the railway would obtain revenue in return for keeping the line operational until the expiration date of the option. Further, a call option on the line would give interested parties in the municipality time to determine whether or not commuter rail was really viable. And as a call option, CN would not be obliged to maintain the track segment beyond the due date of the option.

Without financial/real option alternatives to evaluate the viability of abandoned lines, the willingness of governments to avoid future costs might induce them to pay more to a railway to maintain the original line rather than abandon it. The issue is especially relevant since the recent CTA review suggests that rail abandonment applicable to potential commuter transit lines should be given special consideration (Government of Canada, 2001). A thorough analysis of what price might be appropriate to offer as an inducement to not abandon would require information regarding the probability of alternative uses being created (i.e., a commuter line), along with information on how long into the future such activity would occur (i.e. how many years CN would be expected to maintain the track without any traffic along the line) and the cost of reconstructing the track.[3]

Conclusions and future research

This paper has examined a Canadian case study of rail line abandonment under the lens of real options analysis. We find that depending upon how rail access fees are computed, the real options approach provides an instrument that could be of interest to both sides of the rail abandonment debate. The approach appears to be more applicable to potential passenger rail use, but much of the recent controversy surrounding rail abandonment relates to grain dependent branch lines. It remains to be seen whether or not real options can provide a viable regulatory instrument for abandonment decisions when the rail line moves freight. If the variability of freight movement is high enough, then a real options approach will prove to be valuable to the regulator in the decision-making process.

[3] To the knowledge of the authors, the amount to be paid by Canadian railways for grain dependent branch line abandonment appears to be something of a political compromise with little foundation in reality. However, recent research has shown that the amount is surprisingly close to that necessary to help achieve Pareto optimal rail line abandonment in parts of the province of Saskatchewan (Khakbazan et al., 1999)

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IMPACT OF SHUTTLE RATES ON LOCAL GRAIN FLOWS

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ABSTRACT

Investment in shuttle elevators and the ability of these facilities to utilize the more competitive rates in attracting grain has the potential to influence future local grain flow patterns. This analysis provides an estimate of how shuttle train rates will impact grain flows in North Dakota's grain gathering network. In comparative terms, 2% of the elevators have may originate up to 32% of the average annual the four grains. Increased concentration of bushels has implications for local roads, elevators, short line railroads, bridge infrastructure, and local communities

INTRODUCTION

Shifting trends if the production and movement of bulk commodities have raised a variety of economic and social question. In particular, the concentration of activities at hubs, the abandonment of some lines, and the new role of feeder lines, both road and rail, have implications for local communities and the longer term evolution of the transportation system (Bitzen et al, 1999; Ming and Wilson, 1983; Tolliver, 1989; Vachal, et al, 1998). Here we focus on the importance of shuttle elevators in this process in North Dakota.

A majority of the 600 million bushels of grain produced annually in North Dakota is marketed to destinations outside the state. Railroads

play an important role in many transactions and over 70% of the bushels are marketed via this mode. Railroads have developed a multitude of services to attract grain business, differentiating service and price based on factors such as competition, equipment, service requirements, and operational efficiency.

Existing infrastructure, economic incentives, investment requirements, and financing packages are unique to each shuttle venture. Based on a feasibility and expert opinions, a minimum of 12 million bushels is required for a feasible shuttle operation (Vachal et al., 1998). This bushel requirement would need a substantial increase in facilities when compared to the current average annual handle of 1.2 million bushels for the North Dakota elevator population, and an average annual handle of 5.6 million bushels for the state's largest elevators. Thus, redistribution of bushels in the local elevator industry seems imminent.

The objective of this paper is to an estimate of how shuttle train rates will impact grain flows in North Dakota's grain gathering network. Case study analysis is used to define grain draw areas. The draw areas are determined by rail freight rates and producer delivery costs. Sensitivity analysis is conducted to assess the relative influences of market factors, such as freight rates and producer truck investment.

LOCAL GRAIN INDUSTRY

The focus of this analysis is the North Dakota grain-gathering network. Five indiscrete components of this system are, grain production, producer trucking, local elevator industry, and physical transport infrastructure. The four crops included in this analysis – hard red spring wheat (HRS), barley, durum, and corn – accounted for over 75% of the North Dakota grain between 1995 and 1999 (North Dakota Agricultural Statistics Service (North Dakota Agricultural Statistics Service, 1999).

Producer truck types are defined as single-axle, tandem-axle, semi-

tractor and trailer, and commercial. Trucking is a highly competitively industry, so cost is a rate proxy. Producer truck costs represent the delivery cost for typical farmer-delivered grain traffic. The commercial trucking cost represents longer-term producer truck costs and transported via custom haul.

The spans of truck costs discussed in this section provide a multitude of local grain delivery scenarios. In addition, future investment in truck equipment and employment of custom and commercial grain truck operators are considered. Truck costs range from a high of $.0095 per bushel mile for the single-axle producer truck to a low of $.0017 per bushel mile for a commercial truck operator (Vachal et al., 1996). This range of truck costs will be considered in the local grain distribution model and sensitivity analysis. The commercial truck cost estimate is based on a 1997 study of owner-operator truckload operations by Berwick and Dooley (1997). The estimated cost of $1.15 per mile equates to $.0023 per bushel mile for a payload of 890, assuming no backhaul.

Elevators compete for their share of the North Dakota grain and oilseed market through service and pricing mechanisms. It is the pricing that is considered in this analysis. Elevator board price is equal to the market price, less handling and transportation costs. Transportation cost is a primary determinant in the relative board prices of elevators competing for grain in the local market. It varies with shipment volume, origin, destination, and commodity. For purposes of this analysis, the handling cost, or margin requirement, are assumed to be equal for all North Dakota elevators. This assumption is premised on observations that the local elevator industry is competitive so excess profits, such as high handling fees, cannot be extracted.

Freight rate categories, based in the rate differentials railroads offer in public rail rate tariffs, are:
No Rail – No Rail Access;
Single Car – 1 to 24 Cars;
Multicar – 25 to 49 Cars;

Unit Train – 50 to 99 Cars
Shuttle – 100 Cars or More.[2]

Approximately 28% of the North Dakota elevator population was equipped to handle trains of at least 50 cars in 1999 (Upper Great Plains Transportation Institute, 2000). This group included 101 unit train elevators, seven 100-car elevators, and nine shuttle train elevators. These elevators originated 61% of the annual North Dakota elevator industry's grain and oilseed shipments in 1999. The remainder of the elevator population is comprised of 58 no-rail elevators, 159 single-car elevators, and 86 multicar facilities.

The relative importance of rail varies among individual elevator marketing plans (Figure 1). The group including unit train, 100-car and shuttle facilities tends to market relatively more bushels via rail than truck. This group of elevators marketed 83% of the grain and oilseed bushels shipped by multicar elevators via rail during the five-year period.

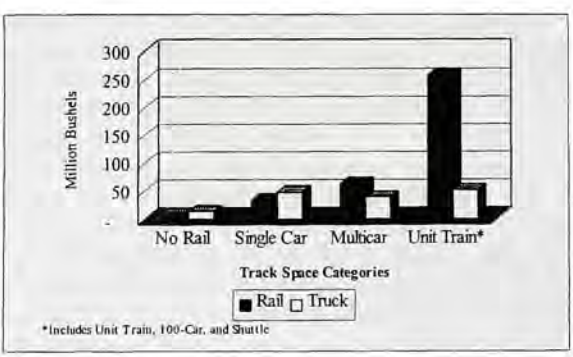


Figure 1. Modal Distribution of the North Dakota Grain and Oilseed Shipments by Elevator Group (Average over 1995 to 1999)

[2] Thecar range for the category definitions may vary slightly by railroad and commodity.

Regarding the physical transport network, the North Dakota road system includes 106,514 miles. Two Class I and three short line railroads operate 3,858 miles of mainline track. The BNSF owns 76% of the 1,460 miles of main line track, with the remaining 353 miles attributed to the CPR. A majority of track in North Dakota – 62%, is classified as branch line. The BNSF operates the majority of this branch line track as well, accounting for 42% of this category mileage. The balance of the branch line track is operated by short line carriers (North Dakota Public Service Commission, 2000).

ANALYSIS

The primary objective of this analysis is to estimate the impact of shuttle train rates on the local grain market. The analysis assumes a profit-maximizing goal for local producers in their grain marketing decisions. Although elevator loyalty and other qualitative factors may influence the producer delivery decision, it is assumed that the local grain delivery patterns satisfy profit-maximizing criterion in the long run.

The analysis concentrates on decisions made by North Dakota farmers in marketing their grain. Spatial analysis is used to couple producer trucking costs with local market board prices for an estimate of producer delivery patterns. Grain production and estimated draw area spans are used as quantitative measures in discussing the delivery patterns.

Estimation of producer delivery costs is a rudimentary, yet essential, task in understanding local grain marketing patterns. A mathematical model emulates the decision made by grain producers. It relies on rail rates, truck costs, and distance in estimating producer decisions for local grain deliveries.

The delivery scenarios for marketing grain in proximity to shuttle facilities are estimated by calculating and plotting a series of

indifference points for the producer decision. An indifference point is defined by that distance at which the net price to a producer is equalized for two competing markets. A series of these indifferent points defines the outlying edge of the draw area for the shuttle facility. The point of indifference is defined by Equation 1.

$$\frac{\left[(P_z - R_{zs}) - (P_z - R_{zi})\right] - T(D_{zs} - D_{zi})}{-2T} \qquad (1)$$

Where s is the focal (shuttle) facility, i is the competition (elevator/process) facility, z is the terminal market, T is the producer truck cost, R_{zs} is the rial rate from the local competitor facility to the terminal facility, R_z is the rail rate from local focal facility to the terminal facility, P_z is the terminal market price (e.g., nearby Minneapolis Futures), D_{zs} is the distance between local competitor facility and the terminal market, and D_{zi} is the distance between the focal facility and the terminal market

Base Case – Wheat

An initial step in assessing the influence shuttle train rates may have on the local grain market is identifying the area affected by estimating draw area boundaries for facilities with access to these rates. Wheat accounted for almost half of the grain produced in North Dakota between 1994 and 1999. Thus, it is the base case commodity for this analysis. A truck cost of $.0025 per bushel mile is applied in the base case (Vachal et al., 1996). It reflects the cost of operating a semi-truck and trailer. Minneapolis is the terminal market used for defining applicable rail rates. A shuttle rate is not published for the Minneapolis market, so the proxy shuttle rate was applied based on industry comments and shuttle train rates quoted for other markets. The shuttle rate is assumed to be $300 per car lower than the unit train rate.

The boundaries estimated using these parameters form the base case scenario and provide an approximation of the affected market area. The base case shuttle draw areas are illustrated in Figure 2. The

unique shape of draw areas for individual shuttle facility locations reflect rail rate relationships, road network, and truck costs represented in the producer marketing decision. Because commodity weights and rail rates are equal, the base case draw areas are applicable for both the HRS and durum wheats. These draw area boundaries were applied to county wheat production data to calculate the volume contained in each of the draw areas. The area included in the 10 shuttle facility boundaries accounts for approximately 45% of the total North Dakota land area. About 38% of the HRS wheat and 39% of the durum wheat production in the state is included.[3]

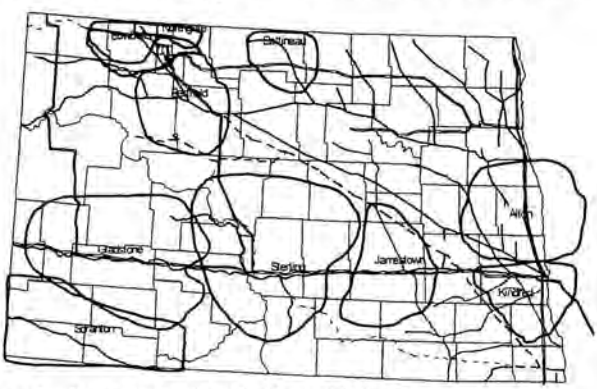


Figure 2. Base Case Shuttle Draw Estimates

The draw areas defined for wheat establish the base case scenario for the remainder of the discussion regarding producer grain deliveries. The following economic analysis addresses the sensitivity of these patterns to factors such as commodity, rail rates, producer truck costs, and commercial truck delivery. The first factor – commodity affects, is illustrated by comparing shuttle-rate based draw areas for barley and corn to the shuttle-rate based wheat draw areas. The barley analysis illustrated is completed for eight of the shuttle facilities. Corn analysis is provided for a single facility, Kindred. To better

[3] Net draw bushel estimates do account for approximate draw area overlaps among shuttle facilities.

form a more coherent discussion of the remaining market factors, Berthold, Jamestown, and Kindred were selected for additional individual case analysis.

Barley

Spatial comparison of draw areas for wheat and barley shows smaller draw areas for shuttle facilities in the barley market, with the exception of Bottineau. Due to production patterns, only 7 of the 10 shuttle locations are considered in the barley analysis.

The draw areas estimated for the remaining seven shuttle facilities covered approximately 23% of the land area in North Dakota. Production in these draw area boundaries is estimated to be 26,354,000 bushels. Less the 119,000 bushels produced in Minnesota, the combined draw areas of the seven facilities equate to 24% of North Dakota's annual barley production.

Barley available in the draw areas for facilities ranges from 7.7 to 1.6 million bushels. Considering that market discussions usually quote a 12 million bushel requirement for a feasible shuttle operation, it seems that a facility would likely not be successful depending on barley as the sole commodity for the shuttle market. In addition, barley has exhibited some of the same tendencies as durum in its dependence on smaller freight lots, based on market comments and data in the Upper Great Plains Transportation Institute's (1997-2001) *North Dakota Grain and Oilseed Transportation Statistics.*

Corn

Corn production is concentrated in the southeastern region of the state so a draw area was estimated for only the Kindred location. The draw area is estimated to include 974,000 acres. In terms of land, the draw area estimated for corn is about two-thirds the size of the draw area estimated for wheat. As discussed in the previous section, corn has a tendency toward adaptability to larger shipment sizes. Therefore, the shuttle rate influence is likely to be strong compared to the other commodities.

Rail Rates

The sensitivity of delivery patterns to adjustments in rates among elevators and railroad pricing strategies is addressed in this section. Case studies for Berthold, Jamestown, and Kindred illustrate the influence of rate adjustments the relative competitiveness of elevators, and thus, the delivery patterns of producers. It is also an indicator of flows for alternative demand scenarios, as shuttle wheat receives are primarily located at export markets.

A study of rail rates allows examination of the effect of alternative shipping costs on the competitiveness of a local elevator. The base case elevator grain draw territories include shuttle rates for facilities equipped to handle shuttle trains. To gauge the affect of these rates on local grain delivery patterns, grain draw territories are estimated.

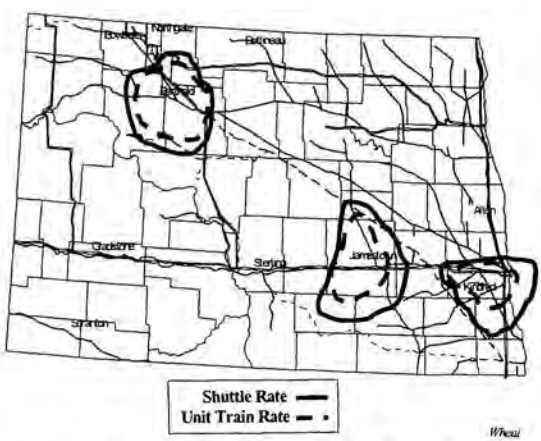


Figure 3. Sensitivity of Elevator Draw Area Boundary to Rail Rates, Wheat

In these studies, other parameters including competing elevator rail rates and producer truck costs, are held constant while the rail rate for the selected shuttle stations is replaced with a unit train rate. These results are an effective measure of the potential impact of shuttle rates

on local grain delivery patterns because the unit train rate has been the lowest cost alternative for shipping grain via rail in the recent past

Land estimates suggest rail rates have a substantial affect on the reach of an elevator's draw area. When the shuttle rate is replaced with the applicable unit train rate, draw areas contract in each of the cases as illustrated in Figure 3. The shuttle train rates increase an elevator's draw area by approximately 50%, compared to the unit train draw area.

Producer Truck Costs

A primary factor in the producer delivery decision model is cost of delivery. Delivery-cost estimates are based on distance and truck cost. The ND producer truck fleet includes an array of trucks from single-axle to semi-truck and trailer (Berwick et al., 2002). To address the producer truck cost factor in grain flows, sensitivity to truck costs is analyzed by developing truck costs at opposite ends of the truck cost spectrum – single-axle and commercial truck. The results generated from this scenario are compared results of the base case scenario – producer semi-truck costs. With this methodology, the diversity of the current producer truck fleet, changing fuel prices, opportunity for custom trucking, and potential for future investment is addressed through the range of truck cost estimates.

The one measure of the effect of applicable producer truck costs is its affect on the size of draw areas for the case study facilities and commodities. For base case in wheat, which uses the producer semi-truck rate of $.0025 per bushel mile, Berthold, Jamestown, and Kindred have draw areas of 2,073; 2,068; and 961 thousand acres, respectively. The first of the two alternative truck costs considered in the sensitivity analysis is the single-axle truck cost. This cost is considered to be the maximum cost among possible producer truck cost scenarios. The cost for operating the single-axle truck is nearly three times higher than the semi-truck trailer, with a cost $.0091 per bushel, as detailed in a previous section. The affect of replacing the semi-truck rate with the single-axle rate is a reduction in the spans of each draw area, compared to the base case, considered in the case

study analysis. The effects are illustrated in Figure 4. The average draw area size decreases by about 44%. The draw area for Berthold is reduced by 18%, 1,704 acres, compared to reductions of 53% (978 acres) and 62% (589 acres) at Jamestown and Kindred, respectively.

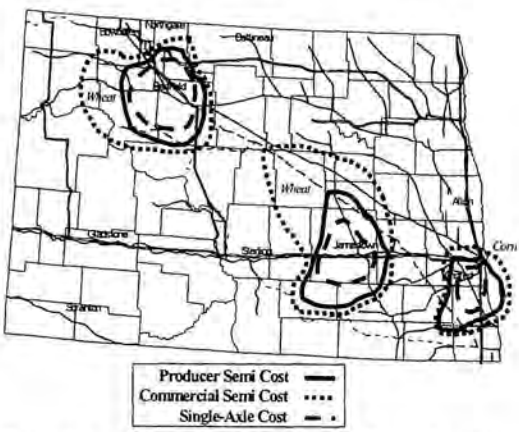


Figure 4. Sensitivity of Elevator Draw Area Boundary to Producer Truck Costs, Wheat

Effects vary substantially in the case of lower producer truck costs, as illustrated by the second scenario in the truck sensitivity analysis – commercial semi-truck. In this truck scenario, a producer-truck cost of $.0017 per bushel reflects the costs for operations such as large farms, custom combine/trucks, elevator-owned trucks, and commercial truck operations. The commercial semi-truck rate is approximately 33% lower than the producer semi-truck operation costs due to economies of equipment use. This truck cost provides the minimum cost for the producer truck cost sensitivity analysis.

Application of a commercial truck rate has a substantial impact on the reach of draw areas for each of the facilities. Berthold and Kindred have similar relative increases in draw area acres when commercial truck draw areas are compared to the draw areas estimated for the producer semi, enjoying more than 80% increase in the size of their

respective draw areas. A smaller, but still notable impact is estimated for Jamestown with its 60% increase in draw area acres.

CONCLUSION

Shuttle rail rates are, in today's grain industry, the railroad's most competitive rate. As these local grain flow patterns adjust to new market signals, demands on the local grain gathering system will need to be addressed. The objective of this study was to provide a market-based synopsis of the potential impact of shuttle train shipments on North Dakota's local grain flows. Spatial analysis was used to estimate producer delivery patterns for alternative rail rate and producer truck cost scenarios. In the base case, wheat, the area included in the 10 shuttle facility boundaries accounted for approximately 45% of the total North Dakota land area. In terms of grain flows, 2% of the elevators may handle one-third of the grain produced in the state. This potential concentration of bushels has implications for local roads, short line railroads, bridge infrastructure, local processors, local communities, and the North Dakota elevator industry.

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Roads As A Public Good: Attitudes And Approaches In North America

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The economics of a road network is complicated by joint consumption and externalities. All citizens regardless of their road usage receive some benefits. The provision of fire, police and school bus service, for example, is contingent upon the existence of roads. At the same time, the benefits to road users are not constant. As the number of drivers and the interaction between drivers rises, the system becomes congested and all users experience reduced benefits.

The cost of building and maintaining roads is high. If only the private costs and benefits of roads are considered, the road network is likely to suffer under investment from a social perspective. Long-term investments in road infrastructure have to be weighed against the size and distribution of their costs and benefits.

The broad influence of roads in society would suggest that they be treated as a public rather than a private good. A review of the historical treatment of roads in North America indicates that this has not always been the case. This work endeavors to define the concept of a public good and provide a historical context for the treatment of roads in North America. Recent literature offers evidence that the public/private road debate at the community, regional or national level in Canada and the United States continues.

What is a Public Good?

An informed assessment of the treatment of roads hinges on the distinction between public and private goods. A pure public good,

according to its economic definition, is a good or service that is non-exclusive and non-rivalry in nature. Non-exclusivity means that it is impossible or extremely difficult to exclude anyone from consuming the good or service. National defense is a common example of non-exclusivity. Security cannot be furnished on a private basis to certain individuals without others reaping benefits of the service free of charge. This dilemma is referred to as the 'free-rider' problem. Non-contributors (or free riders) benefit, even though others pay for provision of the good or service.

The inability of the provider to recoup expenses from all beneficiaries has dissuaded private companies from engaging in the provision of some goods and services. Many road networks have been treated as a public good not because drivers cannot be excluded from using certain stretches of roadway, but because it has been expensive and technologically difficult to do so until relatively recently (Walden, 1999). Non-exclusive public goods and services are typically paid for by society on a collective and compulsory basis through taxes.

The second requirement of a pure public good is that it be non-rival in nature. The non-rival element stipulates that the consumption of a good or service by one party does not diminish the amount of that good or service available to others. The Global Positioning System (GPS) could be considered a non-rival service because reliance upon it by many for navigation does not diminish its availability to specific individuals. The susceptibility of roads to congestion, however, does not conform to this concept. Cars, trucks, buses and bicycles all compete for access to limited road space.

Given the stringent requirements of pure public goods, it is understandable that few goods and services fall into this category. Many more, though, can be considered partial or quasi-public goods. These share some of the characteristics of public goods, but are distinguished by certain capacity constraints, spatial constraints, or exclusivity features. Historically in North America, roads have been considered both partial-public and private goods.

The Historical Treatment of Roads

Land transportation routes in 18th century North America were publicly owned roads and tracks. By the 1790s, these primitive roads had proved to be insufficient to connect the growing settled areas of the eastern United States. Governments implemented pay-as-you-go road financing modeled after the British road system of the era (Klein, 1990). This arrangement proved to be inadequate for the trade of expanding communities and private involvement in the provision of roads soon followed.

The state governments in the late 18th century commissioned the first private turnpikes in the United States[ii]. Over the next 50 years, thousands of miles of these roads were built and private turnpikes became the primary means of intercity travel. Turnpike concessions were granted to associations and companies that commonly appropriated the routes of former public roads and tracks.

Rigorous financial regulation imposed on private turnpikes adversely affected their profitability. Turnpikes were subjected rate controls and non-excludability provisions. Turnpike operators were required to provide toll exemptions for local users, and mandatory 5-10 mile free zones between tollgates. Legislation authorized their creation via the collection of tolls, but economic regulation precipitated the commercial failure of virtually all private turnpikes of the late 1700s and early 1800s.

The treatment of roads in North America shifted to public provision in the 19th century. The financial collapse of private turnpikes underscored the need for alternate road financing schemes to link communities, enable trade and ensure national security. Commercial imperatives strengthened the sentiment that roads were a public good.

By the mid-1800s, Canadian and U.S. governments had responded to society's increased reliance on roads by reverting to public road provision strategies. This approach, which dominated road policy for over one hundred years, was particularly evident during the U.S. and

Canadian road-building campaigns of the latter half of the 20th century[iii]. Of the toll roads that were established in the United States and Canada during this period, some were de-tolled in order to improve traffic flow and appease the public.

In the 1970s, the rising cost of infrastructure works, combined with increased pressure on governments to supply and maintain more extensive, higher quality road networks without increasing taxes, obliged authorities to consider a broader array of options in the provision of roads. The result has been a steady escalation of private involvement in road provision and operation over the past 30 years. This contests the long-standing tenant that roads are a public good to be funded through taxes.

Over 7,500 kilometers of toll roads exist in the United States. Many of these toll routes are publicly owned, but can be considered "private" infrastructure because their tolls exclude consumption by certain individuals and groups. It should also be noted that U.S. legislation dedicates a large portion of revenues collected from fuel excise taxes to road construction and maintenance. Hence, from a technical standpoint, U.S. roads are more akin to a private good.

Traditionally no direct linkage has existed between road user fees and road spending in Canada. This reflects a more public approach to the provision of road infrastructure. While the proliferation of toll roads and bridges that has been observed in the United States has not yet occurred in Canada[iv], there has been a noticeable shift in the approach to Canadian roads. State-of-the-art electronic toll collection systems, such as the one used on the 407 Express Toll Route in Toronto, have made exclusion inexpensive and revenue collection efficient.

Current Trends in Road Provision

In recent decades, governments around the world have embraced mixed road provision strategies in which the role of private companies has been greatly enhanced. The rising cost of building and maintaining public road infrastructure has led governments in western

nations such as New Zealand and developing economies like Mexico to consider public-private partnerships as a solution to road funding crisis. The shift toward the treatment of roads as a private good has triggered opposition from some road users who have become accustomed to publicly funded roads and feel they are being charged to use infrastructure that has already been paid for through taxes. Governments argue that private roads that are built parallel to public roads serve to augment, rather than replace the existing road network.

The increasing ubiquity of toll roads and bridges raises the question of whether privatization will be limited to the provision of alternative routes and new infrastructure works.

The Treatment of Roads in Canada

The vast majority of Canadian roads are financed from a general revenue fund. With few exceptions, no explicit link exists between road related revenues and expenditures. This is a critical distinction that differentiates the treatment of roads in Canada from those in the United States (Blanchard, 1996). While fuel excise taxes, licensing fees and vehicle registration fees are collected in both countries, these charges cannot be considered true road user fees in Canada because the revenues they generate are not explicitly allocated to roads[v]. Informal studies aimed at establishing a direct link between road revenues and expenditures in some jurisdictions have been conducted, but thus far highway expenditure decisions have been made independently of road-related revenues as a matter of Canadian public policy.

The treatment of roads as a public good funded through general revenues has left road infrastructure vulnerable to competing interests. The federal government in particular has been accused of creating a national infrastructure deficit by diverting road revenues to other priority social initiatives such as health care and education. Of the $5 billion per year in fuel tax revenues collected by the federal government, only 5 percent is reinvested in roads. Canada's network of roads and highways has deteriorated so severely in recent years

that it is now estimated that over $17 billion in investments are required to bring the National Highway System up to minimal engineering standards (Redfern and Facette, 1999).

Public resistance to further taxation and the competition for public funds has obliged many jurisdictions to explore the toll road option. Although only a handful of toll roads have been built in Canada, their wide distribution and employment in large new projects suggests that they may take on a more prominent role. Greater private sector involvement in road construction and operation has focused attention on public-private partnerships in road projects and has stimulated examination of the policy implications of this trend.

Hrynyshyn (1995) highlights the experience of the Coquihalla toll highway, a 200-km four-lane highway that links the lower mainland of British Columbia with Kamloops and the rest of the country. Without the guarantee of toll revenue, it is argued, the quick, safe, and convenient Coquihalla route could not have been built and motorists would still have to endure the longer, slower, more dangerous Trans-Canada route through Cache Creek. Hrynyshyn contends that the safety and convenience of toll roads such as the Coquihalla, combined with the central role of tolls in the financing and maintenance of new road infrastructure, may lead to greater support for the treatment of Canadian roads as a private good.

In 1999, a working group comprised of representatives from the Canadian provincial and territorial highway and transportation departments submitted a detailed report to the Council of Deputy Ministers on public-private partnerships (P3s). Although the working group's focus was not solely on the emergence of toll highways and the debate over the public/private treatment of roads, it did undertake a detailed analysis of this area.

The working group examined the applicability of tolls and user pay charges and how federal, provincial and territorial contributions under cost-shared highway agreements should be considered with respect to these charges. The report's assessment of these issues was tantamount

to deciding whether and how the treatment of roads as a private good could occur in Canada. Its findings are particularly valuable considering the broad jurisdictional makeup of the working group and its influence on the direction of road policy at the provincial and national levels.

The report attributes the growing interest in public-private partnership arrangements to the expanding demand for road infrastructure, limited public funds to meet current and future infrastructure needs, and acceptance of a greater role for the private sector in the provision of roads. The public-private procurement approaches examined in the report include Design/Build (DB), Design/Build/Operate (DBO), Design/Build/Finance/Operate (DBFO) options. While each of these options entails private sector involvement, they do not all imply the payment of real tolls or treatment of roads as a private good.

The implementation of specific road user fees that exclude consumption by some individuals or groups is what differentiates the mere involvement of private interests in road procurement from the treatment of roads as a private good. Many of the roads that are designed, built, financed and operated under P3 arrangements are treated as a public good and financed through so-called "shadow tolls". Shadow tolls are payments made by the public sector to the private sector for operation of a highway. Shadow tolls are linked to actual traffic volumes and result in project demand and traffic risks being shared between the public and private sectors. The public sector pays for the use of the road asset rather than its provision. Shadow tolls do not technically affect the treatment of roads as a public good because they are not charged directly to road users, and consequently avoid the diversion of traffic to non-tolled facilities.

The working group's report noted that there were disagreements among its members regarding the application of user fees and tolls on the National Highway System. These disagreements reflect the changing philosophies regarding the treatment of roads in Canada and the diversity of positions and political agendas that exist across jurisdictions.

Among those arguing against tolls, some felt that hidden road user charges such as fuel taxes or licensing fees would be much less expensive to implement than real tolls. This may not be true in light of efficient new electronic tolling technology. Even if toll collection were more expensive, it should be noted that the allocation of user revenues to roads would also constitute the treatment of roads as a private good.

The Canada Transportation Act Review, (CTA Review, 2001) also comments on the future treatment of roads in Canada. In its discussion of roads, the Review Panel acknowledges that only 15,000 kilometres of the 900,000-kilometer Canadian road network are federally owned and maintained. However, the intermodal nature of modern transport and the dire situation of Canada's roads necessitated a review of national road policy and the treatment of roads.

The CTA Review Panel presents a background on the importance of roads, and emerging trends in road use and funding in Canada. The ominous trend of increasing vehicle use and infrastructure demand, and decreasing federal road funding illustrates the need for a new approach to the treatment of roads. The federal government's policy of public road provision is criticized on the grounds that it has promoted an infrastructure deficit in Canada. Badly needed revenues are diverted away from roads, resulting in severe funding shortfalls that drive up local property taxes.

According to the report, growing provincial and territorial opposition to the status quo treatment of roads has triggered a change in road funding philosophy. Whether the solution involves the explicit allocation of fuel taxes, the implementation of real tolls, or the establishment of road management agencies, a consensus appears to be forming that the public treatment of all roads is no longer tenable in Canada. The Panel contends that many of the problems and inequities inherent in public road provision could be solved through greater privatization of the Canadian road network.

Resolution of the current road-funding crisis requires increased dedication of road revenues, improved co-operation among the various levels of government, and a greater onus on drivers to pay the real costs of road use. The Panel claims that these objectives could best be met through the establishment of a Road Agency, as recommended by the World Bank. The Road Agency would oversee funding, management and operation of the country's road network and ensure system-wide responsibility and self-sufficiency. Three options were proposed for establishing road funding and management agencies, all of which entail the treatment of roads as a private good.

The solutions envisioned by the Panel imply significant technical and institutional changes, particularly at the federal level. It is recognized that, despite the economic necessity of these changes, there will likely be substantial entrenched opposition to their implementation. The Panel's view is that the existing system is dysfunctional and that radical reform will be needed eventually. The ongoing debate over the public/private treatment of roads in jurisdictions across Canada is a manifestation of the struggle over these issues.

Thompson (2001) subscribes to the theory that the treatment of roads as a public good is flawed because it does not rely on a full, direct charging structure and is consequently plagued by over consumption and underpayment. Groups ranging from left-wing environmentalists to right-wing free marketers have supported measures that promote the treatment of roads as a private good. Thompson argues that although Canada may not be prepared to fully embrace road pricing strategies, which charge motorists for the full cost of vehicle-use and infrastructure provision, public-private partnerships and toll roads are positive steps that signal key changes in Canada's road policy.

The recent experience in New Brunswick has made Canadian politicians wary of toll roads. A few months after his 1995 election victory, Liberal Premier Frank McKenna announced that his government would allow the introduction of tolls in New Brunswick. The justification for going ahead with tolls was reportedly based on

economics and safety. Private companies were deemed able to build and operate the highway more quickly and cheaply than the government.

Despite government claims that the savings accruing to the public would be put towards social needs, reaction to the toll roads was mixed. In subsequent by-elections in Fredericton and Moncton, Liberal candidates were pressured on the toll road issue. Their support for the treatment of the Trans Canada Highway as a private rather than a public good drew sharp criticism by those living along the toll route and was seen by many as a decisive factor in the Liberal losses in those ridings. The case of toll roads in New Brunswick illustrates the potential public resistance to the treatment of roads as a private good.

In some jurisdictions, the emergence of toll roads has preceded the development of clear policy positions on user pay issues and the privatization of roads. New Brunswick's failure to gain broad public support for the treatment of roads as a private good was partly due to the perceived injustice in how the tolls were applied and set. Ontario's fully automated booth-free 407 Express Toll Route has been well received by the public. But this is due in part to the availability of viable alternatives to that toll route.

The growing role of the private sector and user fees in road provision suggests that Canada is at some point along a continuum between the public and private treatment of roads. Although the complete privatization of the entire Canadian road network is unlikely, fiscal constraints suggest a probable shift toward new highway management philosophies and the more widespread allocation of user revenues and the treatment of Canadian roads as a private good.

The Treatment of Roads in The United States

Road policy in the United States is characterized by a mixed approach that favors the treatment of roads as a private good. Evidence supporting this can be found in explicit legislation that obliges the

U.S. government to allocate the vast majority of revenues from federally imposed road charges to the road initiatives. The 1997 U.S. Taxpayer Relief Act mandated that 16.3 cents of the 18.3 cents per gallon in U.S. federal fuel excise taxes go directly to the Highway Trust Fund and be made available for "highway-related purposes" (Federal Highway Administration, 2000) [vi]. This legislation reversed an earlier decision implemented under the 1993 Omnibus Budget Reconciliation Act that had ordered 4.3 cents per gallon of federal motor fuel tax to be deposited into the General Fund for use towards U.S. deficit reduction. Such reversals of legislation reveal the ongoing debate over the ideal balance between the public/private treatments of roads in the United States.

Another important consideration concerning the treatment of roads in the United States is the issue of public road subsidies. The use of non-road related public funds to subsidize roads in the U.S. is a strategy that adds a public element to U.S. road provision and has resulted in U.S. roads receiving much higher levels of funding than Canadian roads. While the Canadian government is accused of diverting road revenues to non-road initiatives, the U.S. federal government allocates the majority of road taxes to roads, and allows for additional road funding from non-road related tax revenue.

In 1998 the U.S. Congress created a law known as TEA-21 (***Transportation Equity Act for the 21st Century***). TEA-21 provides substantial funding increases for core highways by ensuring that U.S. road revenues are spent on roads. With respect to the allocation of user fees, TEA-21 Chairman Bud Shuster heralded the law as a "victory for the American taxpayer" because gasoline taxes would no longer be shifted to other government spending priorities in the budget. This view, promoting user-fee allocation and the treatment of roads as a private good, is also tempered by the legislation's provisions for deriving a portion of highway funding from the government's General Fund.

The increasing fuel efficiency of modern vehicles and the subsequent reduction in per-vehicle fuel tax contributions has reduced the flow of

revenues to support the American transportation system. The U.S. Department of Transportation has encouraged State DOTs to get into toll financing of roads by passing legislation allowing up to 80 percent of the total construction cost of toll facilities to be financed with federal funds. To the dismay of proponents of "free" (fuel tax funded) roads, these initiatives are the wave of the future (Hinkleman, 1997).

The Georgia DOT faces dwindling per-vehicle fuel tax revenues, and political opposition to fuel tax increases, while like departments of transportation in many states, public pressure grows to expand highway capacity. Toll roads modeled after the highly successful Georgia 400 toll route have been proposed as a solution to this problem. The Georgia 400 model is based on the principle of building new toll roads where the people want them and are willing to pay for them. This scenario would alleviate some of the strain on the state's highway budget, but would further privatize the road network and diminish access to transportation for the less affluent.

Notwithstanding the public's demand for new roads, special interests groups such as influential businesses and construction firms are the most vocal proponents for more toll roads. According to Todd (1999), some Senators currently resisting tolls would be inclined to change their stance if technology permitted their implementation without subjecting the state's highways to stop-and-go traffic. By late 1999, the North Carolina legislature had approved one toll highway and more were on the horizon. This underlines the pivotal role technology can play in the evolution of public policy concerning the treatment of roads.

In Nevada, lawmakers flip-flopped on a bill aimed at authorizing toll roads (Associated Press, 1997). The bill was to allow for the construction of new toll routes that paralleled existing "free" roads. Three days after the bill was passed on a 26-15 vote, an assemblyman who allegedly miscast his vote requested a revote. The result of the second vote was a shocking 13-26 against, a virtual reversal of the first vote. Although it is not explicitly stated, the article implies that

public outcry against the decision to authorize toll roads was largely responsible for the drastic turnaround. Private roads may be on the increase, but they still face substantial pubic opposition in some areas.

In Missouri divergent approaches to the treatment of roads appears to divide along partisan lines (Associated Press, 2001) Democrats are seen to generally favor the tax approach to road funding, while Republicans support tolls or a combination of tolls and taxes. Representatives of both parties agreed that the state's roads were under funded and that additional sources of revenue were necessary to ensure the safety and quality of the road network and enable economic expansion. The road-funding dispute between the House and Senate in Missouri will be put to a public ballot in November 2002.

Conclusion

Roads in North America are increasingly being treated as a private good. The difference between the way Canadian and American roads are financed and operated can be attributed to the distinct social beliefs in the respective countries, which have manifested themselves in road policy.

The treatment of roads in Canada has shifted from a partial-public to a mixed public-private approach. This change has been brought about by budget constraints and growing road infrastructure needs. While Canadian roads are still predominantly treated as a public good, toll roads have gained a foothold in some provinces and have incited considerable debate on the future direction of road policy. Public concern over the possible privatization of the Canadian road network has resulted in the toll road issue becoming a focal point in literature.

In the United States, the federal government's explicit allocation of fuel excise taxes to road initiatives makes all roads technically private. Further privatization has come in the form of toll roads, which now exceed 7,500 kilometers. Significant opposition to real

tolls and the debate concerning their role in highway provision has failed to derail the proliferation of toll roads in the United States.

The bulk of Canada's road system will likely continue to be treated as partial-public good. Certainly, the New Brunswick experience remains fresh in the minds of the politicians. Public acceptance seems to be limited to new projects that offer additional capacity, rather than a single alternative. In light of the changing public/private nature of road provision in Canada and the differing jurisdictional views, it is timely to undertake further work on this topic.

- What are the efficiency differences of financing roads fully from general tax revenues, versus a user pay charging structure incorporating dedicated user fees, direct tolls, or both?
- What are the economic and social impacts of private road provision for low income Canadians and for economically disadvantaged regions?
- What are the political implications of letting our publicly funded east/west National Highway System (particularly north of Lake Superior) fall into disrepair?

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[i] This paper is based on a report that was financially supported by the Manitoba Department of Transportation and Government Services. The views expressed do not necessarily represent those of the Department. The Department provides no warranties as to the validity or accuracy of the information presented herein.

[ii] "At the beginning of each private turnpike the traveler's way was blocked by a long pole across the road. On the pole were sharp points called "pikes". When the traveler paid his toll, the pike pole was turned aside so that he could pass. Because such poles were called "turnpikes", the road was nicknamed the "Lancaster Turnpike". Cain, Wilma W., *Transportation*, Toronto, ON: The Fideler Company, 1966. The sixty-two mile long Lancaster Turnpike, the first hard-surfaced toll road in the United States, was opened in 1794.

[iii] The link between road building and national security cannot be ignored. Hitler's construction of the Autobahns in the 1930s inspired the United States to build its national system of "Interstate and Defense Highways" at the height of the cold war. National security was also one of the justifications for planning and building the world's longest highway, the Trans Canada, in the mid-1900s.

[iv] To date, 19 toll facilities have been established in Canada. Most of these are toll bridges or tunnels between Ontario and the United States. The total length of toll routes in all provinces is 344 kilometres. In the United States there are 7,589 kilometres of toll roads nation wide.

[v] The only jurisdiction to pass any form of road user fee allocation legislation in Canada is British Columbia, which dedicates 2 cents per litter of the provincial excise tax on gasoline and diesel fuel and a $1.50/day tax on vehicle rentals to its Transportation Financing Authority.

[vi] The remaining 2 cents were directed to the Mass Transit Account.

Toll Roads in Canada

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Introduction: This paper describes toll roads (roads, bridges, tunnels) in Canada. Much of the material has been up-dated from information collected while undertaking research for the Canada Transportation Act Review Panel.[1] During the course of that work, it became apparent that there are few information sources on toll roads. This paper attempts to put more information into the public domain in the hope that it will help with the formulation of toll policies.

Toll Facilities: The 19 toll facilities in Canada or, in many cases, between Canada and the United States, are shown on Table 1.[2] Toll roads amount to 385 route kilometres and this only counts half the length of any facility crossing the border. The longest portion (90%) of this distance is accounted for by the 348 kilometres of the Cobequid Pass in Nova Scotia, Highway 407 in Ontario and the Coquihalla in British Columbia. The 385 kilometres, or roughly 800 kilometres on a two-lane equivalent basis, are not much in terms of the estimated 905,000 kilometres (2-lane equivalents) of the entire network. They are also not much in comparison to toll networks in other countries: United States - 7,589 km[3], France - 6,305 km, Mexico - 5,683 km, Italy - 5,550 km, Spain - 2,255 km, Argentina - 8,877 km or Japan - 9,219 km[4] (all in route kilometres).

Toll Rates: Table 2 shows a comparison of tolls for various vehicles. Sources for this and the following table are explained in an endnote.[5] Actual tolls are more complex than those that can be displayed here. The term "e-toll" means the use of a transponder. Usually, there is a fee for this equipment and these are not shown on the table. In some cases there may also be tokens and bulk purchases not reflected in the

rates shown. In other cases there are monthly billing fees not included. The rates shown for the Halifax-Dartmouth bridges apply to both bridges except that trucks over 3,200 kg are not allowed on the Angus L. MacDonald. The rates for the Ambassador, the Detroit-Windsor Tunnel and the Lewiston-Queenston are for fully loaded trucks (tolls are on a gross weight basis).

Table 1: Toll Roads, Bridges and Tunnels

Toll Facility	Location	KM
Angus L. MacDonald Bridge A. Murray MacKay Bridge	Halifax-Dartmouth, NS	1.3 1.2
Cobequid Pass	NS 104	45.0
Confederation Bridge	NB-PEI	13.0
Saint John Harbour Bridge	Saint John, NB	2.0
Seaway International Bridge	Cornwall, ON	2.0
Ogdensburg-Prescott Bridge	Prescott, ON	1.8
Thousand Islands International Bridge	Gananoque, ON	6.9
Highway 407	North of Toronto, ON	108.0
Lewiston-Queenston Bridge	Queenston, ON	1.3
Whirlpool Rapids Bridge	Niagara Falls, ON	0.2
Rainbow Bridge	Niagara Falls, ON	0.2
Peace Bridge	Fort Erie, ON	0.9
Ambassador Bridge	Windsor, ON	1.4
Detroit-Windsor Tunnel	Windsor, ON	0.8
Blue Water Bridge	Sarnia, ON	2.2
Sault Ste Marie International Bridge	Sault Ste Marie, ON	1.9
Fort Francis-International Falls Bridge	Fort Francis, ON	0.2
Coquihalla Highway	Hope-Kamloops, BC	195.0

Several points to note about these tolls:

Electronic Tolls: It is not possible to compile figures on the proportion of tolls collected electronically, although some information is available. For example, according to the Halifax-Dartmouth Bridge Commission, 23.5% of traffic in fiscal 2000 used electronic tolls (MacPass). On Highway 407 the proportion is

probably much higher (there are no toll booths, billing rates for cars without transponders add an extra fee and trucks are required to have transponders). Of the 19 facilities, electronic tolls can be used on five—the Halifax-Dartmouth bridges, 407, Peace and Ambassador—although some others use devices such as dedicated debit cards or charge cards (unlike transponders, these require the vehicle to stop).

Variable Tolls: Assuming a degree of price elasticity, one would expect that operators would set fees so that peak users paid more than off-peak users. Yet the actual instances of this are rare—in fact, as of January 2002 there are no known cases. In January 2002, Highway 407 eliminated its time-of-day and day-of-week tolls entirely.

Tolls for Different Vehicles: All facilities charge larger or heavier vehicles more than smaller or lighter vehicles. But the differences are enormous. At the low end of the scale, the bridge between Fort Francis and International Falls charges the heaviest truck 2.7 times what it charges an automobile. At the high end of the scale, the Lewiston-Queenston Bridge charges a heavy truck 20 times the amount for an automobile. This, however, is a somewhat unfair comparison as it happens that heaviest truck selected is just slightly over the normal fee schedule for Lewiston-Queenston and, as a consequence, it has to pay a special charge. If it were only 30 kilograms lighter, the difference between the automobile rate and the truck rate would be 6.5 times. But even ignoring this case, it is still clear that there is a large disparity in how operators charge larger or heavier vehicles: the Ambassador, the Peace, the Detroit-Windsor Tunnel are all up in the range of 12-to-18 times an automobile toll while most of the rest that are in the range of 3-to-7 times.

Toll Road Activity: Table 3 gives an indication of revenues and traffic (average annual daily traffic) for each facility. Not all reporting periods are the same so exact comparisons are difficult and, in some cases, speculative assumptions are used in an attempt to put toll roads in perspective. Nevertheless, tentative comparisons follow.

Table 2: Toll Rates (CDN $)

	Car	Bus	Truck		
		2 axle	3-axle 12.7tne	5-axle 36.3tne	8-axle 59.0tne
MacDonald-cash	0.75	2.50	3.50	5.25	5.25
MacKay -e-toll	0.60	2.00	3.00	4.50	4.50
Cobequid -cash	3.50	5.00	7.50	12.50	20.00
-e-toll	1.75	4.00	6.00	10.00	16.00
Confederation (2-way toll)	37.75	215.50	43.00	54.00	108.00
Saint John	0.25	?	0.70	1.40	1.75
Seaway	2.25	6.25	6.25	8.50	10.75
Ogdensburg-Pr	3.00	7.45	8.20	11.95	18.65
Thousand Ills	3.00	7.50	9.00	12.00	16.50
407 $/km, e-toll	0.115	0.230	0.230	0.345	0.345
Lewiston-Queen.	3.50	11	4.90	14.00	70.00
Whirlpool	3.50	?	na	na	na
Rainbow	3.50	?	na	na	na
Peace -cash	3.50	15.50	7.00	33.00	63.00
-e-toll	2.80	15.12	7.20	31.68	60.48
Ambassador	3.50	8.00	8.19	23.40	42.27
DW Tunnel	3.50	9.25	10.36	29.60	48.12
Blue Water					
- to US	2.50	5.50	8.25	13.75	22.00
- to Can	2.00	5.00	7.50	12.50	20.00
Sault Ste Marie	1.75	5.75	9.75	17.75	30.00
Fort Francis (2-way toll)	9.00	24.00	24.00	24.00	24.00
Coquihalla	10.00	20.00	30.00	40.00	50.00
Note: some bridge restrictions (Ogdensburg, Thousands Islands) would not allow the 8-axle truck shown to cross at the above weight.					

Traffic: It is estimated that travel on toll facilities—and this only counts half the travel on international crossings—amounts to 1.7 billion kilometres a year.[6] For all of Canada, there were an estimated

310.5 billion vkt on all roads in 2000.[7] Toll roads, therefore, appear to account for a miniscule 0.6% of vehicle activity.

Traffic Levels: There are only eight facilities where AADT figures are above 15,000. This is the rule-of-thumb for highways that have enough traffic for tolls to pay both capital and operating costs. An AADT of 10,000 is the rule of thumb for roads where tolls can pay operating costs; only ten facilities are in this category.

Road Expenditures: Assuming that revenues equal costs (including capital), toll operators spend $429 million a year. The Canadian portion of this, counting only half the revenues of international crossings, is $338 million. This is a speculative estimate. Nevertheless, and even allowing for a large margin of error, it appears that toll roads account for about 2.8% of total road expenditures in Canada.[8] And to put this estimate of $338 million in perspective, toll revenues for the New York State Thruway in 1999 were, in Canadian dollars, $592 million.[9]

Institutional Setting: The structure of the 19 toll facilities is quite diverse as the following thumbnail sketches demonstrate.

The Halifax-Dartmouth Bridge Commission is a public utility and tolls are regulated by the Nova Scotia Utility & Review Board. The provincial government approves borrowing and a clause in the enabling legislation allows the government to take over the bridges once all debt has been retired.

The company responsible for the financing, design, construction, operation and maintenance of Cobequid Pass is the Highway 104 Western Alignment Corporation (HWAC), wholly owned by the Nova Scotia government. There has been a question as to whether or not HWAC is a crown corporation or a crown agency (apparently not). The contractor that actually built and operates the highway is the Atlantic Highway Corporation (AHC), with a subsidiary operating the toll collections. Tolls are set by the government although bondholders can compel increases in some situations. The NS Department of

Transportation and Public Works has a maintenance contract. The contract between HWAC and the private operator specifies that the highway be returned to the province in 30 years.

Table 3: Revenues & Traffic

	Revenues (Million)	AADT
MacDonald MacKay	} $22.5	48,812 35,635
Cobequid Pass	$11.0	7,487
Confederation	Est $18	Est 5,000
Saint John Harbour	$2.4	26,714
Seaway International	$4.5	6,052
Ogdensburg Prescott	$1.8	1,466
Thousand Islands International	$10.3	4,836
Highway 407	Est $150.0	300,000 trips per weekday
Lewiston-Queenston	Est $12.4	12,356
Whirlpool Rapids	Est $1.2	1,180
Rainbow	Est $10.2	10,217
Peace	$32.1	22,536
Ambassador	Est $40.0	Est 32,055
Detroit-Windsor Tunnel	Est $38.0	Est 24,658
Blue Water	Est $24.5	16,031
Sault Ste Marie	$7.6	6,882
Fort Francis-International Falls	Est $4.3	2,464
Coquihalla	$42.2	7,397
Some numbers are speculative; "trip" is a different concept than "AADT."		

Confederation Bridge was financed, designed and built and is operated by Straits Crossing Development or associated companies. A critical component of the financing is an annual federal subsidy. The bridge will be turned over to the federal government in 2032 when the bonds mature. Tolls are set according to the operating

agreement between Straits Crossing and Ottawa and were originally set on the basis of the ferry rates.

The Saint John Harbour Bridge is owned and operated by the Saint John Harbour Bridge Authority, established in 1962 through a New Brunswick statute. The seven-member board is made up of municipal, provincial and federal representatives. Total long-term debt consists of non-interesting bearing loans from the federal government and the agreement is that the Authority makes an annual payment on the principal equal to net earnings, before deprecation and after deducting any capital acquisitions during the year.

The Seaway International Bridge Corporation, the Joint Venture, is an agent of The Federal Bridge Corporation and its US counterpart, the Saint Lawrence Seaway Development Corporation. The purpose of the Joint Venture is to operate and manage the toll bridge between Ontario and New York, based on a 1957 joint venture agreement.

The Ogdensburg-Prescott Bridge is owned and operated by the Ogdensburg Bridge & Port Authority, a US-created (NY law) public benefit corporation. Under its enabling legislation, the bridge reverts to the state once the bonds and other liabilities have been paid in full.

The Thousand Island International Bridge Authority (TIBA) is a New York State public benefit corporation. Its seven-member board is comprised of four Americans and three Canadians. The owner of the Canadian portion is Federal Bridge Corporation, a crown corporation, which has entered into an agreement with TIBA to operate and manage the structures.

Ontario's Highway 407 began with the formation of the Ontario Transportation Capital Corporation (OTCC). The government was in financial difficulty and, in addition, wanted a job-creation plan. Conventional procurement policies—in particular, waiting for annual appropriations from the consolidated fund—would have meant a 20-year construction process.[10] As a result, Ontario opted for a public-private partnership. Although the original idea was to have the private

sector arrange financing, OTCC eventually awarded a design, build and operate agreement. It financed the road itself, and the contract for maintenance of the highway was a separate agreement. There was also a separate agreement for the electronic tolling.

In April 1999 Ontario sold 407 ETR Concession Company to private interests for $3.1 billion. "The consortium will lease the lands from the province for a period of 99 years and will own the road, buildings and other structures on the Highway 407 lands. These will become the property of the province at the end of the lease."[11]

The original legislation required the removal of the toll charges on the retirement of debt. Presumably the sale of the highway has changed this condition. The government's April 1999 press release indicated that "The new owners will have the authority to set toll rates. However, they will be required to achieve pre-set traffic *congestion* relief targets established by MTO in order to increase rates above a specified toll level. . . . . "

The Niagara Falls Bridge Commission, a US public benefit corporation, owns and operates three bridges—the Lewiston-Queenston, the Whirlpool Rapids and the Rainbow. The Commission, created in 1938 under US legislation and licensed under the Extra Provincial Corporations Act of Ontario, operates with an eight-member board, four appointed by New York and four appointed by Ontario.

The Peace Bridge is operated by the Buffalo and Fort Erie Public Bridge Authority, which dates back to 1925. The Authority was created under Canadian legislation as a bi-national commission. There are 10 members on the Board, five appointed by New York and five by Ottawa. The original legislation suggests that the authority shall remain in existence until its bonds are paid and its debt retired. With current plans to build a new bridge, it is unlikely the debt will be retired anytime soon.

The Ambassador Bridge is one of only two privately owned roads between Canada and the United States open to public traffic. The

owners are The Detroit International Bridge Company and The Canadian Transit Company. As a private bridge, no US federal funds could be used to up-grade roads connecting the bridge to the Interstate (I-75). This was resolved in the latest reauthorization of highway funding (TEA-21) and there are now plans for major construction projects on the US side of the bridge

The Detroit-Windsor Tunnel, which opened in 1930, was built entirely by US private interests. In 1990 ownership of the Canadian half reverted to the city of Windsor, ending a 60-year franchise agreement with the Detroit and Canada Tunnel Corporation. The city of Detroit owns the US half and the Detroit and Canada Tunnel Corporation remains the operator.

The Blue Water Bridge was built under the authority of 1930 Michigan legislation. According to Michigan sources, there was an agreement between Canada and the United States that the bridge would become toll free once the debt was retired. This happened in 1962. At this point, the Canadian operator, Blue Water Bridge Authority, began collecting tolls in both directions. Prior to this, each operator only collected tolls in one direction. Under 1970 US federal law, Michigan Department of Transportation was authorized to re-institute tolls on its side of the bridge. Canadian sources have a slightly different story: "In 1964 (sic), following retirement of the construction debt, the Canadian half reverted . . . to the federal government in accordance with the provisions of a 1928 special Act of Parliament . . . " This source makes no mention of an agreement to cease collecting tolls or anything about the Canadian side of the bridge collecting tolls in both directions in 1962.[12] The current organizational structure of the Canadian operator is governed by federal legislation—Blue Water Bridge Authority Act of May 1964. In 1995 both operators agreed to twin the existing span and re-deck the original bridge.

The Sault Ste Marie Bridge is operated by the International Bridge Authority of Michigan. Under US Public Law of 1940, it was allowed to construct and operate a toll bridge. Once the debt is retired, owner-

ship was to revert to Michigan and Ontario. Apparently, this would have happened in 2000 but, under an amendment to US legislation, Michigan was allowed "to continue to administer a toll . . . and use this revenue as a source of funding for maintenance, operations, and future capital improvements to the bridge."[13] The press release notes that the continuation of tolls was also the wish of Ontario.

The Fort Francis-International Falls Bridge is privately owned by the Minnesota, Dakota & Western Railway Company, a Boise Cascade Subsidiary.

The Coquihalla, opened in 1986, was the first new toll facility to be built in Canada in two decades. British Columbia itself had abandoned the idea of tolls in 1964. Unlike other toll roads, bridges or tunnels, the Coquihalla is unique in that it was built by the BC Ministry of Transportation and Highways using ordinary procurement policies. To this day toll revenues are treated just like any other tax in the government's consolidated fund.

The reason why a decision was made to use tolls is not known. Some have speculated it had something to do with accelerating the construction schedule. Others doubt this, pointing to the fact that the decision to start construction preceded the decision to levy tolls. It is also possible the decision to use tolls had to do with the financial constraints faced by the government (the BC economy was either in recession or coming out of one in 1984) or the fact that the province was expecting a lot of visitors for EXPO86 (non residents who did not pay taxes in BC).[14] The tolls themselves are authorized under the Ministry of Transportation and Highways Act.

Policies on Toll Roads: As the preceding notes show, there is no single model for toll authorities. Some exist because of unique acts of Parliament; some are creatures of provincial or state legislation; some exist because of agreements between Canada and the United States; several have had various levels of government help with financing; one is virtually indistinguishable from other provincial roads except for the existence of tolls; one is a public utility; and the three most

recent exist primarily because of the constraints on provincial finances. The new Fredericton-to-Moncton highway was also almost in this latter category although political pressures led to the decision to abandon tolls. The NB government now pays the operator what amounts to a shadow toll.

To put some context into this diversity, it helps to look at the history of toll facilities. After the Second World War, there was a pent up demand for highway capacity. In the US, where many states were required to fund highways from user taxes, the only way to meet this demand was to use toll. Many turnpikes in the northeast were built during this period. The appeal of toll roads largely ended in the United States in 1956 when the federal government began funding the Interstate Highways (legislation prohibited tolls). But the idea of using tolls, although not dedicated user taxes, had been noticed in Canada where several provinces (NS, Que, ON & BC) constructed toll facilities. At one point BC had a toll authority operating seven bridges and tunnels. For reasons that are not clear, provinces abandoned the idea of using tolls during the 1970s and 1980s. Most toll roads disappeared by the 1980s, the exception being the bridges and tunnels between Ontario and the United States, the Halifax-Dartmouth bridges, the Canso Causeway and the Saint John Harbour Bridge.

In the 1980s and 1990s toll roads began to come back into favour because financially strapped governments had to look to some means other than a reliance on taxpayers to build new roads. But this expediency was aided by numerous recommendations of academics and commissions. The Royal Commission on National Passenger Transportation, for example, wrote: ". . . we recommend that: Conventional tolling systems be considered when new or expanded limited-access highways are required, with tolls set to cover any costs of the road link in question that exceed those recovered by fuel taxes. In addition governments could use tolls to levy a higher charge on peak-period users if congestion is a problem on a road."[15]

In looking at this period, four factors, used at various times in various combinations, can be seen to influence the decision to build toll roads: (1) the influence of US policies, (2) the effect of split jurisdictional responsibility, (3) the anticipation of a large amount of non-resident traffic (vehicles not registered in the jurisdiction building the road), and (4) the impact of fiscal constraints on governments as deficit financing lost its political allure. There may also have been the occasional principle of highway finance involved in the decision to use tolls, although the sceptic has the right to remain sceptical.

Future of Toll Roads: At least five-to-seven new toll roads are now under consideration (2 in Québec, 2 in Ontario, possibly 1 in Alberta and 1 or 2 in British Columbia). Certainly the intellectual appeal—judging by the volume of academic papers and commission recommendations—of making road users pay for roads through tolls, or rationing scarce capacity through peak-period pricing, is playing a role in some of these decisions.

But looking towards the future, and notwithstanding the possibility of five-to-seven new facilities, it is not certain that toll roads will play a major role in the Canadian road network—at least where this role is measured in route kilometres. Toll roads seem most appropriate where high traffic volumes in and around major urban centres justify their use. The average AADT for the whole National Highway System in Canada is only 8,900.[16] In only two provinces are average AADT figures on these main highways above 10,000. Conventional wisdom, then, suggests that there are only small portions of the network where tolls could work. And this does not take account of another piece of conventional wisdom: toll roads are politically more palatable where feasible alternative routes exist.

But predicting the future is difficult. It may be that the large decrease in toll collection costs (transponders), a shift in views about how to pay for roads (Canada Transportation Act Review Panel report), continuing pressures on governments' consolidated tax funds for social spending (health, education), and other factors may all change current thinking. There may be tolling possibilities that have not

previously been common: roads built and paid for by the general taxpayer or dedicated taxes but the use of certain lanes at certain times paid for by tolls; freeway access ramps used according to tolls paid; special permit trucks paying what amounts to a toll as their use is monitored with GPS; roads built and paid for by general or dedicated taxes but private maintenance operators compensated through toll revenues; etc.

What is needed is a thorough public debate about toll roads and their place in future road financing.

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[1] Nix, Fred P. 2001. *Alternative Road Financing Arrangements*. prepared for Canada Transportation Act Review Panel, Ottawa.

[2] Lengths from web sites & annual reports. Other sources: (1) Transport Canada (www.tc.gc.ca/programs_and_divestiture) and (2) US DoT. 1999. *Toll Facilities in the United States, Bridges - Roads - Tunnels – Ferries*. In the case of bridges, lengths are for the toll facility, not just the structure. In the case of the Blue Water, length is sum of both bridges. At the time of writing, Whirlpool Bridge remains closed as a result of September 11th. Two other roads might be added to this list: (1) Fredericton-Moncton highway where a form of shadow tolls are used, and (2) the international bridge at Rainy River (some sources show it as a toll bridge but this has not been confirmed).

[3] Op cit. US DoT. 1999.

[4] Lengths for countries other than US as reported in: (1) Estache, A., M. Romero and J. Strong. 2000. "Toll Roads," in Estache, A. & de Rus, G (ed). 2000. *Privatization and Regulation of Transport Infrastructure: Guidelines for Policymakers and Regulators*, The World Bank; and (2) José Luis Nicolini. 2002. "Toll Road Concessions In Argentina: What Can Be Learned," TRB Paper 02-2411.

[5] (1) Halifax-Dartmouth: annual report 2000 & TC web site; (2) Cobequid: www.gov.no.ca/tran/project/cobequidpass.stm. A web site that no longer operates (www.cobequidpass.com) gave AADT figures in Dec/01. (3) Confederation: tolls - www.confederationbridge.com; revenue as per original forecast; traffic based on AADT figures of adjoining NB & PEI highways; (4) Saint John: TC web site & annual report 2000. (5) For 12 Can-US border crossings, StatsCan data from the International Travel

Survey for 2000 (inbound vehicles) doubled. StatsCan combines numbers for Ambassador with those for tunnel. In 2000, there were 10,332,623 vehicles entering Canada through these two points, suggesting a 2-way flow of 20.7 million. Tunnel web site (www.dwtunnel.com) lists traffic as "over 9 million." This suggests that Ambassador handles 11.7 million. (6) Seaway: tolls - TC web site; revenues: FHWA web site (Table 3f-3b) 1999 = US $2,990,000. (7) Ogdensburg-Prescott: tolls - TC web site; revenues - FHWA Table 3f-3b, 1999 = US $1,181,000. (8) Thousand Islands: tolls (effective Feb 1/99) as per fax; revenues - FHWA Table 3f-3b, 1999 = US $5,822,000. (9) 407: tolls as per Jan, 2002 rate sheet; revenues - web site (www.407etr.com) indicates over 300,000 trips/weekday. Assuming an average toll of $2.00, weekly revenues may be in the range of +$3 million. (10) Lewiston-Queenston, Whirlpool & Rainbow: tolls - www.niagara-fallsbridges.com; revenues - FHWA Table 3f-3b, 1999 = US $16,354,000. This has been split in the same proportion as the 2000 traffic; (11) Peace: tolls - www.peacebridge.com. E-Zpass rates are only in US$ and have been converted here at 1.6; revenues - FHWA Table 3f-3b, 1999 = US $18,568,000. (12) Ambassador: tolls - www.ambassadorbridge.com; revenues – with estimated traffic of about 12 million and a $3 toll for automobiles, revenues are probably over $40 million. The Detroit News (Peter Waldmeir, Sept 28, 1997) notes that toll revenues exceed US $20 million. (13) Detroit-Windsor Tunnel: tolls - www.dwtunnel.com; revenues - with annual traffic over 9 million and assuming an average toll of $4, revenues = $38 million. (14) Blue Water: tolls - www.bwba.org & www.mdot.state.mi.us/bluewaterbridge/ the two sites disagree on tolls. For here, the MDoT has been used as the source of the eastbound (to Can) rates and the bwba.org site for the westbound (to US) rates; revenues - FHWA Table 3f-3b, 1999 = US $10,900,000. As this is close to the figure shown for 2000 by MDoT, it is assumed these are revenues for the US operation only. Total revenues are estimated as $14.7 + $9.8 = $24.5 million. (15) Sault Ste Marie: tolls – fax from bridge; revenues - FHWA Table 3f-3b, 1999 = US $5,040,000 (16) International Falls: tolls – fax from bridge; revenues – StatsCan traffic volumes (doubled) were multiplied by Oct 1/00 toll rates. (17) Coquihalla: traffic – BC MTH annual report for 1997/98 suggests total volumes in fiscal 1997/98 were "almost" 2.7 million vehicles; tolls - www.th.gov.bc.ca/bchighways/coquihalla/; revenues - BCMTH, *Annual Performance Report, 2000/2001.*

[6] This is estimated AADT times length (half in the case of international bridges and tunnels). The weak links in this assumption are (1) the Coquihalla where one 1997/98 estimate of AADT is used along with the

assumption that all vehicles travel the complete length and (2) the 407 where the 300,000 trips per weekday have been translated into a guesstimate of 18 million vkt a week on the assumption of an average 10-km trip and volumes on the weekend half the level of a weekday.

[7] Statistics Canada, *Canadian Vehicle Survey, 2000*. cat #53-223-XIE.

[8] Transport Canada. 2000. *Transportation in Canada 1999: Annual Report*. Table 3-5 shows federal, provincial & local expenditures ($11.6 billion for fiscal '99). If toll revenues are added, the actual total is $11.9 billion.

[9] "New York Toll Facilities" (www.ettm.com/ny.html)

[10] SG Hambros. 1999. *Public-Private Partnerships for Highways: Experience, Structure, Financing, Applicability and Comparative Assessment: Objective One Final Report*, prepared for Council of Deputy Ministers Responsible for Transportation and Highway Safety. Much of the information in the text on 407 is taken from this report.

[11] Press release dated April 16, 1999 (www.gov.on.ca/privatiz/).

[12] Michigan DoT: www.mdot.state.mi.us/bluewaterbridge/history.html; and "A Historical Look at the Federal Government's Involvement in Highway Infrastructure" on Transport Canada's web site.

[13] http://levin.senate.gov/releases/031198c.htm

[14] See (1) Kasianchuk, D. A. & W. P. Warburton. 1985. "Forecasting Highway Traffic: The Coquihalla Highway – A Case Study," *Research Seminar Series*, CTC, Spring 1985, (2) Seymour, J. 1992. "Highway Infrastructure Funding Alternatives" paper prepared for the BC Ministry of Transportation and Highways, and (3) Waters W.G. II & Shane J. M. 1987. "Benefit Cost Analysis of a Toll Highway - British Columbia's Coquihalla," *Proceedings*, CTRF annual meeting.

[15] *Directions: The Final Report of the Royal Commission on National Passenger Transportation*. Vol. 1, p 105.

[16] Op cit, Transport Canada. 2000. p 87.

CHANGING THE FACE OF TRUCKING

A. James Park

"The gods had condemned Sisyphus to ceaselessly rolling a rock to the top of a mountain, whence the stone would fall back of its own weight. They had thought, with some reason, that there is no more dreadful punishment than futile and hopeless labor."
-- Albert Camus, from *The Myth of Sisyphus*

INTRODUCTION

See that kid over there on the street corner, the one with the nail in his nose and his pants on backwards? He could be your future son-in-law. Or worse, he could be on his way to a job interview with your company. He could be the next driver you hire.

At age 43, I'm at a loss when it comes to understanding the appeal of driving sharp metal objects through soft, fleshy parts of the body.

My parents referred to the problem as The Generation Gap. Now it's called demography. We've refined the study of inter-generational differences and we can use the science to help understand the past and to prepare for the future. It's the study of human populations. To grasp the inter-generational differences in people, their preferences, their likes and dislikes and more importantly, what makes them that way, is to hold the key to successfully plan for the future. Like it or not, the kids with the nails in their noses are the future, at least in the short term, so we'd better get used to it. But there's a catch: they probably don't like you any more than you like them, but they can live without you. You can't live without them.

The purpose of this discussion is to explore ways the trucking industry can change the way it does business in order to attract the drivers it will need in the near future. Can trucking continue to

simply search for new pools of talent, or will trucking have to adapt to the needs and preferences of the existing pool? My assertion is that trucking will have to become more flexible in meeting the needs of the next generation of driver, rather than trying to find an individual to fit the job. The industry wastes a lot of time and money searching for square pegs in a box full of round ones. They just aren't out there anymore. The shape of the hole might have to change instead.

BACKGROUND

The lure of the open road is one of the most romantic notions in modern society, and trucking has always held a place in our imagination. Few of us have never pondered the prospect of wheeling a big diesel down some lonesome stretch of prairie highway.

And there was a time, not that long ago, when that romance held true even for the work-a-day trucker. But the romance, along with the perceived freedom and independence, has vanished. With the advent of satellite tracking, Just-In-Time delivery schedules, and savagely competitive rate pressures, it's now a game where the winners and the losers are separated by mere tenths of a penny per mile.

There is so much pressure on drivers to perform these days, they often do so in direct conflict with safety and operational prudence. In many ways, they are forced into dangerous situations by shippers who impose steep financial penalties against carriers for service failures and missed delivery appointments. In the wake of our performance-based regulatory philosophy, additional pressure has been placed on drivers to comply and to perform according to ever-tightening schedules and enforcement demands.

The risks associated with being a mediocre trucker continue to rise, while the return for being a good trucker is diminishing. The pressure the system imposes on its employees, coupled with stagnant wages, the ever-present threat of enforcement, and the lack of job satisfaction, are conspiring to force many drivers to re-examine their commitment to the trucking industry. Many veteran drivers will tell you they'd sooner see their sons and daughters in boot camp than driving a truck for a living.

This internal strife comes at a time when the demand for trucking services is expected to grow at an unprecedented rate. The Canada/U.S. Free Trade Agreement, implemented on January 1, 1989, brought with it a huge increase in trade between Canada and the U.S., and placed a heavy demand on truckers to move the freight.

Statistics from the Ontario Trucking Association suggest that trucking facilitated that surge in trade. The value of Canadian exports moved by truck increased from C$58.2 billion in 1989 to C$125.1 billion in 1996. The value of imports shipped into Canada by truck has increased similarly, from C$76.3 billion in 1989 to C$145.2 billion in 1996, and may yet increase by as much as 180% by 2015.[1]

But there's yet another fly in the ointment. As demand continues to grow, the labor supply is tightening just as rapidly. Many existing drivers are heading for the doors, and as industry struggles to fill those empty seats, it'll need more and more new drivers to steer and gear the trucks required to meet the escalating demand.

DEMAND AND SUPPLY: Who are they? Where are they?

The term 'truck driver,' as defined in any statistical profile, covers a lot of ground. For our intents and purposes, we're concerned with employable tractor-trailer drivers, those possessing a valid driver's license permitting them to operate articulated commercial vehicles with a gross combination weight in excess of 4600kg. In trying to quantify the number, various statistical sources look to income tax returns, industry surveys and occupational surveys. Pin-pointing the exact number is difficult because of the variety of sectors in which truck drivers work, such as private trucking, for-hire trucking, construction, manufacturing, agriculture other primary industries.

Human Resources Development Canada (HRDC) in its National Occupational Classification for Truck Driver, suggests there were 206,000 people employed as truck drivers in 1998.[2] The 1996 Census reported 222,800 men earning a living as a truck driver, while the Canadian Trucking Human Resources Council (CTHRC) pegs the number at "over 150,000" for same point in time.[3] A reasonable and safe estimate of the number of working truck drivers, today, would be approximately 220,000.

We've already seen an increase in the employment statistics for truck drivers, with 17.7% increase from 1988 to 1998, and an increase of 20.0% between 1993 and 1998. In comparison, employment in all occupations in Canada grew 12.3% over the same ten years, and 8.2% over the last five.[4]

Trucking's biggest challenge is that the majority of the workforce is older. That means they're looking to slow down a little, many are nearing retirement, and there are fewer drivers coming in from behind to replace them. The chart below shows the largest group of male Class A license-holders in 1997 was the 35-44 group. They are now six years older and that much closer to retiring. Looking next to the general population chart, we see the numbers of men under 35 is shrinking by a substantial amount, taking with it trucking's traditional labour pool. The same patterns apply to women as well.

Male Population in Canada, 1996		**Class A License Holders, Male, Ontario, 1997**	
Age	Quantity	Age	Quantity
20	205,000	21-24	4,144
25	210,000		
30	249,000	25-34	34,447
35	275,000		
40	250,000	35-44	48,702
45	220,000		
50	185,000	45-54	38,469
55	150,000		
60	120,000	55-59	11,379
Source: [5]		Source: [6]	

CTHRC, based on the results of surveys taken for its Sector Study Update (the original Sector Study, *Canadian Trucking Industry: Human Resource Challenges and Opportunities,* published in early 1990, and updated in the fall of 1997) arrived at these conclusions: The industry will experience an increase in demand of 13% for

company drivers, 39% for owner-operators, and 23% for leased drivers over the next few years.

So, with demand as strong as it is, two questions arise: do a sufficient number of Canadians see truck driving as a career opportunity, and if not, how will trucking succeed in recruiting a sufficient number people over the next decade?

SUPPLY AND DEMAND: Is there really a driver shortage?
If you asked 10 carriers, each with 100 trucks if they were experiencing a shortage of truck drivers, each might say they could use an additional 10 drivers. They may not have 10 trucks parked against the fence, but they might be able to slip those 10 drivers into the system to cover vacationing or absentee drivers. The answer to the question would suggest a perceived shortage of 100 drivers, but none of the fleets reported an acute shortage of help, one that might cause them to incur some extra cost in order to make up the shortfall.

If you asked those same 10 carriers where their human resource needs might be in a decade, they would notice that two-thirds of their current roster would be retired by then, and they'd tell you that they'd have a need for 66% more drivers. That doesn't include growth or expansion plans. Do we have a driver shortage in Canada? The short-term answer would have to be no. The long-term answer would be yes. And therein lies the problem.

The market is not presently behaving as if there was an acute shortage. We've seen no real upswing in wages, especially for owner-operators, and many other aspects of the truck driving job have stayed the same or worsened over the past few years (stricter enforcement, more time away, longer waiting periods at shipper's facilities, higher U.S. exchange rates, etc.) suggesting there's no real pressure on the industry to do something to entice drivers to stay in the business, or to attract more drivers into the business. In other words, the costs associated with being a truck driver have increased, the value accrued from the job has declined, yet the need to change the way the industry does business hasn't yet become desperate enough to drive a significant shift in the motis operandi.

There is still a supply of individuals who are interested, but who may not qualify as employable truck drivers, or be suitable candidates, including individuals:

- With criminal records (it's difficult for people with criminal records to gain entry to the U.S. without first procuring the necessary waivers and pardons)
- With drug or alcohol dependencies (pre-employment and random drug and alcohol testing is mandatory in the U.S.)
- With some form of impairment that would disqualify them from operating commercial vehicles (medical, physical, etc.)
- For whom extended absences from home are unacceptable (anyone with childrearing or care-giver responsibilities, commitments that require regular attendance, or people who are simply unwilling to be away for long periods)
- Who may be illiterate or who don't have a satisfactory command of the English language (written and spoken English is a U.S. Dept. of Transportation job qualification)
- Whose work ethic isn't up to industry standards or who have no aptitude for driving commercial vehicles

In addition, there's a sizeable number of applicants out there, mostly individuals who have taken some type of truck driver training, who, amazingly, still can't find work as a truck driver.

These people are deemed too inexperienced by the industry, and hence refused jobs until they gain some experience. The carriers, all but a select few, still refuse to invest any money in developing these new drivers. They expect road-ready professionals to arrive at their door, prepared for the big-league, yet remain unwilling to invest any money to bring their workforce up to a level they define as qualified.

Instead, what the industry is attempting to do is to set the bar even higher, by raising the skill and qualification levels needed to attain a commercial driver's license. This will place more of a burden on the driving schools to develop and deliver a more comprehensive curriculum, at ultimately greater cost to the student, without forcing the carrier to absorb some of the cost of pre-employment training.

It may sound reasonable to want higher entry level standards, but if current practices (low pay, unpaid work, time away from home, lack of advancement, etc.) don't change, who will want to invest a sizeable sum of time and money in a career with little future?

Remember, we're no longer dealing with displaced soldiers, farmers, and under-employed white middle-aged males (trucking's traditional talent pool) as a potential source of labour. We're dealing with a group of 20 to 30-year-old men and women with a decidedly different outlook on life. Here's how the science of demographics is about to deal the trucking industry a really rotten hand.

Our 30-something crowd is already in mid-career, while their slightly younger brothers and sisters are either in the post secondary stream or just emerging, or perhaps they've elected to go the vocational route. In any case, they are already in the beginning stages of another career.

As for the rest of the group, they may be the ones the industry is turning away at the gate because they haven't got the experience.

There's a rather ironic element to all this, but the evidence can only be called anecdotal because of the nature of the complaint. The complaint, however, is being heard from several different quarters.

It's being alleged that traditional source of funding for tuition fees for truck driving courses is drying up because graduates are not staying in the trucking industry. The rational, apparently, is, "why fund a program that isn't producing career-enhancing results?"

The generational profile (Table 1) illustrates the cultural differences between four generations and their sub-groups across the general population. In the trucking industry the ones who presently rule the roost are the Old Guard. The ones who are currently leaving the industry are the Boomer-types, and the 30-Somethings are the group trucking is looking at to fill the empty seats.

In assembling this paper, I spoke with the principals of several prominent Canadian truck driving schools for their take on who was or wasn't coming through the door in 2001, and why. And further,

when asked about the track records of their graduates, their answers are predictable if you recognize the trends. Among the responses:

- We tell them about life on the road, the time away and the expense of eating in the U.S., but it's not until after they've experienced the full impact of the job that they change their minds. That usually takes about three to four months.
- They're finding they're in over their heads if they don't receive enough post-graduation training. They get out there and what they find themselves up against scares the heck out of them. They can't wait to get home and hand the keys back.

Another difficulty the industry faces is competition from the vast range of career options available to young people today: there are literally hundreds of careers that didn't even exist a generation ago, many attainable with a college diploma or some post-secondary education. These are careers with more attractive futures than the trucking industry can presently offer.

Many of these occupations pay extremely well, and most offer linear or non-hierarchical advancement opportunities. Here's what Dale Ritchie, president and CEO of McKenzie College, Halifax, N.S. had to say in comparing a computer animation program at his school to the skills acquired at a truck driving school. "In 10 months, at a cost of $6000, I can put a student into a $20 per hour entry-level job they can literally do at home. The skills are completely portable and they earn while they learn. There's tremendous demand for IT skills today, and there's tremendous flexibility associated with a job like this."

Contrast that statement to this one of Ted Sparkes, proprietor of the Atlantic Transport Training Academy Ltd, an accredited and reputable trucking school in Apohaqui, N.B.: "Two years ago, I'd have had a full class of students on the go, and 20 more inquiring about a career, 75% of them between the ages of 19 and 34, and 25% of those people are changing careers mid-stream. Today, my phone isn't even ringing. I could easily place 200 students into 200 jobs right now."

It's obvious that people outside the industry have a good idea what's going on. My interviews also garnered the following observations:[7]

- We seem to be scraping the bottom of the barrel these days. We have a high number of applicants with criminal records – assaults, break-and-enters, auto-theft, and the like. Not habitual criminals, but people with less than stellar backgrounds. And as soon as we mention drug testing, there's a rush for the door.
- Most of the concerns I've heard from the students concerned the unpaid time spent on the job. They're used to being paid eight hours wages from being at their station for eight hours a day. These folks are smarter, in a streetwise sense, than the older truckers, and they're not happy about working for nothing.
- This industry needs a whole new generation of drivers, but they're not going to find them around here. People can now get a job at a call centre and take home more than a driver can, given the time away and the cost of living on the road. And, nobody is going to fine them for dialing the wrong number.
- This industry seems to be of the opinion that they shouldn't have to pay a training wage because they're already incurring a cost in lost productivity and increased risk. There are just too many jobs that will pay people to learn and then treat them well after they're up to speed. This industry is in one big mess.

To understand why today's youth may not interested in trucking, you have to understand the generation. These people grew up in the fast-paced, high-adventure, technology-dependent world of television and computers. They want constant stimulation and they've established their view of the world through role models like Dennis Rodman, Bill Gates and Quentin Tarantino. They're conspicuous consumers, they want it all, and they don't see driving a truck as a way of fulfilling their dreams.

These are young people whose parents have told them to aspire to something more than driving trucks, and their guidance councilors see trucking as a last-resort kind of job. If they have relatives who drive, they have likely been told it isn't a very good way to make living.

Today's older teenagers and young adults are lost to the trucking industry, equally because of the other possible careers and the cultural gap that exists between them and the industry establishment. These individuals are the round pegs the trucking industry would like to turn into square pegs. Maybe it's time for another approach.

ROUNDING OUT THE HOLE

There are still some young people who would consider a career in trucking, but it's doubtful that there will be enough of them to satisfy the industry's needs. If entry applications to the driving schools and comments from various high school guidance councilors are any indication, the numbers are woefully low. There's the possibility of scooping up transitional employees, downsized from their present careers, but many of them went through the system five or more years ago. Typically, career counseling is included in the severance package, so I spoke with several career-counseling firms and discovered that trucking wasn't even on their radar screens.

It seems that not many people want to become truck drivers anymore, and many of the existing drivers seem to agree with them.

Current Irritants

Pay is generally not thought of as a big problem today, but there are problems associated with pay.

- The concern most commonly expressed by drivers is the lack of pay for the many on-duty tasks they're required to perform, such as loading, unloading and dealing with customs, etc. Drivers feel the lack of paid on-duty time is disrespectful. It sends a message that carriers still view drivers as a dime-a-dozen.
- Discrepancies between mileage paid and mileage run are usually small but highly irritating. The issue of paid versus practical miles sets up an enormous and unnecessary conflict.
- When rates of pay are the same across the board, regardless of experience or seniority, it gives the junior drivers little to work toward, and devalues the contribution of the experienced driver.
- Owner-operator rates remain nearly 35% below where they should be. Carriers don't seem too anxious to rectify the problem, while owner-operators seem as reluctant to force the

issue to a resolution. The result is abysmally low return on the owner-operator's investment, with no one willing to address the problem.

Time away from home has become the hot issue over the past few years as drivers age and their priorities change. But travel is what trucking is all about. How do we overcome this obvious dichotomy?

- Drivers feel that carriers consistently put profits ahead of their own personal concerns. The travel isn't a problem, except when the carrier won't bring the truck home. Equipment utilization is seen as a priority, at the expense of time at home.
- The reality of today's two-income family, with a second spouse working and generating an income, has relieved some of the pressure on the sole income-earning partner. For truck drivers, this translates into less incentive to stay out on the road earning money. As well, there has been a shift in men's attitudes toward home and family, so that they are just as likely as women drivers to want to spend more time at home.
- More attention could be paid to regular scheduling, shorter trips, and a shift back to the hub-and-spoke distribution system. Carriers who have a regional customer base consistently report lower turnover rates than the long-haul carrier.[8]

Trucking has little to offer in terms of career advancement, and studies have shown that younger workers expect to change careers up to seven times over their working life. If trucking is unable to offer the opportunity for at least lateral advancement, it will be seen as a liability rather than an asset in choosing trucking as a career.

- Drivers reach their maximum salary rate after just 2.59 years on the job, on average.[9] The range between an entry-level wage and an experienced wage is minimal, and the wages are often identical across the entire fleet. Even if there's no advancement in career potential, the wage should be expected to rise as experience accrues and the driver becomes more of an asset.
- Where does a driver go from the driver's seat? There's little hope for advancement within the company because of the highly stratified structure and the small number of inside opportunities.

- If any desire exists to keep pace with the changing demands of our technology-based economy, truck drivers who are working away from home for 70 to 100 hours a week will have difficulty scheduling time off for night school or other educational pursuits.

WHAT'S TO BE DONE?

Like the mythical Sisyphus, trucking seems doomed to repeat its mistakes. According to the terms of his punishment, Sisyphus was condemned to an eternity of frustration in hopeless and futile labour. The trucking industry could avoid a similar fate if only it would look within itself for solutions rather than commissioning study upon study to arrive at the same conclusion. The potential for failure lies not in asking the same questions, but in beginning with the same parameters.

The industry is constantly bemoaning the shortage of qualified drivers. So, what is qualified? Is it right to expect only experienced, road-ready veterans to be out looking for work? The experienced drivers already have jobs! The industry should be looking for trainable drivers. The Class A, or Class 1 license, like a bachelor's degree, is just a license to learn. Any college or university graduate enters the workforce competent to start the job, but they're not experts. Most employers expect to make substantial investments in the education and training of that employee. Sadly, the same can't be said for the trucking industry.

Rather than attempting to increase the entry-level requirements, stiffening the tests and forcing more elaborate and costly training programs, the industry should be investing a little of its own money in developing the talent they pluck out of the driving schools. Like the farm system in professional sports, the driving schools are a training ground. The company is the team, and the one who invests most wisely in its recruits, and has the most to offer, will win.

If it costs too much to pay a senior driver to coach and develop the junior talent, then maybe there's something wrong with the rates. We hear of companies putting a team of drivers together, to gain experience in the two-person cab, but then running the truck so hard

the trainer spends most of the training time asleep in the bunk. And worse, they're inclined to pay the trainee little more than expense money while they're learning. That's not training, it's exploitation.

The industry could be investing in a multi-tiered apprenticeship program where drivers are recognized and paid for their experience and safety record. The mechanism already exists to track violations and accidents, why can't it be used to track the positive aspects of a driver's career? This would enhance a driver's employability, and minimize risk to the carrier. Senior drivers should be paid to train junior drivers, thereby adding another dimension to the career path.

At the end of the day, there's a lot more to be gained by retaining existing drivers than hiring a never-ending stream of new and short-lived drivers, but that would require a paradigm shift in the way the industry does business. There are plenty of men and women who would make fine truck drivers if the industry weren't so insistent that the employee fit the job. And when it comes to recruitment, if the package was more attractive, we would have less difficulty in finding people willing to give the industry a try.

With a bit of imagination, the trucking industry could be a wonderful place to work. Sadly, it would appear that money is in greater supply than vision. I'll leave you with a few ideas to consider: think not of where the industry is today, but where it might be if concepts like these are, or are not, implemented:

-Apprenticeship programs
-Rewards for good performance
-Hub & Spoke distribution
-Career advancement potential
-Enhanced intermodal cooperation on long-haul routes
-Better employee advocacy
-Paid meal allowances
-Experience-based pay scale
-Educational opportunities
-Better pay/paid leave for training
-Professional Driver designation
-Pay for all on-duty tasks
-More inclusive operating philosophies
-Raise freight rates

Table 1 – Generational Profile[10]

	Life Story	Opportunity & Outlook	Present Life Status
The Old Guard 1930 – 1946	Most senior workers Built the present system Practical, hard-working Value-conscious Expect return on investment	Good post-war opportunity Right place at the right time Lived through hard times Civic-minded and given to self-sacrifice	Senior managers, policy makers Empty nesters, homes are paid Close to retirement Have difficulty comprehending their offspring's values due to the difference in up-bringing
Front End Boomers 1947 – 1960	Control cultural norms Immense buying power Playing the system to suit their own needs Never unemployed	No shared perspectives with younger Boomers Had most of the opportunity Optimistic about future Strong work ethic	Feathering their nests for retirement Maximizing earning potential Firmly entrenched upper and middle management
Tail End Boomers 1960 – 1966 (Gen X)	Had more opportunity Optimistic about future Strong work ethic Trailing edge, always lining-up Optimistic, but jaded	Protecting their own interests Life has been a struggle, high costs fewer opportunities Began work during recession Solid work ethic, pragmatic	Stuck at the tail end of a large stagnant group Less opportunity to advance Trying to maximize earnings Actively participating in raising families
Baby Busters 1967 – 1980 3o Some-thing	Plenty of opportunity for college education Good choice of schools and careers Seven career changes expected	Started their working lives in tough economic times, No entry level experience until mid-twenties Entrepreneurs, self-reliant Want both a career and a life	Already into their second or third career Buying homes, settling down Raising families Little stability in their lives Proficient with technology

Notes

[1] Trucking: The Vital Link Between Canada – US Trade. 1998, Ontario Trucking Association.
<www.ontruck.org/stats/docs/stat98mar16.htm>

[2] Job Futures 2000 National Occupation Classification: Truck Driver. Human Resources Development Canada (HRDC).
<http://jobfutures.ca/jobfutures/noc/7411.html>

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[4] Job Futures 2000 National Occupation Classification: Truck Driver. Human Resources Development Canada (HRDC)
<http://jobfutures.ca/jobfutures/noc/7411.html>

[5] Population Projections for Canada, Provinces and Territories: 1993-2016. Statistics Canada, Catalogue 91-520 (December 1994).

[6] Ministry of Transportation of Ontario – Driver Licensing Statistics. Driver population as at 31/12/97.

[7] Numerous interviews were conducted for this paper with the principals of several respected truck driving schools across Canada, several high school guidance councilors, the president of a community college specializing in computer sciences, and more than few existing and potential truck drivers.

[8] Canadian Trucking Operations 2001 Compensation and Benefits Report: National Report, Drivers. Toronto: Cerno Research Inc.

[9] Canadian Trucking Operations 2001 Compensation and Benefits Report. National Report, Drivers. Toronto: Cerno Research Inc.

[10] The data on this table were compliled by the author from the following sources:
Foot, David K. Boom Bust & Echo: How To Profit From the Coming Demographic Shift. Toronto: Macfarlane, Walter & Ross, 1996.
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Options for Reducing Automobile Dependence in Urban Areas
A Case Study of Toronto

Richard M. Soberman, Professor Emeritus, University of Toronto and Associate, Trimap Communications Inc.

Background

In most major cities of the world, there is a growing consensus that the likelihood of meeting future transportation needs through road expansion alone appears impracticable from the standpoint of sustainable development, environmental impacts, liveable communities, and the accessibility for all groups of society.

In Canada, however, opportunities for reducing car dependency and improving the competitiveness of transit, in the view of many, is complicated by the fact that there are no federal government programs for public transportation operations or capital investment, making it the only OECD country in this situation. In fact, except for B.C., Alberta, and Quebec, there are no formal provincial programs to assist urban transit. In Toronto, transit funding issues are exacerbated even moreso because in Ontario:

- municipalities are creatures of the province which limits their sources of revenue,
- no regional authorities with identified funding sources exist, and
- the provincial government limits sources of transit subsidies to property taxes alone.

Within this constrained environment, the new City of Toronto (formerly Metropolitan Toronto) is now preparing a transportation plan based on reduced car dependency.

The City's Transportation Vision

The first stage of a comprehensive transportation plan for Toronto involved development of a transportation vision -- a concise statement of desired transportation system attributes. Recognizing

the high degree of interdependence among land use, urban design, urban transit and the characteristics of the road system, the principal attributes of this vision are[1]:

1. *Integrated land use and urban design that leads to fewer and shorter trips,*
2. *Public transit service that is more competitive with the private automobile,*
3. *Improved transit accessibility for the disabled and seniors,*
4. *Efficient goods movement that enhances economic competitiveness,*
5. *Traffic engineering and street design that encourage walking and cycling,*
6. *Less need to own or use an automobile,*
7. *Safeguards for the protection of the natural environment,*
8. *Reduced air pollution and emissions from transportation, and*
9. *Equitable pricing and financing of transportation services.*

The main thrust implied by this vision is to reduce automobile dependence and improve the competitiveness of transit. Nice idea, but there are plenty of 'doubting Thomases' and, until civic officials are prepared to 'walk the talk', the whole idea may be more fiction than fact.[2]

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[1] Richard M. Soberman, *A Transportation Vision for the City of Toronto Official Plan*, Toronto: City of Toronto, Urban Development Services, April 2000.

[2] According to one expert, "the automobile genie is out of the bottle, and there is no way we are going to stuff it back in". A.S.Lang, "Urban Transportation at the Turn of the Century", St. Paul, Minnesota: Macalester College, 6 November 2000.

The Existing Toronto Transportation System

Toronto is served by about 5,200 km of roads basically organized in a grid that facilitates reasonable coverage of the entire area by surface transit (buses and streetcars), supplemented by a few expressways and a subway network. Within the City, all transit service is provided through a single, highly integrated, one fare system operated by the Toronto Transit Commission (TTC).

Toronto also benefits from inter-regional bus and commuter rail services provided by GO Transit throughout the Greater Toronto Area (GTA). GO Transit rail services focus on a downtown terminal, the destination of 96 percent of all trips.

Some comparative data relating to the relative scale of each operation are shown in Table 1. Note that although the TTC carries about ten times the number of passengers daily, in terms of passenger-km of travel, the two systems are comparable. Note also that both systems achieve comparable operating cost recovery ratios which are by far, the highest in North America.

Although the TTC experienced a serious decline in ridership from a high of about 450 million in 1988, much of that loss has now been recovered. GO Transit rail services, by contrast, have experienced continuous growth since they were first introduced in 1967 and there is lots of evidence to suggest that for a long time, "if you build it, they will indeed come". A doubling of service frequency on the Bradford route in 1998, for example, led to a doubling of ridership.

In the City, public transit accounts for about 32 percent of all morning peak period trips, considerably higher than elsewhere in the GTA for many reasons (population densities, route configurations, etc.). However, for travel from these regions to the City, mode splits increase dramatically and, for travel to Toronto's downtown, even moreso.

These data, as well as other studies indicate first, that the transportation needs of the City of Toronto cannot be considered

independently of travel by residents of the surrounding municipalities to and from the City and, second, that there is a significant latent demand for even more downtown oriented commuter rail and rapid transit service, now limited by available capacity.

Table 1
Comparative 1997 GO Transit and TTC Statistics

Item	GO	TTC
Service Area (km^2)	8,300	620
Annual passengers (millions)	35	381
Annual passenger-km (millions)	1,110	1,112
Average trip length (km)	32	3
Operating Revenues ($millions)	109	549
Operating Expenses ($millions)	178	707
Capital Budget ($millions)	48	437
Workforce	964	9,483
Rail Service		
Number of routes	7	3
Route km	361	63
Bus & Streetcar Service		
Number of routes	7	144
Route km	1,231	2,400
Vehicles in Service		
buses	174	1,240
Wheeltrans buses	na	144
streetcars	na	164
subway & RT cars	na	534
passenger coaches	329	na
locomotives	45	na
Total	548	2,082

The Planning Approach

Since the main thrust of the transportation vision is to reduce automobile dependence and improve the competitiveness of transit, in contrast to traditional approaches to plan development that focus on reducing or eliminating projected capacity deficiencies at key locations, the current approach involves attempting to:

- penetrate areas that now have poor transit coverage (possibly through alternative forms of transit delivery),
- improve connectivity and coverage of the surface and rapid transit systems, and
- enhance connections with regional transit services (including park and ride for long distance commuting from low density suburban areas).

Figure 1, for example, illustrates one dimension of accessibility by highlighting specific traffic zones that are 'transit disadvantaged' in the sense that only a small proportion of all jobs in the City can be reached within 45 minutes by transit. (In this diagram, the more lightly shaded areas have access to the fewest number of jobs.)

Achieving the goal of reduced automobile dependence therefore suggests that these are the same areas where attempts should be made to improve transit competitiveness, particularly for those areas identified in the Official Land Use Plan as opportunities for accommodating more residents and jobs.

Elements of changes and/or improvements to the existing transportation system include land use policies and specific transportation investments and policies that can be grouped into "building blocks", as shown in Figure 2.

Figure 2 also shows certain linkages between these elements, as in the case of on-street parking regulations and transit priority, or between land use intensification policies and rapid transit expansion. Other linkages relate to local urban design (e.g. mixed land use) and new transit routes (including alternative means of service delivery),

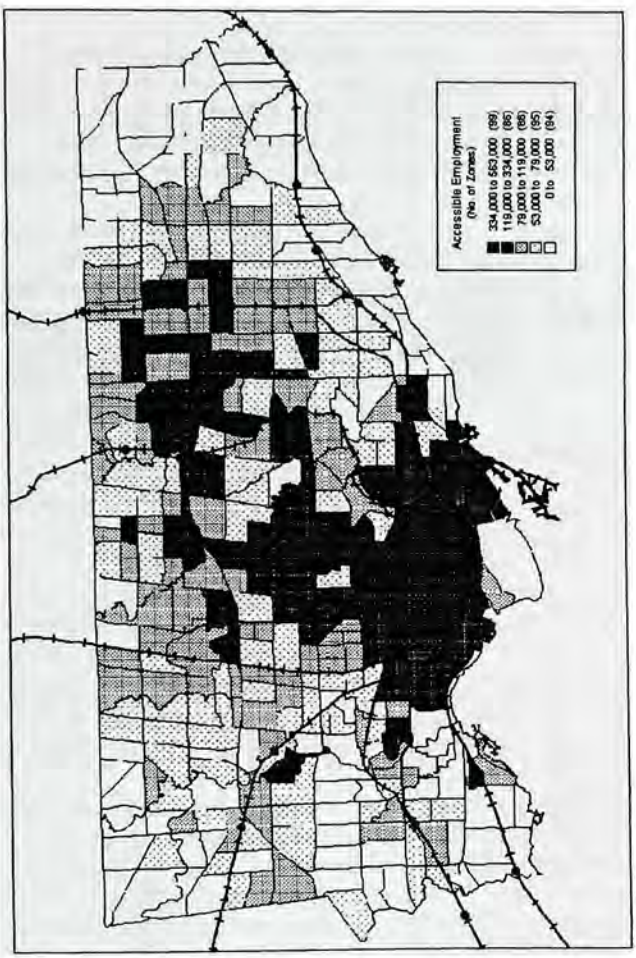


Figure 1 - Employment Accessibility by Transit

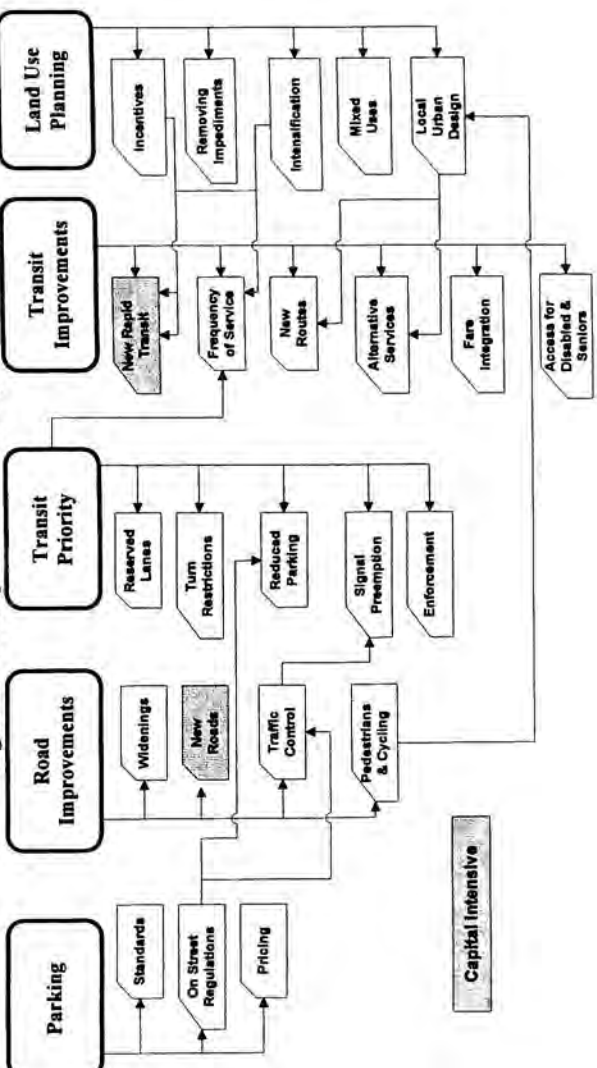


Figure 2 - Transportation Building Blocks

development incentives around transit stations, and traffic control and signal pre-emption for transit vehicles.

Some of these changes/improvements involve significant capital expenditure, as in the case of new roads and expansion of the rapid transit system, whereas others may involve more modest investment to modify traffic signals and acquire additional transit vehicles. Two key points should be noted with respect to these building blocks.

First, most of the emphasis in Toronto has been placed on the expansion of the rapid transit system, most notably, subways, commuter rail, and advanced technology involving linear motor propulsion and automated train operation (identical to Vancouver's Skytrain). Toronto also prides itself on an extensive network of streetcars and LRT. These systems, however, are costly to construct and also require the acquisition of very expensive vehicles. Other than for HOV lanes, Toronto has devoted little or no attention to bus rapid transit. Given the current funding situation, it seems clear that more emphasis will have to be placed on such less expensive, bus based services.

Second, the vast majority of the building blocks shown in Figure 2 involve policies that are far less expensive in terms of capital requirements but far more difficult to achieve in the political environment. Transit priority measures that increase the average speed, vehicle productivity, and capacity of existing high volume streetcar and bus services are the most notable of these.

For surface transit, the time required for boarding and alighting, as well as delays at traffic signals, reduce travel time competitiveness relative to the private car. Methods of fare collection such as exact fare and passes can shorten transit vehicle time at stops, but random delays at traffic controlled intersections, often caused by automobile turning movements, further detract from transit competitiveness.

The main benefit of transit priority is higher speed. Priority treatment may involve such measures as reserved lanes, protected right of way

(where other vehicles have no practical means of access), and signal priority at intersections. Very modest investment is required for this type of priority treatment. Obviously, there would be negative impacts on automobile users, the main reason why municipal officials are reluctant to introduce such measures. As with any traffic regulations, of course, the effectiveness of transit priority schemes depends upon adequate enforcement.

Nevertheless, unlike rapid transit where priority is guaranteed, priority for surface transit offers benefits to both users and operators, largely as a result of economies of scale that can be achieved. For example, through priority treatment,

- travel times by transit are reduced,
- the increase in speed attracts additional users,
- frequency of service can be increased without any increase in either the number of vehicles or drivers which, in turn,
- further adds to the attractiveness of the service.

Consider, for example, a streetcar service that runs every 5 minutes over a 10 km route and now requires 60 minutes to complete one round trip. If 5 minutes can be saved in each direction (30 seconds at 10 intersections, for example), the following changes occur:

Item	Without priority	With priority	Change
One-way time (min.)	30	25	5
Round trip time (min)	60	50	10
No. of streetcars/drivers	12	12	None
Capacity (passengers/hour)	1200	1440	240
Headway (min)	5	4.2	0.8

In other words, using the same number of vehicles and drivers, priority measures reduce waiting times and increase capacity by 20 percent at practically *no additional cost.* (Alternatively, the same number of passengers could be served with fewer vehicles and drivers.)

Naturally, these measures result in additional inconvenience and delay for other road users but that is the difference between *rhetoric* and *action* as far as reducing automobile dependence is concerned. (Overall, the justification for transit priority increases as transit vehicle frequency increases.)

Implications for the New Transportation Plan

In formulating changes to the transit system the key principles used can be summarized as follows:

Land Use and Urban Design

1. Transit supported, intensification, with higher density development allowances and appropriate parking standards in the vicinity of major transit nodes.
2. Zoning related to transit supported development finalized *prior* to budget approval for the construction of routes and stations.
3. Approval of new development applications based on considerations that include desirability with respect to pedestrians and cyclists, as well as access to transit stops and stations.
4. Built form and street design that encourage walking and cycling.

Transit Expansion and Operations

5. Priorities for capital investment in new public transportation services and facilities based on:
    - increases in overall transit system ridership and mode split or, in special cases,
    - contributions to achieving overall goals and objectives of major public policy initiatives such as redevelopment of new areas and 'infilling', and
    - application of the most cost effective technology for major new infrastructure.
6. Maximization of opportunities for cost effective inter-connections between local and inter-regional services.

7. Encouragement of alternative transit service delivery in areas that supplement the existing system but which cannot be served effectively by conventional services.
8. Improving access for the disabled and seniors and accounting for the needs of these individuals in all *new* facilities and the acquisition of *replacement* vehicles.

Roads, Parking, and Traffic Engineering

9. Transit priority for the use of street space expanded to include:
    - all roads and major intersections involving streetcar service, and
    - high frequency bus routes.
10. Expansion of the bicycle lane network in areas of highest bicycle use and modifications to both rapid transit stations and surface transit vehicles to accommodate cyclists.
11. Recognition of the increasing importance of efficient truck movement for the economic competitiveness of the City and the GTA.

Funding and Governance

12. Development of innovative alternatives for funding improvements to the City's transportation system based on sources other than property taxes.
13. Solicitation of provincial approval to implement more equitable methods of pricing the complete range of transportation services provided by the City.

Based on these principles, various options have been developed, as treated elsewhere, that involve both policies and infrastructure improvements.[3] Clearly there will be trade-offs in the evaluation process regarding the allocation of road space among different users (autos, transit vehicles, trucks, cyclists, pedestrians), which should be

[3] Richard M. Soberman, *Reducing Car Dependence: Transportation Options for the City of Toronto*, Toronto: City of Toronto, Urban Development Services, March 2001.

made within the context of the overriding aim of reducing auto dependence.

In the case of higher order transit options that involve large capital expenditures, the main *transportation* indicators to be tested include:

- effects on transit ridership and mode share,
- relative improvements in accessibility for transit disadvantaged areas,
- impacts on air pollution and greenhouse gas emissions,
- cost effectiveness, and
- funding requirements.

The accessibility measures will require particular attention in order to determine relative priorities of potential transportation initiatives from the standpoint of a broader range of land use and non-transportation criteria. Based on the preliminary methods developed thus far, it will be important to estimate:

- overall effects on access to employment (or other activities) as a function of transit travel time for the transit alternatives, and
- changes in accessibility by specific geographic area.

Barriers to be Overcome

Achieving agreement on the new transportation vision for Toronto appears much easier than actually taking policy and investment decisions that support these ideals, largely due some of the more important barriers treated below.

An Unlevel Playing Field

Although improved transit is an important cornerstone of the transportation vision, in today's environment the automobile has, more or less, been institutionalized as a way of life throughout North America. A significant proportion of those who use automobiles are subsidized in some way by their employers or through tax deductions that cover the costs of ownership, operation, and parking. Thus,

where such individuals compare the costs of using transit versus using their cars, 'their' costs are understated by a significant amount.

Differing Needs
The attractiveness of transit depends upon a great many factors such as population density, concentration of employment, and street patterns. Since there is a wide variation in such characteristics among various communities within the City and the GTA, one vision of urban transit probably does not 'fit all'.

Imbedded Biases
The vision statement was developed, in part, through a consultative process that primarily involved a variety of *single issue* advocates who may not be representative of the true diversity of the entire community. A vision developed by a small and unrepresentative group of planers and constituents, therefore, may not always obtain 'buy-in' from a much larger segment of the total community needed to make it work.

Conflicting Objectives
Vision setting frequently leads to conflicting objectives. Exclusive bicycle lanes, for example, can conflict with reserved bus lanes and raise safety issues where deliveries of goods are involved. Preservation of neighborhoods through some forms of 'traffic calming', as another example, raises hazards for cyclists in some cases and leads to some increase in both fuel consumption and greenhouse gas emissions. Due to the single issue orientation of most participants in typical consultative approaches to transportation planning (noted above), such conflicts are not easily resolved.

Institutional Constraints
Transit services in Toronto are now funded solely from tax revenues obtained from property owners. Travel demand, however, is rarely dictated by municipal boundaries. As a result, the ability to effectively match the supply and demand for urban transit is constrained by jurisdictional responsibilities that preclude one community spending money to serve the residents of adjacent or

nearby communities. Thus, achieving agreement on equitable funding and levels of service often means that with such fragmented decision making, agreement on improvements lags far behind the increase in needs. And so, people just drive.

In addition, there is a range of institutional constraints imposed by the provincial government on what the City can do to seek alternative sources of financing transit. In Ontario, municipalities are not empowered to raise revenue from other than property taxes whereas in other provinces, municipalities have access to other fees and charges. Moreover, there are examples of provincial highway policies within the GTA which will encourage more long distance commuting by car that conflict with the City's transit policies.

Funding and Fiscal Priorities

Fiscal priorities of both the provincial and federal governments -- both of which, increasingly, see deficit and tax reductions as more important policy objectives than the expansion of public services -- may, in fact, represent the key impediment to achieving new visions for urban transit. For Ontario, health care is the number one issue and rising public concern about funding health care certainly exceeds public concern about urban transit. The same can be said for the City itself which is now required to find additional funding for expanded responsibilities in education, social services, and policing.[4]

In Summary

Simply stated, setting aside some of the barriers noted above, just "how much" automobile dependency can be reduced remains the challenge. Clearly, adoption of a vision for reducing car dependence is meaningless without appropriate policies and priorities that become

[4] This fact has not gone unobserved by municipal officials across the country, as documented by Richard M. Soberman and Brendon Hemily, *Public Transportation in Canadian Municipalities: Implications for the Canada Transportation Act and the Federal Role in Transit*, Ottawa: Canada Transportation Act Review, March 2001.

part and parcel of *legal* plans, changes in municipal by-laws, and *programmed* budgets.

It is also meaningless without a willingness to spend *less* on unnecessary capital intensive projects and *more* on cost effective technologies that increase coverage. In addition, it is meaningless without a political and *bureaucratic* willingness to alter priorities for the use of existing road space in ways that favour transit over parking and pedestrians over cars.

There is ample evidence, not only in Toronto, but elsewhere, that simply throwing more money into capital-intensive transit projects has only marginal impact on travel behaviour. In the end, the urban transportation problem is really a problem of land use, growth management, and the selective use of increasingly scarce funds.

Congestion Pricing In The Morning And Evening Peaks: A Comparison Using The Bottleneck Model

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1. Introduction

Growing traffic congestion and advances in electronic tolling technology have spurred interest in congestion pricing as a way to make more efficient use of roads. Road pricing has been implemented in many places around the world, including Singapore, Norway, and a number of public and private roads in North America including Highway 407 north of Toronto. Because traffic fluctuates over the course of the day, it is advisable to study congestion pricing using dynamic models. Much work has been done for the morning peak, but the evening peak has received little attention — perhaps because it is believed to be similar to the morning.

Empirically, differences between the morning and evening peaks in duration and average travel speeds have been documented. These differences are presumably due to a combination of factors: more non-work trips and intermediate stops in the evening, higher accident rates in the evening, possible differences in route choice, and differences in trip-scheduling preferences and constraints. The purpose of this paper is to consider one of these factors — scheduling preferences — and to demonstrate that this alone can produce significant differences between morning and evening in the efficiency gains and welfare-distributional effects of congestion pricing. To facilitate analysis, attention is limited to work trips although a large fraction of trips are made for other purposes even at peak periods. Scheduling preferences for morning and evening work

trips are assumed to differ in just one respect: in the morning they are dictated by *arrival* time, whereas in the evening they are dictated by *departure* time.

The model adopted is Vickrey's (1969) bottleneck model, which has been widely used to study the dynamics of traffic congestion in the morning peak. This model was also used in two pioneering studies of the evening commute by Vickrey (1973) and Fargier (1983). Their papers illustrate some differences between morning and evening in departure-time patterns, but they do not provide a systematic comparison of the impacts of congestion pricing. The current paper attempts a more general analysis. By investigating the efficiency and welfare-distributional impacts of congestion pricing, it also complements a companion paper (De Palma and Lindsey, 2002) on the existence and uniqueness of equilibrium in morning and evening.

Section 2 summarizes the bottleneck model. Section 3 reviews its well-known properties for morning travel with identical individuals, and establishes that these properties also hold for the evening. Section 4 investigates how things change when travellers differ in work hours. Section 5 extends consideration to heterogeneity in values of time and intensity of trip-timing preferences. Section 6 concludes.

2. The Model

The model is based on Vickrey's (1969) bottleneck model of the morning commute, which is reviewed in Small (1992) and Arnott *et al.* (1998). Here the model is applied to the evening commute as well. There are N commuters or "users" who drive alone to and from work along the same route. Route capacity is governed by a bottleneck with a maximum service rate of s vehicles per unit time. If the arrival rate of vehicles at the bottleneck exceeds s, a queue develops. Free-flow travel time is assumed without loss of generality to be zero.

For the morning commute, t will be used to denote departure time from home, t_a arrival time at work, and t_M^* preferred arrival time at work. Schedule delay, x, is defined as the difference between actual

and preferred arrival time: $x \equiv t_a - t_M^*$. Given zero free-flow travel time and a queuing time of q, $t_a = t + q$. Trip cost is the sum of travel time and schedule delay cost: $C_M = \alpha q + D_M[x]$. Parameter a is the value of travel time (VOT) and $D_M[x]$ is the schedule delay cost function. For the evening, t_E^* will denote preferred departure time from work, t actual departure time from work, and t_a arrival time at home. The schedule delay cost function, $D_E[x]$, is defined in terms of the difference between actual and preferred departure time: $x \equiv t - t_E^*$. The model is otherwise the same as for the morning.

Following common practice, the schedule delay cost functions will be assumed to be linear. For the morning, $D_M[x] = \beta[-x]^+ + \gamma[x]^+$, where β is the unit cost of arriving early, γ is the unit cost of arriving late, and $x^+ \equiv Max[0, x]$. To assure that the equilibrium departure rate is finite, $\beta < \alpha$ is assumed. For the evening, $D_E[x] = b[-x]^+ + c[x]^+$, where b is the unit cost of departing early and c is the unit cost of departing late. No condition on the relative magnitudes of parameters b, c and α is required for existence of an equilibrium, although it will be assumed as a counterpart to the morning that $c < \alpha$.

To facilitate comparison, it will further be assumed that the morning and evening are similar in three respects: (1) for each user the same VOT applies, (2) arriving early in the morning and departing late in the evening are equally costly, and (3) arriving late in the morning and departing early in the evening are equally costly too. Formally:

For each user: a is same in morning & evening, $b = \gamma$, $c = \beta$. (1)

3. Identical Users

In order to determine the impacts of congestion pricing, it is first necessary to solve for the no-toll equilibrium (NTE) and the social optimum (SO). The morning is treated first, and then the evening.

The morning

If users are identical, they must all incur the same trip cost in equilibrium. The departure rate must therefore be such that the time derivative of trip costs is zero. Given the trip cost function $C_M(t) = \alpha q(t) + D_M\left[t + q(t) - t_M^*\right]$ this implies

$$\left(\alpha + \frac{dD_M}{dx}\right)\frac{dq}{dt} + \frac{dD_M}{dx} = 0 . \qquad (2)$$

If $R(t)$ denotes cumulative departures by time t, and $A(t)$ cumulative arrivals, $q(t)$ can be written

$$q(t) = s^{-1}\left(R(t) - A(t)\right) = s^{-1}\left(R(t) - s(t - t_0)\right), \qquad (3)$$

where t_0 is the time at which departs begin. Substituting eqn. (3) into (2), the equilibrium departure rate, $r(t) \equiv dR(t)/dt$, can be written

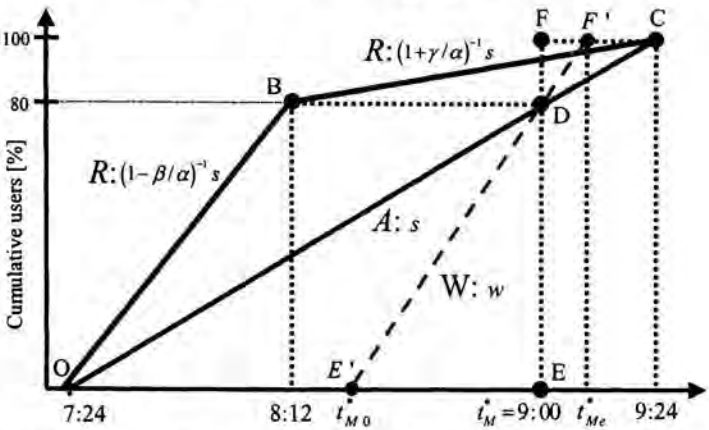
$$r_M(t) = \frac{\alpha}{\alpha + dD_M/dx}\, s . \qquad (4)$$

For early departures this yields $r_M(t) = (1 - \beta/\alpha)^{-1} s$, and for late departures $r_M(t) = (1 + \gamma/\alpha)^{-1} s$.

For purpose of illustration, as well as to lead in to the numerical example of Section 5, the following parameter values will be assumed: $N/s = 2$ [hrs], $\alpha = 10$ [\$/hr], $\beta = c = 5$ [\$/hr], $\gamma = b = 20$ [\$/hr], $t_M^* = 9:00$ and $t_E^* = 17:00$. The length of the official work day is thus $t_E^* - t_M^* = 8$ hours, and the peak lasts for $N/s = 2$ hours.

Figure 1 depicts the NTE. (The dashed line W extending between points E' and F' will be discussed in Section 4.) The cumulative departures curve, R, passes through points O, B and C. The cumulative arrivals curve, A, is a straight line with slope s passing through points O, D and C. The first user departs at 7:24 and (given zero free-flow time) arrives immediately, thereby avoiding

Figure 1: Morning equilibrium



congestion but incurring an early arrival cost of $\beta(9:00-7:24)$ $=5\cdot(96/60)=8$. The last user, who departs at 9:24, also avoids congestion and incurs a late arrival cost of $\gamma(9:24-9:00)$ $=20\cdot(24/60)=8$. (The early and late arrival delays are large because of the unrealistic assumption that everyone wants to arrive at the same time and is equally averse to schedule delay.) And the user who departs at 8:12 arrives on time at 9:00, but incurs the maximum queuing delay cost of $\alpha(9:00-8:12)=10\cdot(48/60)=8$. Everyone else incurs a combination of queuing time and schedule delay cost that adds up to the same \$8 total.

The curve *R* can be thought of as offering a "menu" of schedule and congestion delays amongst which users choose by selecting a departure time. Given identical preferences, they are indifferent between departing at any time between 7:24 and 9:24. Curve *R* therefore represents a (common) indifference curve for users. Overall, 80% of users arrive early and 20% arrive late. Denoting the NTE with

a superscript *n*, total travel time cost is $TTC_M^n = \alpha \cdot OBC$, and total schedule delay cost is $SDC_M^n = \beta \cdot ODE + \gamma \cdot DFC$.

The social optimum (SO) is defined as a social surplus maximum. With demand fixed, this is equivalent to a total travel cost minimum. Because queuing time is a deadweight loss in the morning, the SO entails no queuing and a minimum total schedule delay costs. This is accomplished by maintaining the departure rate at capacity for a period N/s, and timing departures so that the first and last users' schedule delay costs are equal. Since this condition also holds in the NTE, total schedule delay costs are the same in SO and NTE: $SDC_M^o = SDC_M^n$, where superscript *o* denotes the SO.

It is readily shown (*e.g.* Vickrey, 1969) that the SO can be decentralized by imposing a smoothly time-varying toll that replaces queuing time as the means of rationing arrival time slots. The toll starts at zero at 7:24, rises linearly to a maximum of \$8 at 9:00, and then decreases linearly back to zero by 9:24. Toll revenue therefore matches total travel time costs: $TR_M^o = TTC_M^n$. Tolling yields an efficiency gain, G_M, equal to the reduction in total trip costs:

$$G_M \equiv TC_M^n - TC_M^o = TTC_M^n + SDC_M^n - SDC_M^o . \qquad (5)$$

The efficiency gain has two components: the elimination of queuing time cost, and the change in schedule delay cost. Because $SDC_M^n = SDC_M^o$, the net gain equals TTC_M^n. Finally, the private costs borne by users including toll are $PC_M^o = TC_M^o + TR_M^o$. Given $TC_M^o = SDC_M^o = SDC_M^n$, and $TR_M^o = TTC_M^n$, $PC_M^o = TC_M^n$: tolling leaves private costs unchanged. In summary, for the morning commute with identical users the following identities hold:

$$G_M = TR_M^o = TTC_M^n, \text{ and } PC_M^o = TC_M^n . \qquad (6)$$

The equalities in (6) are useful from a policy standpoint. Since congestion delay can be measured from traffic counts, the first pair of equalities allows one to estimate the efficiency gains and revenues from tolling *ex ante*. And the second equality suggests that drivers

should benefit from tolling if any of the revenue is either returned to them as rebates, or used for improved road maintenance, transit, or some other service that is useful to them.

The evening

The evening NTE can be derived in the same way as for the morning. Given trips costs of $C_E(t) = \alpha q(t) + D_E\left[t - t_E^*\right]$ the equilibrium condition on the departure rate is

$$\alpha \frac{dq}{dt} + \frac{dD_E}{dx} = 0 . \qquad (2E)$$

Using (3) one obtains

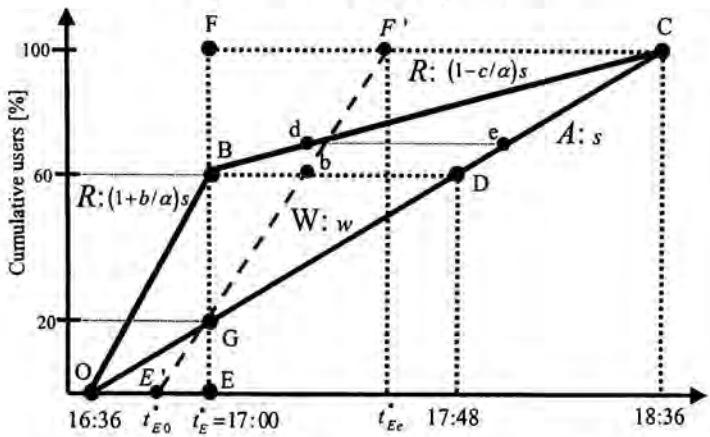
$$r_E(t) = \frac{\alpha - dD_E/dx}{\alpha} s . \qquad (4E)$$

For early departures this gives $r_E(t) = (1 + b/\alpha)s$, and for late departures $r_E(t) = (1 - c/\alpha)s$.

Figure 2 depicts the evening NTE for the parameter values introduced earlier. (The dashed line W, and points b, d and e, will be explained in Section 4.) Given the assumptions in (1) the evening is a mirror image of the morning. The first and last users escape queuing and incur the highest schedule delay costs, while the user who departs on time at 17:00 experiences the most congestion. 60% of users depart early, and 40% late. Total travel time cost is $TTC_E^n = \alpha \cdot OBC$, and total schedule delay cost is $SDC_E^n = b \cdot OBE + c \cdot BFC$. Though it is not obvious from the geometry, $TTC_E^n = TTC_M^n$ and $SDC_E^n = SDC_M^n$.

The evening differs from the morning in that there is a tradeoff between travel time costs and schedule delay costs. To see this, note that if everyone left work at t_E^* schedule delay costs would be avoided, although congestion would be horrendous. Nevertheless, given the assumption $c < \alpha$, it is readily shown that queuing is undesirable in the SO. As in the morning, this dictates that the departure rate be maintained at capacity and timed to coincide with

Figure 2: Evening equilibrium



the NTE travel period. A time-varying toll can again be used to support the SO. And the identities in (6) also hold for the evening:

$$G_E = TR_E^o = TTC_E^n, \text{ and } PC_E^o = TC_E^n. \qquad (6E)$$

Section 4 investigates whether the symmetry between morning and evening survives in the face of user heterogeneity.

4. Heterogeneity in Desired Arrival and Departure Times

In contrast to what is assumed in Section 3, people keep widely different work hours. Vickrey (1969) and others have explored the implications of this heterogeneity for the morning by assuming that t_M^* has a uniform distribution in the population. This specification will be adopted here for t_E^* too under the assumption that everyone works the same number of hours so that the same distribution applies for t_M^* and t_E^*. The main purpose of focusing on this one dimension

of heterogeneity is to demonstrate that it is enough to break the symmetry between morning and evening.

First consider the morning, and suppose the cumulative distribution of t_M^* is given by the dashed line W in Figure 1, with slope w and support $\left[t_{M0}^*, t_{Me}^*\right]$. Although only the one user who starts work at 9:00 is still indifferent between *all* points on the original R, R is still an equilibrium. In particular, an equilibrium obtains if users depart in order of their preferred arrival times, with the user with desired arrival time t_{M0}^* departing first at 7:24 and so on. Total schedule delay costs are then given by $SDC_M^n = \beta \cdot ODE' + \gamma \cdot DF'C$. These costs are again minimized in the SO if departures begin at 7:24. And the same time-varying toll as in Section 3 supports this as an equilibrium. Therefore, all the identities in (6) still hold. It can be shown (see Small, 1992, p.119) that this is true of the morning in general as long as all users have the same VOT.

Now consider the evening, and suppose that the cumulative distribution of t_E^* is given by the dashed curve labelled W in Figure 2, with slope w and support $\left[t_{E0}^*, t_{Ee}^*\right]$. By the same reasoning as for the morning, the original departure interval [16:36, 18:36] remains best for the SO. But this interval is no longer a NTE. To see this, note that for the R shown all users with $t_E^* > 17:00$ prefer to depart after 17:00. (For example, the user at point b on W strictly prefers to depart on time at point d on R, and incur a queuing delay of de, rather than depart early at point B and suffer a longer delay of BD.) This is inconsistent with equilibrium because 80% of the population will want to depart after 17:00, whereas the R shown allows only 40% to do so.

In the actual NTE, therefore, departures begin after 16:36. (Space constraints preclude a figure showing it.) Indeed, if work hours are sufficiently dispersed that W is flatter that the initial segment of R

(i.e. $w < (1 + b/\alpha)s$), then *no one* departs early. This means that the identities in (6E) no longer hold for the evening. Because the SO entails an earlier departure period than does the NTE, tolling makes users with early work hours worse off because they incur greater early schedule delays. Those with late hours incur smaller late delays, and are better off. Tolling is therefore no longer welfare neutral.

5. More General Heterogeneity

People differ not only in when they work, but also in their VOT and costs of schedule delay. First consider the implications of this heterogeneity for the NTE. In the model with identical users the morning departure rates are $r_M(t) = (1 - \beta/\alpha)^{-1}s$ and $r_M(t) = (1 + \gamma/\alpha)^{-1}s$ for early and late arrival periods respectively. These departure rates depend on the ratios β/α and γ/α, which reflect users' willingness to queue or "queuing tolerance" in order to reduce schedule delay. If users differ in their queuing tolerance, the departure rate varies more or less continuously over the rush hour, and individual users self-select into departure times that minimize their costs. Users with high queuing tolerance arrive close to (or at) their t_M^*, whereas those with low tolerance travel in the tails of the rush hour in order to avoid congestion. Similarly, in the evening users with high b/α and c/α depart close to (or at) their t_E^*. Trip timing is therefore determined jointly by the distribution of preferred departure or arrival times, and by queuing tolerance.

Because queuing remains undesirable in the face of general heterogeneity, the timing of departures — as well as the order in which users depart — is chosen in the SO to minimize total schedule delay costs. Once again, a time-varying toll suffices to decentralize the SO. In the morning users with large β and γ arrive close to their t_M^*, and in the evening users with large b and c depart close to their

t_E^*. Trip timing is therefore determined jointly by the distribution of t_M^* or t_E^*, and by aversion to schedule delay.

To explore the implications of general heterogeneity, Assumption (1) and the assumptions on t_M^* and t_E^* in Section 4 will be retained. In addition, the following assumptions about the joint frequency distribution of α, β, γ, b and c are adopted:

1. α is lognormally distributed: $\ln\alpha \sim N(A,\sigma)$.
2. In the morning $\beta = \beta_0\alpha^\lambda$, with $\beta_0 > 0$ and $\lambda \in [0,1]$. In the evening $b = b_0\alpha^\lambda$, with $b_0 > 0$.
3. All users have the same γ/β (and therefore the same b/c).

Assumption 1 is consistent with some empirical studies. There is little evidence for or against Assumptions 2 and 3. The distributions of queuing tolerance and unit schedule delay costs are determined by λ in Assumption 2. If $\lambda = 0$, there is heterogeneity in queuing tolerance but not in schedule delay costs. If $\lambda = 1$, the opposite is true.

The model was solved numerically for a range of parameter values. A base-case distribution of VOT was chosen by setting A=2.178 and $\sigma = 0.5$, and truncating the distribution at the 1% and 99% fractiles. This results in a mean hourly VOT of \$9.83, and a range of [\$2.76, \$28.24]. The remaining parameters are consistent with the numerical example of Section 3. Parameter β_0 was chosen so that the median value of β/α in the morning is 0.5. With $\gamma/\beta = 4$, the median value of γ/α is four times as big for each user. For the evening, b_0 was chosen to get a median value of b/α equal to 2, and hence a median value of c/α equal to 1/2. Finally, the values N=1, s=0.5 and w=1 were chosen so that each rush hour lasts for 2 hours, and t_M^* and t_E^* are each uniformly distributed over a one-hour interval.

Table 1 reports the results for several sets of parameter values, leading up to the base-case values of greatest interest and realism.

Attention is focused on the ratios G/TTC^n, TR^o/TTC^n and PC^o/TC^n, and the fraction of user who are made worse off by tolling. In the first two rows $\sigma = 0$, which implies that a, β, γ, b and c all have degenerate distributions and the value of λ is immaterial. In Row 0a, $s/w = 0$: there is no heterogeneity in any dimension, and the ratios are all 100% as they must be by (6) and (6E). Row 0b restores heterogeneity in t_M^* and t_E^*. The three ratios remain zero for the morning, confirming what was claimed in Section 4. But for the evening, G/TTC^n falls well below 100, whereas TR^o/TTC^n and PC^o/TC^n are well above 100. Tolling therefore generates more toll revenue that would be expected using the model with identical users, but yields lower efficiency gains and raises total private trip costs. Sixty percent of users end up worse off (those with earlier work hours) so that a proposal for congestion pricing would be defeated at the ballot box.

Table 1: Impacts of tolling in morning and evening

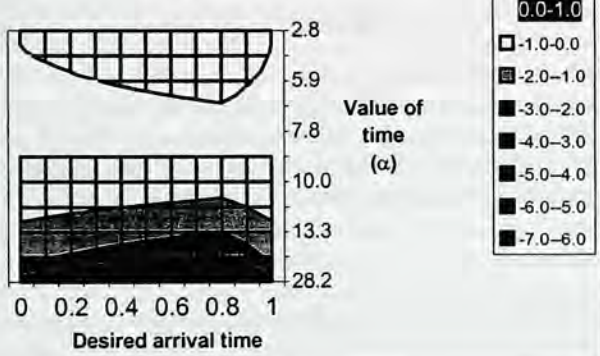
	Parameter values			Morning impacts [%]				Evening impacts [%]			
	σ	λ	s/w	$\frac{G}{TTC^n}$	$\frac{TR^o}{TTC^n}$	$\frac{PC^o}{TC^n}$	worse off	$\frac{G}{TTC^n}$	$\frac{TR^o}{TTC^n}$	$\frac{PC^o}{TC^n}$	worse off
0a	0	—	0	100	100	100	—	100	100	100	—
0b	0	—	0.5	100	100	100	—	65	120	144	60
1	0.5	0	0	100	159	123	100	100	159	123	100
2	0.5	0.5	0	138	126	95	50	138	126	95	50
3	0.5	1	0	170	100	74	0	170	100	74	0
4	0.5	0	0.5	100	169	137	100	65	166	168	76
5	**0.5**	**0.5**	**0.5**	**134**	**124**	**95**	**50**	**87**	**118**	**121**	**62**
6	0.5	1	0.5	160	92	66	0	98	89	93	48

Rows 1-3 restore heterogeneity in a, β, γ, b and c, while re-imposing identical work hours. The morning and evening ratios turn

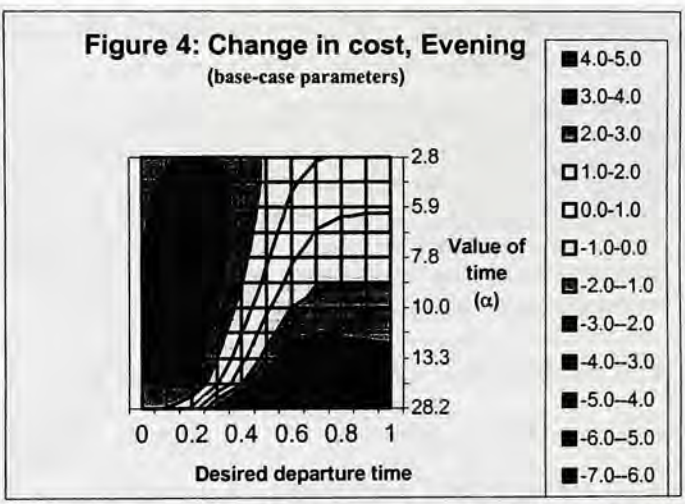
out to be identical. (This property is specific to the example.) The impacts of tolling are sensitive to λ. With $\lambda = 0$ there is heterogeneity in queuing tolerance, but none in unit schedule delay costs. Tolling leaves schedule delay costs unaffected so that $G/TTC^n = 100$. But toll revenue greatly exceeds queuing delay costs, thereby leaving everyone worse off. As λ rises (Rows 2 and 3) differences in queuing tolerance diminish, and differences in unit schedule delay costs grow. Thus, G/TTC^n rises and TR^o/TTC^n and PC^o/TC^n both fall.

Finally, Rows 4-6 restore heterogeneity in all dimensions. Varying λ has the same qualitative effect as in Rows 1-3. But the morning and evening ratios now differ significantly. In the morning, G/TTC^n exceeds 100 with $\lambda > 0$ because tolling not only eliminates queuing, but also reduces schedule delay costs. But schedule delay costs increase in the evening because departures get spread out. Since toll revenues are similar, users fare less well than in the morning.

Figure 3: Change in cost, Morning
(base-case parameters)



Figures 3 and 4 show the welfare-distributional effects of tolling for the base-case parameters. Desired arrival and departure times are plotted over the interval $[0,1]$. In the morning, users with above-median VOT are better off, which is consistent with the general view that tolling favours people with high values of time. The impacts are largest at 0.8 when the toll reaches a maximum.



In the evening users with early hours are the most adversely affected, as expected. Less obviously, the effects are worst for those with intermediate VOT. This is because these individuals have intermediate unit schedule delay costs, and incur appreciable penalties when they are "forced" to depart early in the SO.

6 Conclusions

This paper has analyzed congestion pricing of commuting trips using Vickrey's bottleneck model. Morning and evening commutes are assumed to differ in just one respect: scheduling preferences in the morning are governed by *arrival* time, whereas preferences for the evening are governed by *departure* time. If workers are identical,

three properties hold in both peaks: (1,2) the efficiency gains from tolling, as well as toll revenue, equal the costs of congestion in the absence of tolling, and (3) tolling leaves private trip costs unchanged.

Once traveller heterogeneity is introduced, these equalities break down. The efficiency gains and welfare-distributional effects of tolling in morning and evening also differ. Depending on the degree of heterogeneity in VOT, unit schedule delay costs, and preferred times of travel, the efficiency gains from tolling may be appreciably smaller in the evening. Tolling also tends to make a larger fraction of people worse off. The case for tolling may therefore be weaker in the evening in terms of both economic efficiency and political feasibility.

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PERFORMANCE EVALUATION OF MODERN ROUNDABOUTS ON SOUTH GOLDEN ROAD

by
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In 1998, the City of Golden, Colorado began renovations to the South Golden Road corridor. This report provides a review of the selected corridor design, which incorporates four modern roundabouts, and compares and contrasts it to the original partially-signalized configuration (two signalized intersections; two two-way stop-controlled) and to a theoretical signalized-improved configuration (three coordinated signalized intersections; one two-way stop-controlled). Empirical pre-construction and post-construction data were collected and compared to theoretical data generated with the calibrated Synchro/SimTraffic model of the signalized-improved configuration.

The configuration with four modern roundabouts resulted in less delay per vehicle than the theoretical configuration. Travel times are 40 to 50 seconds less per vehicle with roundabouts compared to a signalized configuration. Minor street delay per vehicle was reduced by 45 seconds at the Utah Street intersection with a roundabout compared to the original configuration and by 10 seconds compared to the theoretical configuration. Eighty-fifth percentile speeds in the corridor have been reduced from 48 mph to 33 mph through the combination of roundabout installation and a reduction in the posted speed limit.

There are no indications that the findings of this study are limited to the corridor in question and could not be applied to other locations. This study represents an argument for examining a series of roundabouts as a feasible alternative under certain corridor conditions.

PERFORMANCE EVALUATION OF MODERN ROUNDABOUTS ON SOUTH GOLDEN ROAD

In 1998, the City of Golden, Colorado implemented a plan that would transform a one-kilometer section of South Golden Road. South Golden Road is both a major arterial street serving southeast to northwest movement and a commercially active area with many deeded access points.

The goals for redevelopment were to improve the aesthetics, increase vehicle and pedestrian safety, reduce delays for entering traffic at Utah Street, reduce travel speeds and maintain through capacity. Two concepts were considered by the City of Golden. The first concept consisted of medians and a new signal at Utah and the second concept was also with medians but roundabouts at Utah and Ulysses instead of signals. A series of four roundabouts was ultimately implemented with roundabouts at Utah, Ulysees, Lunnanhaus and Johnson.

This study was undertaken to determine the net effect on travel times and vehicle delay at individual intersections due to the transformation of the corridor. Also included is a comparison of pre-construction, post-construction and theoretical travel times through the corridor, delay at individual intersections and a comparison of estimated delay to a Synchro/SimTraffic simulation if the corridor had been rebuilt with a new signal at Utah Street/South Golden Road. These performance measures were used to gauge the operational result of the transformation.

Study Methodology

In August1998 and September 2000, intersection and lane geometry

measurements were collected. The post-construction counts were approximately one month after the final asphalt overlay was installed and landscaping was almost completed. In both cases, video cameras were set up on a nearby bluff to record the intersections and collect volumes and vehicle classification for each approach during the peak hours. Queue lengths for some approaches could also be observed from the video tapes.

The theoretical timings for each intersection's traffic signal were optimized using the Synchro/SimTraffic 5.0 software program. Travel times within the theoretical model were determined by identifying vehicles as they entered the network and measuring their travel time to respective points in the model.

A comparison of travel times and levels of service between pre-construction, post-construction and simulation configurations was performed to determine the benefits of each.

Modern Roundabouts

Despite having a well-established international presence, it has only been during the past several years that roundabouts have been considered as a traffic control option with much frequency in North America. Not until the 2000 version of the Highway Capacity Manual (FHWA, 2000) was released was there a unified attempt to describe the design and operation of North American modern roundabouts.

Roundabouts have characteristics that differentiate them from traffic circles, rotaries and traffic calming circles. The primary distinctions are listed in Table 1. Figure 1 illustrates the features of a typical modern roundabout design.

Roundabouts have a proven safety record that is superior to other forms of traffic control (Oursten and Bared, 1995, Insurance Institute for Highway Safety, 2000, Schoon and van Minnen, 1994). The superior

Table 1
Distinctive Characteristics of Roundabouts

	Roundabouts	Traffic Calming Circles	Traffic Circles/ Rotaries
Traffic Control	YIELD control on all entries	May use STOP, YIELD or no control	May use STOP, YIELD or no control
Priority	Circulating vehicles always have the right of way	Circulating vehicles typically have the right of way	Some traffic circles require circulating traffic to yield to entering traffic
Design Speed	Arterial - <50 km/h Local - <25 km/h	Low speed	May be 70 km/h or higher
Pedestrian Access	Only allowed across the approach legs behind the yield line	Typically on the approach legs ahead of the yield line	Some circles allow access to the center island
Direction of Circulation	Always counter-clockwise and pass to right of the center island	Left turning vehicles may be permitted to pass to the left of the island	Typically counter-clockwise and pass to right of the center island
(AUSTROADS, 1993 and FHWA, 2000)			

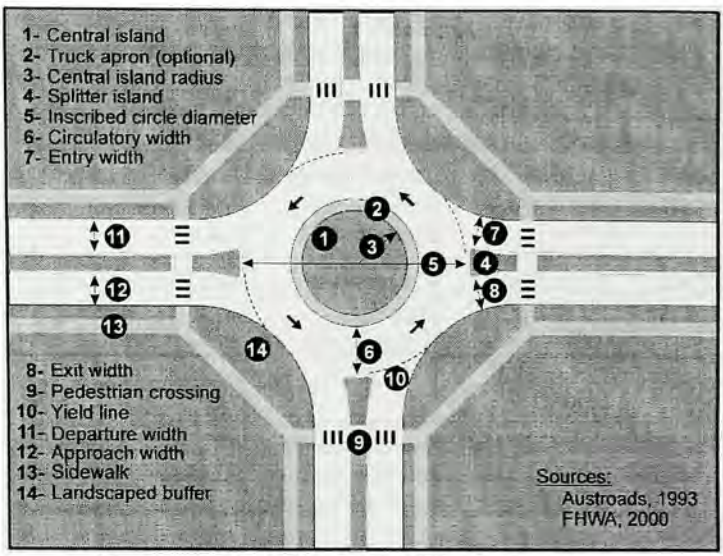


Figure 1 - Typical Roundabout Design Components

safety record of roundabouts is attributed to the following factors:

- the reduction in vehicle speeds
- elimination of high angles of conflict
- reduced complexity of decision making
- splitter islands provide a safe refuge for pedestrians
- splitter islands permit pedestrians to cross one direction of traffic at a time
- roundabouts require a conscious action by all drivers regardless of whether pedestrians or other vehicles are present

Roundabouts are not appropriate for all intersections just as traffic signals are not appropriate for certain sets of conditions. Given the appropriate conditions, a one-lane roundabout can service between 20,000 and 26,000 vehicles per day (vpd) depending on turning volume

distributions. A two-lane roundabout can service between 40,000 and 50,000 vpd (FHWA, 2000).

Corridor Configuration and Volumes

The South Golden Road corridor consists of four intersections along a 1,000-meter roadway. Prior to reconstruction, the majority of the corridor was 25.6 meters wide consisting of two travel lanes in each direction, a two-way left-turn lane, bike lanes and on-street parking. Figure 2 illustrates the lane configurations and traffic control for each intersection both in 1998 and 2000. South Golden Road is also a bus route and a truck route.

Figures 3 and 4 show 1998 and 2000 peak-hour turning movements at the intersections of Johnson, Utah and Ulysses. All of the intersections were counted simultaneously to eliminate the need to balance volumes. Other corridor data collected included vehicle classifications and

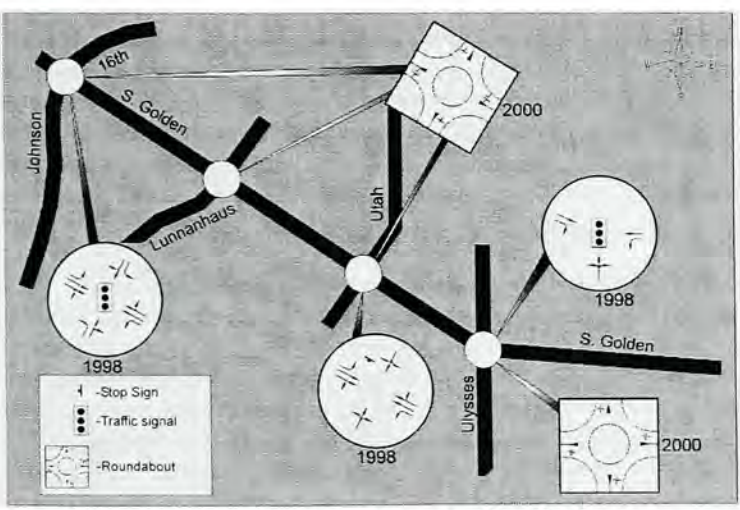


Figure 2 - Lane Configurations and Traffic Control

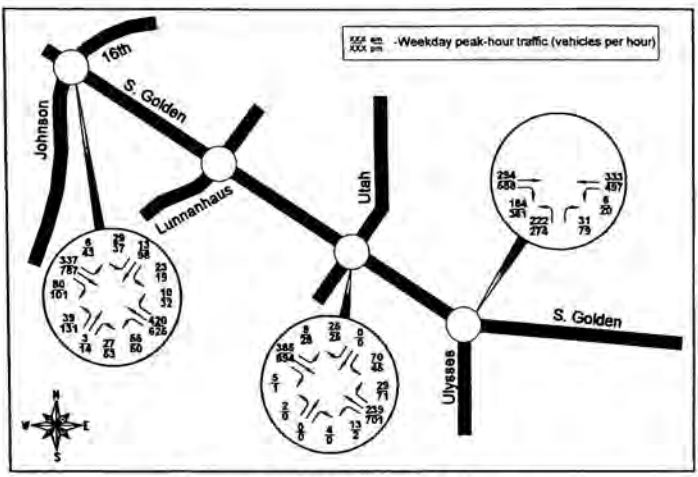


Figure 3 - 1998 Traffic Volumes

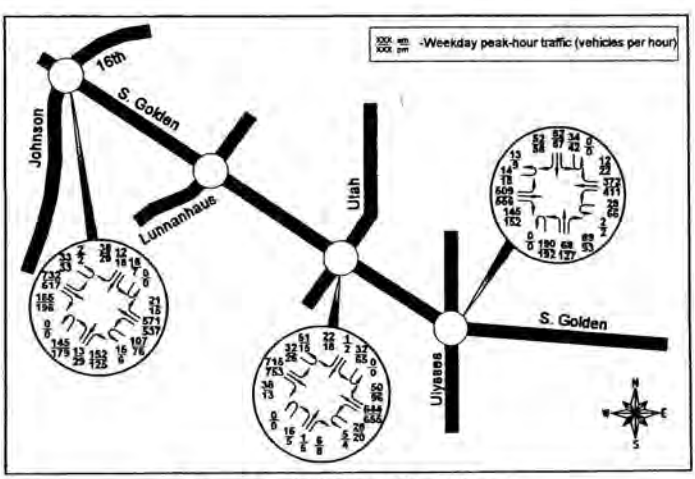


Figure 4 - 2000 Traffic Volumes

bicycle/pedestrian counts. The vehicle classification data were used to calibrate the Synchro/SimTraffic model. Travel times within and through the corridor were collected using the Average Vehicle Method (Robertson, 1994). Sidra 5.20 was chosen as the analysis package for the operation of individual roundabouts because it incorporates a gap-analysis methodology which was selected for the evaluation of roundabouts.

Simulation Model Calibration

Synchro/SimTraffic 5.0 was chosen to simulate the corridor signalization scenario. This included evaluating possible signal timings, measuring theoretical travel times within the corridor and measuring delay at the intersections. Synchro was also used to select appropriate traffic signal timings based on the desired corridor travel speed and traffic volumes. Highway Capacity Software version 4.1 was selected as the analysis software for signalized and unsignalized intersections since it is the industry standard in Colorado and can be compared to Sidra.

To calibrate the model, observed values of intersection queue lengths were compared with the simulation results. The network was calibrated to the 1998 counts to ensure that the simulated results resembled the actual traffic operations during that period. Adjustments were made to various program variables to reduce the differences between observed and modeled queues. The 2000 volumes were used with the vehicle/driver behavior from the calibrated model.

After calibration, the network was modified to reflect the redeveloped corridor assuming traffic signals were theoretically installed at the Ulysses Street, Utah Street and Johnson Road intersections. Vehicle queues were selected as the variable that would be used to calibrate the model. Queue lengths were simple to measure in SimTraffic and the 1998 video tapes contained enough information on base year queues for comparison. Figure 5 shows these values illustratively. Data was

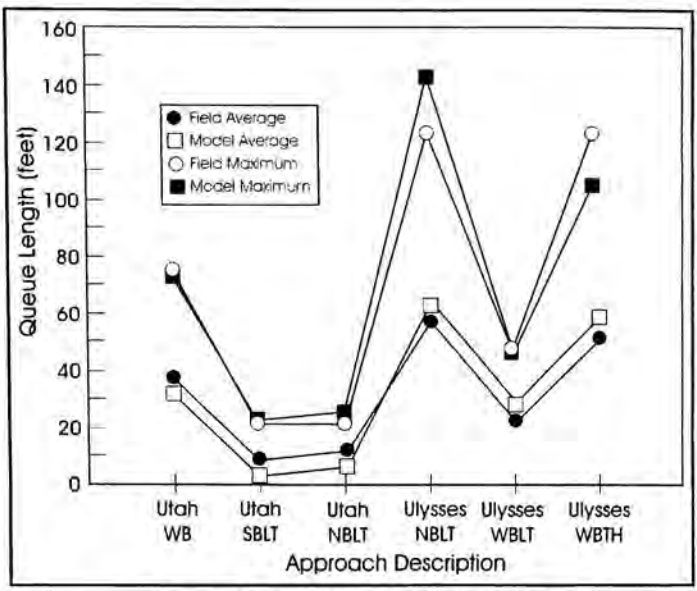


Figure 5 - Peak Hour Queue Lengths

collected from the SimTraffic simulation runs and the video tapes and then compared using linear regression and R-squared tests.

R-squared analyses were performed on the average and maximum queues (for observed and modeled data) to obtain estimates of the percentage variation explained by the simulation model for average and maximum queues. R-squared is the relative predictive power of a model.

For the maximum queue lengths, the generalized R-squared value for the average queue lengths of the South Golden Corridor, is 0.904 and for the maximum queue lengths the R-squared value is 0.949. As both of these values indicate that over 90 percent of the variation has been explained, it can be stated that the model is a good predictor of real world actions.

The slopes and intercepts of each linear regression analysis of observed versus estimated data were further tested for accuracy by performing t-tests. The t-tests showed that for both the average queue and maximum queue, the slopes were not significantly different than 1.0 and intercepts were not significantly different than 0. This is further confirmation that the SimTraffic model was calibrated to the 1998 field observations.

Travel Times and Levels of Service

The 1998 travel times are less comprehensive than the 2000 travel times and simulation travel times due to a lack of available information in 1998. During both the 1998 and 2000 counts there were no incidents or accidents that occurred in the corridor. The 1998 noon-hour travel time data and peak hour counts were not collected as it was erroneously believed that the morning peak hour was higher than the noon peak hour. After the 48-hour counts were reviewed, it was apparent that the noon peak hour is significantly busier than the morning peak. This is primarily due to the high number of restaurants concentrated in the corridor. Since the noon peak hour contains high turning and through volumes on S. Golden Road, analysis of this peak was considered more important than the morning peak hour.

Both 1998 and 2000 levels of service were calculated with Sidra and HCS software and are summarized in Table 3. Operationally, there were not any significant congestion problems in 1998 or 2000. In 1998 during the afternoon peak hour, it was difficult for vehicles to execute a left turn from Utah Street onto S. Golden Road due to the large through volumes. This is confirmed by a calculation of more than one minute average delay per vehicle on Utah Street.

The levels of service for noon and afternoon peak hours in 2000 are quite constant. Each intersection operated at LOS "B". As expected, the delay on Utah Street was significantly reduced during the afternoon peak hour (15.7 seconds from 61.7 seconds). At the same time, vehicles on South Golden experienced more delay at the Utah intersection due to the

Table 3
Intersection Level of Service and Delay per Vehicle (seconds)

		1998		2000 Round-abouts		2000 Signals		2000 Signals	
		AM	PM	Noon	PM	Noon	Noon	PM	PM
Software[1] / Intersection		H	H	S	S	H	ST	H	ST
Ulysses/S. Golden[2]		A 7.5	B 14.7	B 12.0	B 13.6	B 16.3	--- 19.6	B 18.4	--- 14.3
Utah/ South Golden	Entire Intersection	--- 2.3	--- 2.6	B 12.2	B 12.3	A 2.2	--- 6.3	A 2.4	--- 6.1
	Only Utah Approach	D 32.3	F 61.7	B 15.0	B 15.7	C 28.9	--- 23.0	C 29.6	--- 25.7
Johnson/S. Golden		A 7.5	A 8.4	B 11.9	B 11.8	B 12.8	--- 13.7	B 12.6	--- 21.3

Notes:
1 - Analysis Software used was H - Highway Capacity Software 2000, S - Sidra 5.20 or ST - SimTraffic 5.0
2 - This intersection was three-legged in 1998 and four-legged in 2000

installation of the roundabout. An increase in delays for vehicles on South Golden was inevitable as the introduction of any control (signal, roundabout or Stop-sign) introduces delay to this previously uncontrolled thoroughfare. Despite the addition of the fourth approach, during the evening peak hour the Ulysses intersection experienced a drop in delay per vehicle after the roundabout was installed.

Travel Times and Levels of Service for the Simulation

All of the travel times for the corridor are shown in Figure 6. Travel times from the signalized corridor simulation runs indicate that the signalized option would have greater travel times than the 1998 configuration. The increase would be due to a combination of factors including; 1) a reduced speed limit, 2) the introduction of traffic control for north/south movements at Utah, 3) sub-optimal intersection spacing for the desired progression speed, and, 4) the addition of a fourth approach to the Ulysses intersection.

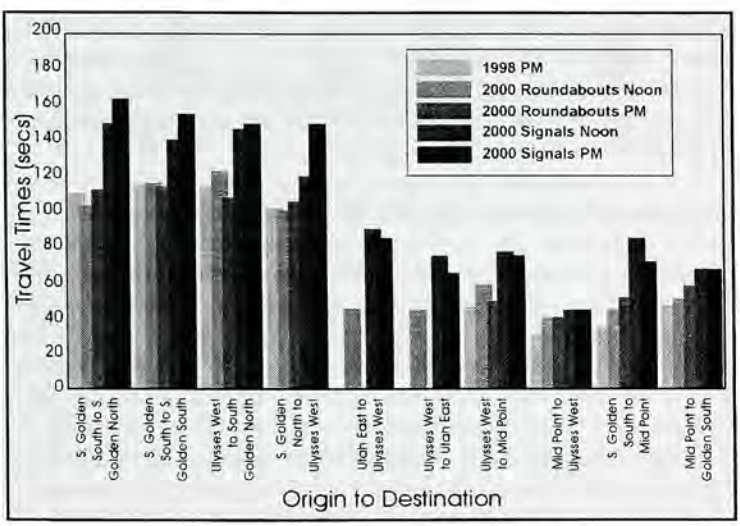


Figure 6 - Corridor Travel Times

The levels of service and delays for the intersections shown in Table 3 are the theoretical delays using the HCS software and the timings from Synchro. Also listed are the expected delays from an average of several separate simulation runs of SimTraffic.

Comparisons of Configurations

There are significant differences between each of the three corridor configurations. Many of the differences have major impacts on delay and travel times. An attempt has been made to limit the comparisons between configurations that are essentially equivalent except for the roundabouts. For example, the comparison of Ulysses Street LOS in 1998 versus Ulysses Street LOS in 2000 or versus the SimTraffic model is irrelevant as the intersection was three-legged in 1998 but four-legged in 2000 and in the model. Similarly, the travel times required to traverse the entire corridor for 1998 versus 2000 and versus the SimTraffic model are not directly comparable for two primary reasons: 1) the posted speed limit on South Golden Road was lowered from 35 mph to 25 mph when the roundabouts were installed; and, 2) installation of any traffic control device will increase delay on the approaches that were not previously controlled.

Comparison of Intersection Delays and Levels of Service

Figure 7 illustrates the evening peak hour delays for various intersections and approaches. In a comparison of 2000 afternoon peak hour delays, the roundabouts have the lowest delay per vehicle at the Ulysses and Johnson intersections. It is evident that the construction of the Utah roundabout has reduced the delay per vehicle on Utah Street. The delay per vehicle at Utah increases for the overall intersection but is dramatically reduced for the Utah approach with either a signal or a roundabout. A similar but less extreme improvement would occur if a signal was installed instead of a roundabout. Either configuration would have achieved the City's goal of reducing delay for Utah Street traffic entering the corridor.

Comparison of Corridor Travel Times

Figure 6 illustrates the travel times in the corridor for the various scenarios. Operational delay associated with mid-block turning movements is assumed to be equal in all three cases. Prior to the reconfiguration of the South Golden Road corridor, the posted speed

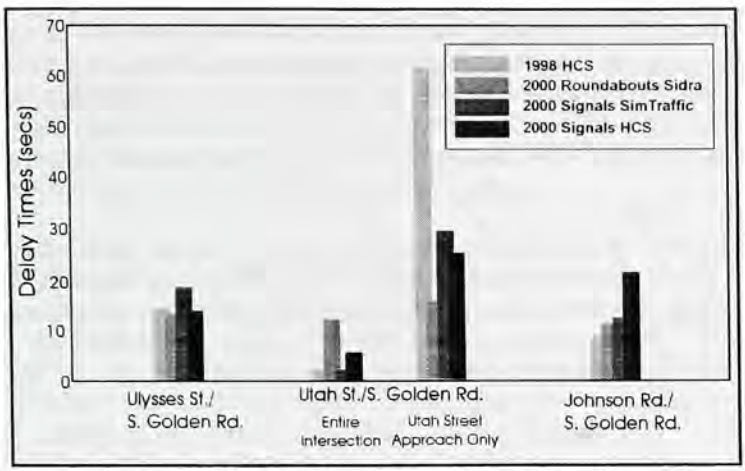


Figure 7 - Peak Hour Delays By Approach

limit in the study area was 35 mph. The current design has a posted speed limit of 25 mph. A 1998 speed study indicated that the 85th percentile speed was approximately 48 mph. In combination with the installation of the roundabouts, the lower speed limit has contributed to a reduction in the 85th percentile speed to approximately 33 mph. Over the length of the corridor, that would translate into approximately an additional 21 seconds of travel time without any delay due to congestion.

As shown in Figure 6, the travel times to and from Utah Street are significantly less when comparing the roundabout configuration to the signalized configuration. Travel times through the entire network are similar with the roundabouts compared to the original configuration. If the desired speed reduction could have been achieved without changing the intersection controls, travel times in the corridor would have been increased by 21 seconds. Adding 21 seconds to the original travel times results in times that indicate the roundabout option would be more

efficient than the original configuration at moving traffic.

Travel times are 40 to 50 seconds less with roundabouts compared to a signalized configuration. Despite an increase in delay for South Golden Road at Utah Street with a roundabout, the difference is primarily due to decreases in stopped time at the Johnson and Ulysses intersections.

Conclusions

This study did not attempt to identify every factor that may or may not have had an impact on delay in the corridor. Instead it focused on the resulting operational changes due to the transformation of the entire corridor. From the analysis of the field data and simulations for South Golden Road, the following conclusions can be made:

- The installation of a series of roundabouts on South Golden Road has resulted in lower travel times than would have been the case had a series of traffic signals been installed;
- The installation of a roundabout at the intersection of Utah Street/South Golden Road has resulted in a significant reduction in delay for Utah Street traffic;
- If a traffic signal had been installed at Utah Street/South Golden Road, the reduction in delay for Utah Street traffic would have been less than with a roundabout;
- This corridor was slated to undergo a transformation either with raised medians and roundabouts or raised medians and a new signal at Utah Street. The speed limit was to be reduced regardless of which option was selected. The results of this study clearly indicate that travel times in the corridor are less for the roundabout option than the traffic signal option for both intersection delay and corridor travel times.

It should be noted that this study is one of the first to compare overall corridor travel times and intersection delay where a series of signals plus stop control are replaced by a series of roundabouts. There are no indications that the findings of this study are limited to the corridor in question and could not be applied to other locations. This study represents an argument for examining a series of roundabouts as a feasible alternative under certain corridor conditions.

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CHANGES IN SCHEDULE TIGHTNESS AMONG LONG-DISTANCE TRACTOR-TRAILER DRIVERS IN THE UNITED STATES

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1. INTRODUCTION

Since the mid-1930's, all interstate drivers of commercial vehicles in the U.S. have been subject to hours-of-service rules (HSR), which prescribe limits on driving time and total on-duty time, see Appendix. However, violations of HSR are believed common (e.g., Braver et al.,1992) and controversy over the efficacy of HSR has raged almost since its inception. Virtually all parties agree that fatigue is a serious problem and, as such, there should be limits on the amount of time commercial drivers can drive during any day or week. However, many contend that adherence to HSR may actually impair safety as the rules do not account for the driver's circadian rhythm, the body's internal clock (e.g., Office of Technology Assessment, 1991 and Wylie et al., 1996). A less frequently mentioned, but related, safety concern is that legal limits on driving time may encourage higher speeds.

In 1994, in this Proceedings, the results of a 1991 study were reported investigating the frequency of schedule-induced HSR and/or speed limit violations by long distance drivers of tractor-trailers. The results indicated that approximately a quarter of the drivers were likely to be in violation due to their schedules. In this paper are the results of a 2001 study using the same approach. Repeating the study was of interest both

to identify and quantify changes which might always be expected over a 10 year period and because 38 states have increased their speed limits since 1991. Moreover, the U.S. Government is currently considering various options for revising HSR. The study reported here focuses on a subset of long distance drivers identified in the 1991 study as being at particular risk, those with refrigerated trailers.

2. PREVIOUS LITERATURE

Hertz (1989) estimated violations during an ongoing trip. Along U.S. 90 eastbound in Washington State, tractor-trailer drivers were questioned to determine which were heading to or through Minnesota and had no interim pickups or drops. Information regarding hours since the last 8-hour break, and whether there were one or two drivers was also collected. In Minnesota, rigs were identified (by their trailer license numbers) and transit times calculated. Based upon the transit times and the other information collected, schedule tightness estimates were derived. Hertz's approach had the dual advantages of observing actual transit times and incorporating some information regarding prior driving times. The percentage of drivers assumed to have violated HSR and/or speed limits depended upon the assumed legally attainable average trip speed. At 40 MPH average trip speed, 91 percent of the drivers appeared to have been in violation, while if 60 MPH average trip speed was assumed, 30 percent were in violation during the Washington-to-Minnesota trip.

The Hertz approach was not without problems. First, it is difficult to record accurately trailer tag numbers. The checkpoints in Minnesota were along the two most likely routings (U.S. I-90 and U.S. I-94, which branches off from U.S. 90). However, only 43 percent of the vehicles identified in Washington State as traveling to or through Minnesota were identified in Minnesota. Hertz notes that this may, in part, be due to recording errors. It seems reasonable, therefore, to assume that some incorrect matches were made due to the same cause. Second, Washington State Patrol officers collected the initial information,

including self-reported hours since the last 8-hour break. The potential for response bias is obvious. Third, measurements were over a portion of a movement, rather than from one origin to one destination. Finally, while there are advantages to holding trip distance essentially constant (at about 1,200 miles), it is unfortunate that the influence of variations could not be examined.

Employing an earlier version of the approach used in this study, Beilock and Capelle (1987) and Beilock (1990) estimated schedule tightness by interviewing drivers about the origin and destination and expected arrival time for their current trips. The findings indicated that between a fifth and a third of drivers would need to violate HSR and/or speed limits to meet their current trip schedules. Unfortunately, they collected no obtain information regarding the hours driven prior to the current trip and, as a result, could not explore the ramifications of the 60 and 70 hour driving limits. In the followup to that study, reported in CTRF's 1994 Proceedings, Beilock (1994) found that, depending upon upon the assumed average speed limit, between 17 and 30 percent of the drivers were found to have violation-suspect schedules and between 14 and 26 percent had schedules sufficiently demanding to also be judged as violation-inducing.

Braver et al. (1992) questioned drivers about the overall pressures to which they are subjected. Thirty-one percent of the drivers reported that they typically exceed the 60 or 70 Hour Rules and an additional 36 percent admitted to exceeding total work (but not driving) hour restrictions. Finally, 6 percent did not indicate the nature of the infraction, but stated that they had violated HSR during the previous month. The primary weaknesses of the study were the potential for response bias and incorrect recall of remote events.

3. CURRENT STUDY APPROACH

Current-trip schedule tightness is estimated by a variation of the approach used by Beilock and Capelle (1987). Following Hertz,

estimates of previous driving times are incorporated. This is particularly important to account for the HSR's 60 hour and 70 hour rules, which stipulate that a driver cannot drive more than 60 hours in any seven day period or more than 70 hours in any eight day period.

3.1 Response Bias

To mitigate the response bias problem interviews were conducted in a non-threatening manner. The survey sites were Florida Agricultural Inspection Stations. The primary function of these stations is to record movements of agricultural products. The inspectors have no role in nor authority over safety enforcement and normally were not within hearing distance of the interviews, hence drivers tended to be relaxed. The enumerators were University of Florida students. They introduced themselves as students, made clear that the survey was anonymous and voluntary, and held the questionnaire so that the respondent could observe the questions and notations. The questions were designed to make it unlikely drivers would realize that HSR adherence calculations would be made. This was done by: 1. having a very limited number of questions, which related to the current study, 'buried' in a much larger questionnaire; 2. having the most crucial questions deal with future, rather than past [and, therefore, self-incriminating] events; and 3. not requesting sufficient information to conclusively determine HSR adherence. No comments by respondents indicated awareness of the purpose of or unease about these questions.

3.2 Schedule Tightness Estimation

Distance traveled is simply the product of the average speed and driving time. A driver may increase distance by increasing either the average speed or driving time or both. An index of schedule tightness was developed using the estimated average speed a vehicle would need to maintain to reach the next destination without being late and with the driver obeying the driving times mandated by HSR.

Drivers were interviewed on-the-road, during a movement from the Florida Peninsula. Schedule tightness estimates were developed for that movement. To accomplish this, the following information was requested from drivers:

1. Locations of the origin point and next pickup or drop for the current movement.
2. Time and date by which the next pickup or drop point must be reached not to be considered late.
3. If there is a co-driver in the truck.
4. The number of miles driven over the previous seven days.

Enumerators also recorded the time, date, and location of the interview.

Three basic assumptions were made:

1. No extended rests were taken prior to reaching the interview site.
2. If no expected arrival time at the next destinations was indicated, the schedule was very loose.
3. A driver with (without) a co-driver at the time of the interview had (did not have) a co-driver over the previous seven days.

Previous driving time was estimated by determining the time required to complete the driver-reported mileage driven over the previous seven days assuming the same distance was driven each day. In the analysis, four scenarios were examined assuming average road speed limits of 55 MPH, 60 MPH, 65 MPH, and 70 MPH. Corresponding to these, it was assumed that over the period before the current trip, drivers averaged 10 MPH under the speed limits. These are the maximum speeds the U.S. Department of Transportation considers possible for a vehicle to maintain, over an extended trip, without being suspect of violating HSR or speed limits.

3.2.1 Weekly Work Hours Estimation

In the development of the schedule tightness index, driving time was constrained, by forcing adherence to HSR, and the necessary average speed determined. The process was essentially reversed to estimate weekly driving time. First an average speed was assumed, and then the driving time necessary to cover the driver's weekly mileage determined. The time period for which mileages were estimated was the seven days ending with the driver's arrival at the destination he/she traveled to after being interviewed. The arrival time was assumed to be the latest time, reported by the driver he/she could get to that destination without being considered to be late.

3.2.2 Violation-Suspect and Violation-Inducing Schedules

In keeping with U.S. D.O.T. practice, a schedule will be considered Violation-Suspect if, while obeying HSR, average attained speeds must equal or exceed 10 MPH less than the assumed average speed limit. A schedule will be considered Violation-Inducing if, while obeying HSR, average attained speeds must equal or exceed 5 MPH less than the assumed average speed limit. For example, obeying HSR, if an average attained speed of 56 MPH must be achieved to meet the schedule and if the average speed limit is assumed to be 65 MPH, the schedule would be considered to be Violation-Suspect. If the average attained speed was 61 MPH, the schedule would be considered both Violation-Suspect and Violation-Inducing.

4. DATA

On November 30, 2001 (6:00pm-midnight) and December 1, 2001 (10:00am-4:00pm) interviews were conducted with 485 long-distance truck drivers of rigs with refrigerated trailers as they exited the Florida Peninsula. Three Florida Agricultural Inspection Stations, located on U.S. I-10, U.S. I-75, and U.S. I-95, served as interview sites. All interviews were conducted on the outbound (i.e., northbound or

westbound) sides of the highways.

The number of available spaces at each Station was limited, necessitating suspensions in the selection process until parking spaces became available. As the probability of being skipped because of no room was essentially the same for all drivers, this was unlikely to introduce bias into the sample.

It proved impossible to calculate exactly the overall refusal rate, but it was under 10 percent and there were no indications of bias.

5. RESULTS

The results are disturbing. Depending upon the assumed average speed limits and only accounting for the current trip, it is estimated between 19 and 37 percent of the drivers had schedules that were Violation-Suspect and between 17 and 31 percent had schedules that were also Violation-Inducing, see Table 1. Taking into account the 60 and 70 hour rules, it is estimated between 33 and 49 percent of the drivers had schedules that were Violation-Suspect and between 30 and 42 percent had schedules that were also Violation-Inducing.

5.1 Produce & Ornamentals

Unlike other types of loads, produce and ornamentals have limited shelf lives. Moreover, at several markets, such as New York's Hunts Point, it is typical for carriers to be given very brief windows for making delivery, with severe penalties for late deliveries. Given these facts, it is not surprising that schedules for those hauling produce or ornamentals are more demanding, on average, than for drivers with other refrigerated loads, unrefrigerated loads, or empty. The extent of these differences, however, is startling, all of which are easily significant at the .01 level of probability. Only five percent of those not hauling produce or ornamentals had Violation-Suspect or Violation-Inducing schedules, see Table 1. In sharp contrast, even assuming average speed limits of 70

MPH and only accounting for the current trip, an estimated 25 percent of those hauling produce or ornamentals had Violation-Suspect schedules and 22 percent also had Violation-Inducing schedules. Taking into account the 60 and 70 hour rules and/or assuming lower average speed limits results in higher estimated percentages of Violation-Suspect and Violation-Inducing schedules, 45 and 41 percent, respectively.

5.2 Team and Solo Drivers

A driver may acquire off-duty time by resting in the tractor's sleeper berth. With a co-driver (team driving), one driver may be off-duty while the vehicle is moving. Not unexpectedly, team drivers were found to have very low incidences of Violation-Suspect or Violation-Inducing schedules, see Table 1. The differences between team and solo drivers were significant at the .01 level of probability.

5.3 Owner-Operators

It is common wisdom that owner-operators are more likely to violate HSR and/or speed limits than company drivers. The results suggest that this view is incorrect. As can be seen in Table 1, owner-operators are slightly more likely than others to have tight schedules if the 60 and 70 hour rules are ignored and the reverse if these rules are taken into account. In no case, however, are the differences significant at conventional levels of probability.

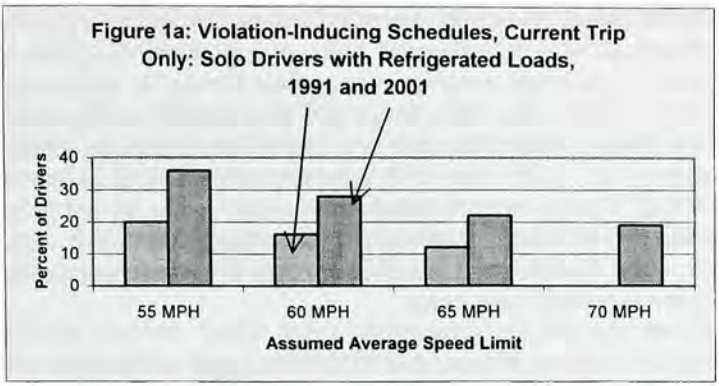
5.4 Trip Length

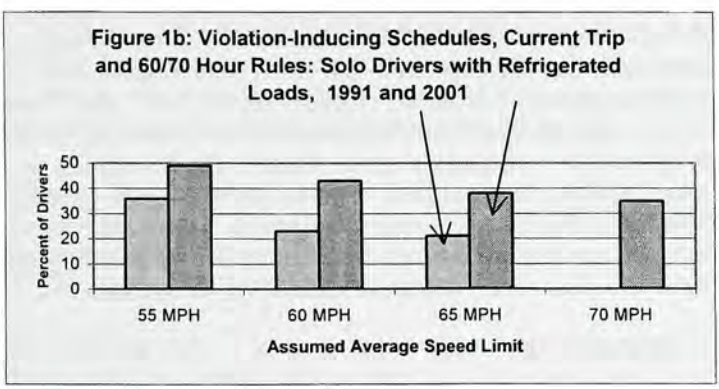
Consistent with the 1991 study, trip length is strongly related to schedule tightness. In particular, trips under 500 miles have markedly looser schedules than longer journeys, see Table 1. Differences across trip lengths were significant at the .01 level of probability.

5.5 Comparison with the 1991 Study

Assuming the same average speed limits, schedules in 2001 were 50 to 100 percent higher than corresponding estimates for from the 1991 study. But this does not mean that there has been a corresponding increase in actual violations. Clearly schedules became more demanding over the decade between the two studies. But likewise, speed limits have increased in nearly 80 percent of the states. The extent to which drivers are able to meet these tighter schedules legally due to higher average speed limits versus committing HSR violations or exceeding speed limits is unknown.

However, it appears clear that schedules have become increasingly tight, though the determining the extent requires more analysis. Assuming a higher (lower) average speed limit lowers (raises) estimated incidences of tight schedules. In 1991 and assuming average speed limits of 55 MPH, of the solo drivers with refrigerated loads an estimated 20 percent had Violation-Inducing schedules taking into account only the current trip, and 36 percent had Violation-Inducing schedules if considerations regarding the 60 and 70 hour rules were also taken into account. Almost surely this overestimates schedule tightness as average speed limits in 1991 certainly exceeded 55 MPH. Similarly, 70 MPH was almost surely higher than the actual average speed limits in 2001 and assuming 70 MPH would understate schedule tightness. Regardless of whether only the current trip was taken into account (Figure 1a) or the 60 and 70 hour rules were also incorporated into the estimation (Figure 1b), the percentages of Violation-Inducing schedules were nearly identical using 55 MPH and 70 MPH average speed limits for 1991 and 2001, respectively. Again, this example demonstrates that increased incidence of Violation-Inducing since the early 1990s appears to have occurred, but the extent remains uncertain.





Note: 70 MPH scenario not calculated for 1991.

6. SUMMARY AND CONCLUSIONS

The extent to which tight schedules encourage exceeding speed limits and/or driving times mandated by Federal Hours of Service Regulations has been examined for long distance drivers of refrigerated tractor-trailers. The results are grim in two regards. First, the estimated

percentages of drivers with tight schedules are high, particularly for solo drivers, those with refrigerated loads, and those traveling over 500 miles. For example, assuming average speed limits of 65 miles per hour and only considering the current trip, it is estimated that 22 percent of solo drivers with refrigerated loads had Violation-Inducing schedules (Figure 1a). This rises to 38 percent if information about previous driving is incorporated to include consideration of the 60 and 70 hour rules (Figure 1b). The second reason for gloom is that, despite increased speed limits, the incidence of tight schedules appears to have increased over the past decade.

The U.S. Congress and U.S. D.O.T. are engaged in a lengthy, if not interminable, considerations of potential revisions for HSR. Considerable money and effort have been devoted to studying the biological rhythms of drivers. Certainly it is vital to have driving/work time regulations which promote safe motor vehicle operations. But these regulations, however well-conceived, will have limited effectiveness if the schedules drivers are expected to meet pressure them to ignore driving time and/or speed limits. The Government should consider putting more emphasis on mechanisms to ensure compliance, rather than finding the perfect driving/work time scheme. Such mechanisms would likely include a sharing of responsibility among those who give drivers schedules and the drivers themselves.

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8. APPENDIX

Hours of Service Regulations as contained in Part 395 of the Federal Motor Carrier Safety Regulations

On-duty time includes all time spent: driving or performing any work-related function. This includes passive functions such as waiting for loads and sitting in the cab while a co-driver operates the vehicle.

Off-duty time includes all time in which the driver is not responsible for the truck and is not performing any other work for the carrier. Resting in the sleeper berth qualifies as off-duty time.

Maximum Driving and On-Duty Time

10-hour driving rule

After 8 consecutive hours off-duty, 10 hours of driving is permitted.

After 10 consecutive hours of driving, no driving is permitted prior to an 8 hour off-duty period.

15-hour on-duty rule

Driving is not permitted after 15 hours of on-duty time.

60-hour rule

A maximum of 60 hours of driving is permitted during any seven-day period. When this limit is reached, driving is not permitted until 48 hours has passed.

70-hour rule

A maximum of 70 hours of driving is permitted during any eight-day period. When this limit is reached, driving is not permitted until 48 hours has passed.

TABLE 1: PERCENTAGES OF DRIVERS WITH VIOLATON SUSPECT (VS) OR VIOLATION INDUCING (VS) SCHEDULES: CURRENT TRIP (C) or CURRENT OR 60/70 HOUR RULE (CW)

	Assumed Average Speed Limit															
	55 MPH				60 MPH				65 MPH				70 MPH			
	VS		VI		VS		VI		VS		VI		VS		VI	
	C	CW	C	CW	C	CW	C	CW	C	CW	C	CW	C	CW	C	CW
ALL DRIVERS	37	49	31	44	31	44	24	37	24	37	19	33	19	33	17	30
PRODUCE/ORN.																
YES	51	68	43	60	43	60	32	52	32	52	25	45	25	45	22	41
NO	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
TEAM DRIVING																
YES	19	30	11	22	11	22	8	19	8	19	5	14	5	14	5	14
NO	38	50	33	44	33	44	25	39	25	39	20	34	20	34	18	31
OWNER-OPERATOR																
YES	39	53	33	45	33	45	26	37	26	37	20	32	20	32	19	29
NO	37	23	30	44	31	44	24	40	24	40	19	35	19	35	16	33
TRIP LENGTH																
UNDER 501 MILES	8	10	7	9	7	9	5	7	5	7	5	7	5	7	5	6
501-1,000 MILES	41	59	41	57	41	57	33	50	33	50	24	41	24	41	23	36
OVER 1,000 MILES	57	74	45	64	45	64	35	55	35	55	27	48	27	48	24	45

Locating Emergency Response Units for Dangerous Goods Movements: How to Assess the Risk

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ABSTRACT: Transportation of Dangerous Goods (DG) poses special risks on our society. Quantitative Risk Assessment (QRA) provides the information needed to make risk management decisions. QRA models often do not consider Emergency Response (ER) capabilities that might response to the accident. This paper introduces a time dependant QRA model to assess DG accidents risks on a regional road network. The model takes into account the available ER capabilities on the road network and how such capabilities affect level of risk on different parts of the region under consideration.

INTRODUCTION

Transportation of Dangerous Goods (DG) has become an essential part of our industrial society. Currently in North America, Dangerous Goods are produced and consumed in great quantities. Hence, they are being transported in large amounts over transportation network. The transportation of Dangerous Goods poses special risks on both population and the environment. For any Dangerous Goods incident, risk can be defined simply as the product of the likelihood of the incident taking place and its consequent damages. Normally, this is expressed as an expectation (e.g. expected number of fatalities per year)

and is obtained by summing these risks over all likely outcomes or damages for different factors and conditions (Rhyne, 1994).

Risk associated with transportation of Dangerous Goods has been the focus of many research efforts. Not only qualitative methods but also Quantitative Risk Assessment (QRA) techniques have been developed to assess Dangerous Goods accidents risk. QRA provides the information needed to make risk management decisions. QRA help answer questions such as: Is there adequate safeguards to control the risks of catastrophic accidents? Are current design and operating strategies sufficient to meet reliability goals? Will implementing certain recommendations significantly reduce risks? Which design option minimizes risks at an acceptable cost? It allows public and private organizations to save time and money by cost-effectively allocating resources toward those areas that pose the most significant risks.

Previous research trends in DG risk include two major areas. The first area involves assessing the risk associated with a certain location, e.g. a facility produces, uses or store DG. In this area, QRA is used to identify the major risk contributors for a given facility or operation. The second research area focuses on risk assessment related to routing and scheduling of DG movements on the road network. Assessing the risk from all DG movements over a certain area or region did not have the same level of attention as the previous 2 research areas.

Another deficiency of the previously developed QRA models is the lack of consideration of the Emergency Response (ER) capabilities that might respond to the

accident. Although lots of research has been devoted to transportation of DG risks, little has been done to incorporate Emergency Response in the QRA of DG accidents. Emergency Response plays an important role in DG accident. Prompt response to DG accidents could dramatically reduce the risk associated with such accidents.

This paper introduces a time dependant QRA model to assess DG accidents risks on a regional road network. The model takes into account the available ER capabilities on the road network and how such capabilities affect level of risk on different parts of the region under consideration. The model accounts for response time from the nearest Emergency Response unit and how it will affect accident consequences. The model aims at finding a risk measure for the considered region based on types and volumes of DG being transported over the region road network, probabilities of DG accidents on different network links, different population densities over the region, and availability of ER capabilities in the region, plus other location specific factors.

Risk

In studying transportation of DG, Risk-based approach allows explicit consideration of population distribution, emergency response time and frequency of incidents. This approach provides a practical platform for evaluating the trade-off between system costs, total network risk, and risk and response time thresholds at individual nodes. This paper represents a time dependant QRA model.

As shown in equation 1, risk is usually defined as the product of the likelihood of an incident and the consequence that might result from such incident.

Risk = Frequency of Occurrence * Consequence (1)

Figure 1 illustrates the framework for the time dependant QRA model.

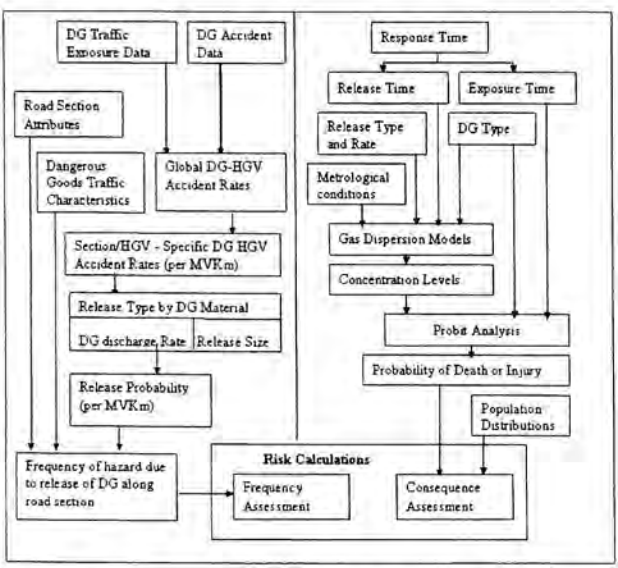


Figure 1: Time Dependant QRA model framework for the transport of DG.

The frequency of DG incidents is a function of several factors including, the probability of DG accident, release by type and quantity and the corresponding DG exposure

in terms of DG volumes being transported. The consequent damages that may result from DG incidents depend on a number of factors, such as the type of DG involved, weather and atmospheric conditions (e.g. wind direction and speed), emergency response time, and on-road and off-road population densities. Emergency response time applies to the time interval from start of incident till initiation of emergency response measures. These measures include containment of release and/or fire, evacuation and sheltering, redirection of traffic and cleanup. During the emergency response time interval, the consequent damages associated with any given incident can escalate rapidly due to increasing damage propagation (increasing number of people coming within a given threat level). Clearly, reduced emergency response time would mean more confined hazard area and reduced threat.

Consider a regional highway network represented by a directed graph G (N, A), where N is a set of network nodes, $N = \{j, j = 1,2,3,...,nd\}$ and A is a set of network links, $A = \{l, l = 1,2,3,...,nm\}$, as shown in Figure 2. Nodes represent population centers as well as highway intersections. Network links serve only as connections between nodes and have been assigned appropriate travel times.

Over the network, there exists a set of *np* Dangerous Goods Emergency Response Units (DG-ERU), denoted by P, where $P = \{i, i = 1,2,3,..., np\}$. The DG-ERU are assumed to exist only at network nodes (i.e., $P \subset N$).

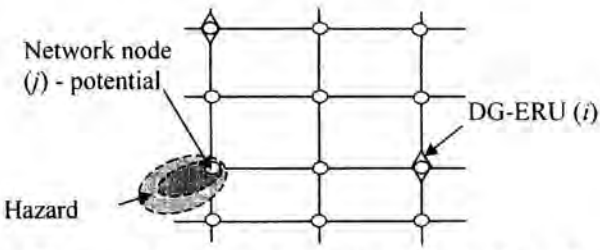


Figure 2: Highway Network Model for Time Dependant QRA

In developing this model it is assumed that risk is aggregated at node level. DG incidents on links are aggregated to adjacent nodes. Each node on the network will be assigned half the incidents that take place on all adjacent links. Hence, response time from the nearest DG-ERU to the node, population density distributions around node, and meteorological conditions at the node are used in calculating DG risk. As shown in figure 2, the time dependant QRA model consists of two sub-models, the frequency model and the consequence model.

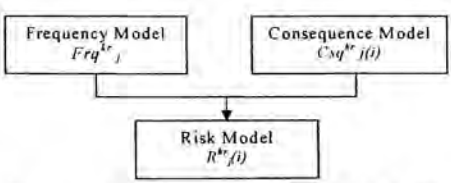


Figure 3: Components of Risk Model

For a certain DG type, k, and release type, r, frequency model calculates release frequencies at network node j ($Frq^{kr}{}_j$) and consequence model calculates consequences

at network node, j, when response occurs from the nearest DG-ERU, i ($Csq^{kr}\,j(i)$). The two models are combined to calculate $R^{kr}{}_j(i)$, risk at node j when response occurs from node i.

For k DG type and r release type, $R^{kr}{}_j(i)$, risk associated with j when DG-ERU is located at i, can be expressed as:

$$R^{kr}{}_j(i) = Frq^{kr}{}_j * Csq^{kr}\,j(i) \tag{2}$$

Where $Frq^{kr}{}_j$ can be estimated either by statistical analysis of historical data or from incident prediction models. $Csq^{kr}\,j(i)$ represents the consequent damages that result from a DG incident at j when the nearest DG-ERU, i, respond to the accident. In this study this consequence is measured in terms of total number of fatalities. Note that both frequency and consequences in equation (2) depend on DG type and release type.

The total risk on the network from a certain DG type k and release type r is defined as the summation of risk over all network nodes nd.

$$Risk^{kr} = \sum_{j} R_j^{kr}(i) \tag{3}$$

Total risk on the network is the summation of all risk from different types of DG and release, as illustrated in Equation 4.

$$Risk = \sum_{k}\sum_{r} Risk^{kr} \tag{4}$$

FREQUENCIES

First step in calculating risk is to obtain DG release frequencies. Accidents involving DG are rare events. Historical DG accident data are often very limited making it difficult to obtain accident and release frequencies for Dangerous Goods. Saccomanno, et. al. (1993) studied different risk models and reported DG accidents and release estimate from seven different North American and European organizations .

There are over 3000 regulated DG material in Canada. For practical consideration, Button (1999) classified DG into four major types: toxic liquefied gas, flammable liquefied gas, toxic liquid and flammable liquid. Button also classified releases into four major types: large leak, small leak, large spill, and small spill. We found these classifications to be computationally practical; hence, they will be used in this model. For each DG type, Button was able to estimate release probability of different release types given accident type (e.g. collision) and load size (e.g. large load). Combining release probabilities from Button's work with truck accident rates and exposure data for DG movements gives release frequencies for different DG types and release types. Button's estimates for release probabilities are the most recent published work that we could find in the literature. However, they need to be combined with reliable DG traffic data and detailed Heavy Goods Vehicles traffic data in order to obtain release frequencies. Unfortunately, such detailed data are not available to us at the time of this research. Hence, in this model we will use the

general DG accident and release probability estimates reported by Saccomanno, et. al. (1993).
For the purpose of this paper only toxic liquefied gases will be considered. Further more, chlorine was chosen to represent toxic liquefied gases. Steps for obtaining release frequencies for any of the 4 major DG types are identical and applying those steps to chlorine gives an example on how release frequencies could be obtained. On the consequence side, toxic liquefied gases are considered the most complicated to model among the 4 major types of DG accidents. Modeling consequences for toxic liquefied gases would involve estimating material release rate into the environment, modeling of gas dispersion into accident site vicinity, calculation of time dependant concentration levels and dosage, determining lethality levels and finally estimating number of fatalities.

CONSEQUENCE

Consequence analysis is used to estimate the magnitude of health effects associated with accidents involving DG. Specific components of consequence analysis are: estimating DG release rates to the environment, atmospheric dispersion analysis, and estimating the effects a release might have on the public. Only immediate health effects in form of fatalities are considered in this research. Long term heath risks and environmental risks are not considered at this stage. It is assumed that emergency response will occur from the nearest DG-ERU at a time equal to the response time (*tij*). It is also assumed that upon the arrival of DG-ERU on the

accident site some type of action will be taken to contain the release, suppress toxic vapor, evacuate the surrounding area or effectively shelter exposed population. Hence, it is assumed that release time is equal to response time (t_{ij}).

As discussed before, liquefied Chlorine will be used as an example to illustrate consequence analysis. Chlorine is a heavier than air gas that is highly toxic. When released, it starts to evaporate (as a puff cloud) into the surrounding atmosphere. With time and depending on the action of the wind, this cloud slumps and begins to be dispersed as a plume. This results in different levels of concentrations starting with higher concentration near the point of release and decreasing outwards. Boundaries of different levels of concentration are usually referred to as hazard areas, hazard envelopes, or isopleths, as shown in Figure 4.

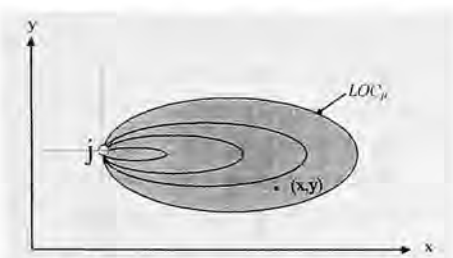


Figure 4: Hazard envelops at release node j

The most outer hazard envelop is called "Level Of Concern" (LOC) and is defined as the lowest concentration level that results in immediate threat to human health. Actual size of LOC as well as other

different hazard envelops depend on many factors, e.g. release rate, metrological conditions, and release duration. In Figure 4, node j represents a DG release site while LOC_{ji} is the Level Of Concern at response time t_{ij}. Point (x, y) represent a point within LOC_{ji}.

The consequence damages at release point j and up till response occur at time t_{ij}, Csq_{ji}, can be obtained by integrating fatalities within LOC boundaries as follows:

$$Csq_{ji} = \int_{x} \int_{y \in LOC_{ji}} LL_{ji}(x,y) * Pop(x,y) * dx\ dy \qquad (5)$$

Where $Pop(x,y)$ is the population density at (x,y), $LL_{ji}(x,y)$ is the lethality level defined as the probability of being killed for a person residing at (x,y) for the period of exposure (or response time tji).

The lethality level at a specific location (x,y), $LL_{ji}(x,y)$, is a function of concentration level at (x,y), duration of release or exposure and some site specific factors (e.g. topography, vegetation, and meteorological conditions). In traditional risk analysis, lethality level is usually determined through a process called probit analysis. The expression for lethality level is of the form:

$$LL_{ji}(x,y) = \int_{-\infty}^{z_{0ji}(x,y)} \frac{1}{\sqrt{2\pi}} e^{\frac{z_{ji}(x,y)^2}{2}} dz_{ji}(x,y) \qquad (6)$$

Where $z_{0ji}(x,y) = \dfrac{P_{rji}(x,y) - 5.0}{1.0}$

The probit value (Pr) in the above expression can be defined generally as:

$$P_{r\,ji}(x, y) = a + b * \ln TL_{\,ji\,(x,y)} \qquad (7)$$

Where *TLji* is the Toxic Load at point I when response occur from DG-ERU j. Toxic Load is defined as the concentration of pollutant gas at a given location (to which people may be exposed), taken to a power, multiplied by the period of time that the pollutant is present [ALOHA users manual, EPA 1999].
Toxic Load has the general form of $(c^m * t)$, where c in concentration in ppm, t is exposure time in sec. and a, b and m are model parameters that depends on DG type and can be calibrated through empirical analyses. The power m to which the concentration is taken is intended to account for the particular effects of a chemical as estimated from toxicological data. For chlorine, the OECD study (1999) provides the following parameter values, $a = -5$, $b = 0.5$ and $m = 2.75$.

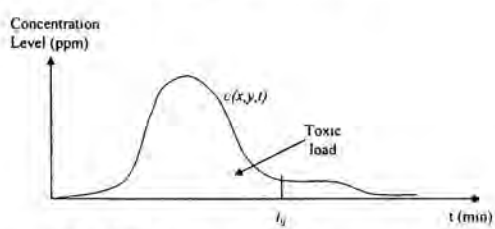


Figure 5: Time-varying Concentration Levels

Due to the dynamics of gas dispersion, the concentration level at a given location is likely not constant over time, as shown in Figure 5.

For a variable concentration c over time t, the toxic load could be calculated by integrating cm over time t from t =0 to $t= t_{ji}$ as shown in equation (5)

$$TL_{ji}(x,y) = \int_0^{t_{ij}} c_{ji}(x,y)^m \, dt \tag{8}$$

Where t_{ji} is the time of exposure (min), $c_{ji}(x,y)$ is the concentration level (ppm) at point (x,y) at time t_{ji}. $c_{ji}(x,y)$ can be obtained using available gas dispersion models. A number of such models can be found in the literature. For the purpose of this research, ALOHA, a gas dispersion model developed by the EPA of USA has been used (EPA, 1999).

CASE STUDY

To illustrate the model features and to explain different steps in obtaining frequencies and consequences of DG releases, the model is to be applied to part of Southwestern Ontario region. A map of the region is shown in Figure 6.

The network: A geographical information system (GIS) database for road network was adapted for this study. GIS representation assists in organizing and analyzing transportation data. The data is obtained from The National Atlas of Canada [Natural Resources Canada, Canada Centre for Remote Sensing, GeoAccess Division]. GIS is a valuable tool integrating transportation system data with other forms of tabular data. The data is a digitized representation of major road network. The

network consists of nodes represent cities as well as road intersections.



Figure 6: Southwestern Ontario area covered by case study

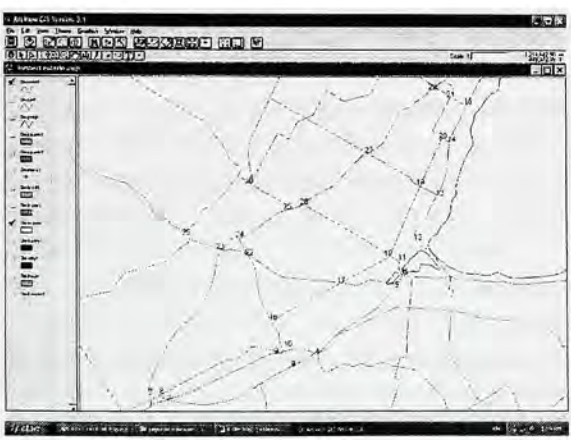


Figure 7: Digitalized road network under study

Figure 7 shows the study area as viewed in ArcView software for GIS. The study area consists of 30 nodes and 44 links. The link data includes link number, tail node, head node and link length in meters.
Posted speed and Average Annual Daily Truck Traffic (AADTT) for the considered links were obtained from Transport Canada, Ontario Region, 2000. Posted speed was used with link length to calculate free flow travel time on links. AADTT was used as an input to calculate accident frequencies.
DG traffic: Chemical products account for 5.3% of total domestic and international "For Hire" trucking traffic in Canada in 1999 (Transport Canada, 2000). We assumed that chemical products correspond to dangerous goods. Hence the previous percentage will be used to represent DG movements. Chlorine accounts for 0.43% of total dangerous goods movements in Canada by tonnage (Transport Canada, 2002). Although in Canada chlorine is transported by rail, for the purpose of this case study it is assumed that chlorine is transported totally by road. To calculate traffic volume of chlorine transported on different links the following equation will be used:

Chlorine AADTT = AADTT * 5.3% * 0.43% (9)

The annual chlorine movement on each link can then be calculated using equation 10

Chlorine movement in vehicle-km/year on each link (10)
= Chlorine AADTT * 365 * link length

As discussed earlier, accident frequencies are taken from different studies carried out by different countries (Saccomanno et. al. 1993). Seven studies gave different estimate of DG truck accident frequencies. To obtain an estimate for our case study, we took the average of the different estimates after eliminating the two extreme values. This gave DG truck accident frequency of 7.36E-7 / truck-km. For chlorine, giving an accident already occurred; the previous report gives 5 different estimates for probability of release taken from 5 different sources. For the purpose of this study, we took the average of 3 values after eliminating the 2 extremes. This gives a release probability of 0.87%. Frequency of release on each link can then be obtained by multiplying the previously calculated Chlorine movement in vehicle-km/year on each link by DG accident probability and DG release probability.

DG-ERU locations: To find towns and cities with capabilities to respond to DG accidents, we checked the official web sites for all towns within the region under study. We found 10 towns with some kind of DG response capabilities, they are namely Mississauga, Milton, Oakville, Burlington, Hamilton Guelph, Kitchener, Cambridge, Brantford, and Woodstock. Although there are big differences in the level of available DG response capabilities among those cities, for the purpose of this paper it is assumed that all of them have DG-ERU.

Response time: It is assumed that response will occur from the nearest DG-ERU using shortest path. Response time is set equal to 80% of Free Flow travel time plus 1

minute penalty for going through an intersection and 3 minutes penalty for starting from a town or going through a town. Another 3 minutes were added to response time to account for initiation of mitigation measures.
Wind speed and direction were obtained from environment Canada web site. Norms for different climate stations within the region were investigated. It was found that winds of 15 km/hr blowing from west could well represent conditions within the whole region. Other assumption include: ground roughness equivalent to open country, partly clouded skies, air temperature 18 C, a release rate of 2 kg per sec.

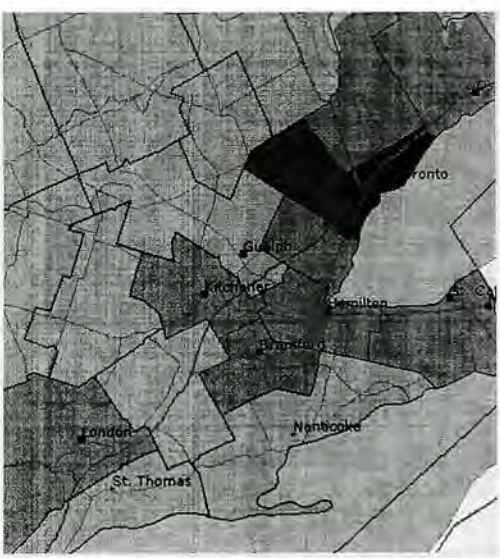


Figure 8: Population distribution within the considered region

Population distribution: Only off-road population was considered in the analysis. Population distribution was taken from National Atlas of Canada based on Censes Canada 1996. It is assumed that no shelter or evacuation occur until response occur.

Calculations and results: To calculate frequencies of release on links, equations 9 and 10 were used together with estimated DG accident and release probabilities. Table 1 shows network links sample, their attributes and calculated frequencies.

Table 1: Link attributes and release frequencies.

link No	From node	To node	Length	Posted speed	Travel time (min)	Average Annual Daily Truck Traffic	DG AADTT	DG Annual Traffic (truck*km)	Accident / year ($*10^{-1}$)	Release / year ($*10^{-1}$)
1	1	2	4250	100	3.19	7500	1.71	2651.47	1.95	1.69
2	2	3	32247	60	40.31	1000	0.23	2682.42	1.97	1.71
3	3	4	5978	60	7.47	1000	0.23	497.27	0.37	0.32
4	4	5	26249	100	19.69	3500	0.80	7642.19	5.62	4.87
5	5	6	2488	100	1.87	10000	2.28	2069.61	1.52	1.32
6	6	11	3435	100	2.58	10000	2.28	2857.35	2.10	1.82

After determining annual release frequencies on all links, these frequencies were aggregated at nodes by assigning half of each link release frequency to the adjacent node. Table 2 shows node sample

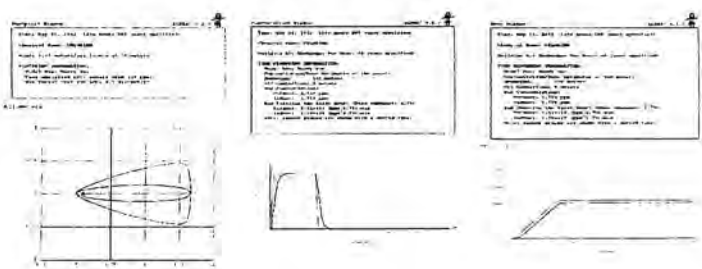
The calculated response time was then used as an input to gas dispersion model and probit analysis. Gas dispersion modeling was done using ALOHA (EPA, 1999). A grid system was used to model the hazard area around potential release site (node j). The area is divided into 100 m intervals in the downwind direction and 20 m intervals in the crosswind direction. Concentration level

distribution with time and toxic load were calculated for each point on the grid within the level of concern.

Table 2: Node sample

Node No.	DG-ERU	Response time	Frequency of release ($* 10^{-3}$)
1	1	6	1.08322
2	1	10.1875	4.455356
3	10	16.3715	1.134343
4	10	12.76	3.309074
5	6	8.866	3.468042

Figure 9 shows an example of ALOHA output.



(a) **(b)** **(c)**

Figure 9: ALOHA output. (a). Footprint of gas release, (b). Concentration distribution with time at point (x,y), (c). Toxic Load with time at point (x,y).

Lethality level at each grid point is then calculated using toxic load. Figure 10 shows different downwind Lethality Level distributions for different release durations while Figure 11 shows how consequences vary with response time when all other factors are kept unchanged.
Running the model for the specified region gave a risk measure of 0.12 fatalities per year from transportation of chlorine only. Finally Table 3 shows a summary of results for all nodes and the total risk on the network.

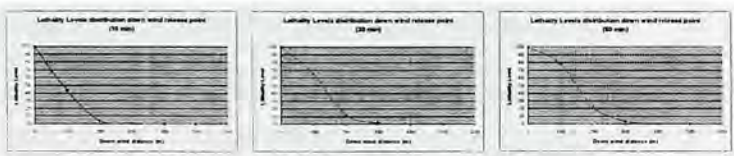


Figure 10: Comparison of Lethality Level distributions down wind release point for different durations of 2 kg/sec, Chlorine release

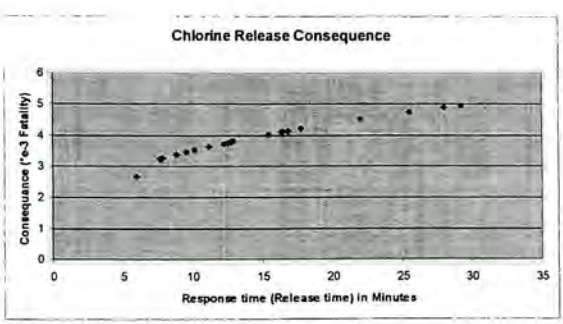


Figure 11: Variation of consequences with response time

Table 3: Consequences, Frequencies and Risk at different road network nodes

Nodes (j)	Nearst DG-ERU (i)	$Csq\ j(i)$	Frq_i	Risk $R_i(i)$
1	1	0.129177	0.001083	0.139927
2	1	0.169283	0.004455	0.754215
3	10	0.431155	0.001134	0.489078
4	10	0.397136	0.003309	1.314151
5	6	1.414421	0.003468	4.905271
6	6	1.130299	0.001571	1.77612
7	1	0.156671	0.008393	1.314867
8	1	0.174505	0.000973	0.169717
9	10	0.338448	0.003753	1.270151
10	10	0.282575	0.00101	0.28534
11	6	1.450381	0.002846	4.128024
12	12	0.95268	0.005051	4.811781
13	12	1.456527	0.006929	10.09196
14	14	0.95268	0.006242	5.946421
15	15	1.870375	0.002701	5.05192
16	10	0.434996	0.001164	0.506152
17	6	1.689641	0.001851	3.127298
18	6	1.59896	0.002402	3.841084
19	27	1.681275	0.001331	2.238285
20	14	2.240205	0.003703	8.296231
21	15	2.596996	0.003401	8.831454
22	22	0.788518	0.001367	1.077871
23	22	1.110346	0.010645	11.82015
24	22	1.102881	0.005327	5.875323
25	30	0.317735	0.005302	1.68464
26	27	0.269927	0.006095	1.645312
27	27	0.95268	0.010498	10.00164
28	15	2.860431	0.006275	17.94968
29	20	0.788518	0.000989	0.780209
30	29	0.172236	0.000665	0.114464
Total Risk (*e-3)				120.2388

CONCLUSION

This paper represents a time dependant Quantitative Risk Assessment Model for transportation of Dangerous Goods. The model takes into account time needed to initiate mitigation efforts by qualified emergency response units. The model is capable of calculating societal risk in a certain region from DG transportation

activities. The model is useful in many applications such as studying the effect of DG movement and emergency response policy changes on the level of societal risk.

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The Transborder Travel and Tourism Market During the 1990s

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For many years Canada and the United States have enjoyed the world's largest bilateral international trading relationship. In a normal year, over 75 percent of Canada's exports of goods and services are to the United States. Canada is in turn the largest market for U.S. exports. In 2000, total trade between the two countries reached $465 billion. Trade in services accounted for $39.5 billion of this total.

Travel and tourism is the largest component of transborder trade in services, reaching almost $16 billion in 2000. In the past decade the transborder market in travel and tourism has been subjected to several important exogenous shocks. First, the value of the Canadian dollar fell relative to the U.S. dollar over the decade, dramatically changing the costs of transborder visits. Second, in February 1995 Canada and the United States implemented a new accord governing air services between them. This new agreement increased service and lowered the price of transborder airline travel.

The goal of this paper is to examine the evolution of trade in travel and tourism services between Canada and the United States in the 1990s. It will profile changes in these markets on a national basis. It will examine in detail the impacts of the1995 air services accord and the decade-long change in the Canadian dollar-U.S.dollar exchange rates using a simple economic precept, the law of relative prices. The paper finds that the law of relative prices can be used to explain much of the changes that occurred in this market during the 1990s.

Growth in Transborder Trade in Travel and Tourism

The economies of the United States and Canada became increasingly intertwined in the 1990s. Propinquity played an important role in their economic evolution, as did the 1998 Canadian-U.S. Free Trade

Agreement and the 1994 North American Free Trade Agreement. Because travel is an income-elastic good, one would presume that given the growth in the Canadian and U.S. economies in the 1990s, Canadian-U.S. trade in travel and tourism would exhibit substantial growth as well. Table 1 confirms this expectation. From 1989 to 2000, total trade in tourism services rose from $8.8 billion to $13.4 billion, or 58 percent. Trade in passenger transportation increased from $1.0 billion to $2.5 billion over this time span, or 145 percent. These data understate the growth in transborder passenger travel, however. As they are collected on a balance of payments basis, they fail to capture payments made for transborder services between residents of the same country. For example, a New Yorker's purchase of a ticket on American Airlines to fly from La Guardia to Montreal would not be included in Table 1.

The Impact of Exchange Rates

As we noted in the introduction, several exogenous changes have occurred in this market. One important change is the long-term shift in the exchange rate between the Canadian and U.S. dollars. Table 2 indicates that the value of the U.S. dollar has risen relative to that of the Canadian dollar over the decade. At the end of 1990, one U.S. dollar cost C$1.1600. A decade later, one U.S. dollar cost C$1.5224—a descent of about 31 percent. Although the value of the Canadian dollar declined starting in October 1991, the decline began to accelerate commencing in late summer 1992.

Economic theory provides a variety of insights regarding the predicted impact of these exchange rate changes on the transborder travel and tourism market. Of particular value is the law of relative prices: when the price of one good falls relative to the price of a second good, consumers will increase their purchases of the first good relative to their purchases of the second good.

Table 1

Transborder Tourism Trade

	U.S. Exports	Canadian Exports	Total Trade
	(in millions of dollars)		
2000	7055	6367	13422
1999	6670	6135	12805
1998	6206	5718	11924
1997	6945	4904	11849
1996	6842	4670	11512
1995	6207	4319	10526
1994	6252	3914	10166
1993	7458	3692	11150
1992	8182	3554	11736
1991	8499	3705	12204
1990	7093	3541	10634
1989	5385	3396	8781

Transborder Passenger Fare Trade

	U.S. Exports	Canadian Exports	Total Trade
	(in millions of dollars)		
2000	1713	827	2540
1999	1540	712	2252
1998	1478	587	2065
1997	1361	470	1831
1996	1331	391	1722
1995	1284	306	1590
1994	1186	302	1488
1993	1191	260	1451
1992	1099	227	1326
1991	1040	249	1289
1990	979	255	1234
1989	811	224	1035

Table 2
Exchange Rates

	(Canadian dollars per U.S. dollar)
1990	1.1600
1991	1.1457
1992	1.2727
1993	1.3307
1994	1.3884
1995	1.3695
1996	1.3618
1997	1.4267
1998	1.5422
1999	1.4733
2000	1.5224
2001	1.5775

N.B.: Noon exchange rate, December 31.
Reported by Bank of Canada web site

This law of consumer behavior can be used to explain changes in the transborder travel and tourism market. To simplify the exposition, we will assume that there are two kinds of goods available to North Americans: U.S. goods and Canadian goods. Holding everything else equal, if the value of the Canadian dollar falls relative to that of the U.S. dollar, then Canadian goods become relatively cheaper to Americans and U.S. consumers should purchase more of them. Similarly, U.S. goods have become relatively more expensive to Canadians and Canadians should purchase less of them.

Of course, for transborder trade in travel and tourism to occur, residents of one country have to be transported physically to the second one. To examine the impact of the law of relative prices on transborder travel and tourism, we further assume that international trade in travel and tourism services is affected by the prices of two bundles of goods: transportation costs and tourism costs. The former bundle includes air fares, parking costs at the airport, taxi fares, costs

associated with the use of personal vehicles on transborder trips, etc. The latter bundle consists of goods and services that tourists buy once they are in the foreign country. These products include housing, meals, admissions to entertainment venues, etc.

For same-day transborder travelers, the impact of exchange rate changes on the cost of the first bundle of goods, transborder transportation services, may be relatively small, depending on their mode of transportation. For transborder travelers who drive across the border, most travel costs are tied to costs associated with car ownership—depreciation, insurance, etc. Such costs are denominated in the traveler's home currency and are thus unaffected by exchange rate changes. Other transborder travelers may use commercial air services. Because of the complex demand and supply factors that affect that market, international air fares are not directly responsive to exchange rate changes, although exchange rates may have an indirect influence on fare levels. Thus the impact of exchange rate fluctuations on international air fares is attenuated in most situations.

Exchange rate changes do have a major impact on the second type of goods, those which travelers buy in the host country. In the case at hand, the bundle of in-country services that American tourists buy in Canada became relatively cheaper for them, while the bundle of in-country services that Canadian tourists buy in the United States became more expensive for them. This would suggest significant shifts in transborder travel and tourism expenditures should occur. The share of transborder transportation and tourism services purchased by U.S. citizens should increase; conversely the share purchased by Canadian citizens should fall. Table 1 is consistent with this prediction. U.S. tourism expenditures in Canada have risen faster than Canadian tourism expenditures in the United States. U.S. purchases of transportation services from Canadian providers have similarly increased faster than Canadian purchases of transportation services from American providers. This is particularly noticeable after 1992, when the decline in the Canadian dollar began in earnest.

Table 3 provides more detailed information about transborder trade in tourism and transportation services. Overnight and same-day visits by Canadian residents to the United States fell over the period 1990 to 1999. Conversely, overnight and same-day visits by U.S. residents to Canada have increased over this time span.

Canadian Travel to the United States

Table 3's data can be analyzed in greater detail. Consider same-day travel to the United States by Canadian residents. Table 3 indicates that 1) such travel has declined by 47 percent during the 1990s; 2) travel by land (almost all of which is by personal motor vehicle) has fallen by a similar percentage; and 3) travel by air has increased slightly. These observations can be explained by changes in relative prices. The first observation occurred because the price of tourist services purchased in the United States has increased for Canadian residents due to the decline in the value of the Canadian dollar. The second observation resulted from the same phenomenon. Indeed, much same-day travel by automobile is motivated by cross-border shopping trips. The decline in the value of the Canadian dollar would substantially reduce the utility of such trips. Travel by air has increased slightly. This is consistent with the decline in transborder air fares due to increased competition generated by the new transborder air services accord implemented by Canada and the United States in February 1995. By the end of the second year of the agreement, average transborder air fares had fallen by 22 percent.[1]

Now consider Canadian resident overnight travel to the United States. Table 3 indicates that 1) such travel has declined by 18 percent during the 1990s; 2) travel by land (almost all of which is by personal motor vehicle) fell by 33 percent; and 3) travel by air has increased by 23 percent. These observed changes in travel patterns can be explained by the same forces that affected same-day travel. Of greater interest, however, is the comparison between same-day and overnight travel

[1] U.S. Department of Transportation, *The Impact of the New US-Canada Aviation Agreement At Its Second Anniversary* (April 1997), p.6

Table 3
Canada-U.S./U.S.-Canada Travel by Mode of Transportation
(Thousands of roundtrips)

	1990 Number	1996 Number	1999 Number	% change 1990-99
Canadian resident overnight travel to U.S.	17,262	15,301	14,116	-18.2
Air	4,039	4,496	4,962	22.9
Land				
Motor vehicles	12,770	10,251	8,563	-32.9
Personal vehicles	12,164	9,579	7,869	-35.3
Other	416	521	556	33.7
Canadian resident same-day travel to U.S.	53,171	37,398	28,081	-47.2
Air	137	124	150	9.5
Land				
Motor vehicles	52,629	37,159	27,807	-47.2
Personal vehicles	51,829	36,267	27,107	-47.7
Other	405	115	124	-69.4
U.S. resident overnight travel to Canada	12,252	12,909	15,180	23.9
Air	2,372	3,047	3,760	58.5
Land				
Motor vehicles	9,103	9,097	10,419	14.5
Personal vehicles	8,381	8,325	9,609	14.7
Other	778	692	900	15.7
U.S. resident same-day travel to Canada	22,482	25,563	29,450	31.0
Air	165	365	525	218.2
Land				
Motor vehicles	21,412	24,700	28,315	32.2
Personal vehicles	20,692	23,804	27,318	32.0
Other	905	492	595	-34.3

Source: U.S. Department of Transportation, North American Trade and Travel Trends, p. 18

by Canadian residents to the United States. Note that relative to overnight travel, a higher percentage of total trip costs for day-trippers is composed of tourist services, which bore the full brunt of the decline in the value of the Canadian dollar. Consistent with this observation, same-day transborder travel by Canadians fell by 47 percent, but by only18 percent for overnight travel. Similarly, same-day travel by motor vehicle fell by 47 percent, whereas overnight travel by motor vehicle dropped only 33 percent. Same-day travel by air rose almost 10 percent, but by 23 percent for overnight travelers. Presumably the increase in air travel was due to the decline in transborder air fares engendered by the 1995 Air Services Accord.

U.S. Resident Travel to Canada

In this section we will analyze travel by U.S. residents to Canada. We begin by considering same-day travel. Table 3 indicates that 1) such travel has increased by 31 percent during the 1990s; 2) travel by land (almost all of which is by personal motor vehicle) rose over 32 percent; and 3) travel by air more than tripled. These observations can also be explained by changes in relative prices. The first observation occurred because the price of tourist services purchased in Canada fell for U.S. residents. The second observation resulted from the same phenomenon. As we noted above, much same-day travel by automobile is motivated by cross-border shopping trips. The decline in the value of the Canadian dollar would substantially raise the benefit of such trips to U.S. residents. Travel by air skyrocketed. American travelers benefited from both the declining Canadian dollar and the decline in transborder air fares subsequent to the 1995 air services accord.

Now consider U.S. resident overnight travel to Canada. Such travel has increased by almost 24 percent during the 1990s; 2) travel by motor vehicle rose by 14.5 percent; and 3) travel by air has increased by 58.5 percent. These observed changes in travel patterns can be explained by the same forces that affected same-day travel. Travel to Canada decreased for all Americans because of the decline in the value of the Canadian dollar. The growth of transborder travel by air exceeded that of transborder travel by private auto. We noted earlier

that most transportation costs incurred through the use of private autos is denominated in the home currency. Therefore, the transportation component of the cost of overnight transborder visits by U.S. motorists did not change very much. Because of increased competition in tranborder aviation markets, the transportation costs of overnight visits to Canada by U.S. residents using commercial airlines did decline. Hence the law of relative prices predicts, and Table 3 confirms, that air travel would increase faster than travel by motor vehicle for U.S. residents visiting Canada overnight.

We can also compare same-day and overnight travel by U.S. residents to Canada. Relative to overnight travel, a higher percentage of total trip costs for day-trippers is composed of tourist services, which became cheaper to Americans because of the decline in the value of the Canadian dollar. Consistent with this observation, same-day transborder travel by Americans rose by 31 percent, but by only 24 percent for overnight travel. Same-day travel by motor vehicle rose by 32 percent, whereas overnight travel by motor vehicle increased only 14.5 percent. Same-day travel by air rose 218 percent (albeit from a very low base), whereas it increased only 58 percent overnight travelers.

Comparison of Travel Behavior of U.S. Residents and Canadian Residents

The theory of relative prices can also be used to explain differences in the transborder travel behavior between Canadian residents and U.S. residents. Table 3 indicates that same-day travel by U.S. residents increased 31 percent, while it fell 47 percent for Canadian residents. This is as expected, for U.S. transborder travelers benefited from the decline in the value of the Canadian dollar, while Canadian travelers were hurt by it. The same pattern holds for overnight visitors, although the increase/decline is dampened relative to what was observed for same-day travelers. As discussed earlier, this is due to the fact that a higher proportion of the cost of same-day transborder travel is exchange-rate sensitive.

Travel by Trip Purpose

Table 4 provides information about transborder travel by trip purpose. Same-day transborder travel by Canadians plummeted regardless of trip purpose. Since the costs of such travel are exchange-rate sensitive, this result is not surprising. However, overnight travel by Canadian businesspersons rose substantially, while VFR (visit friends and relatives) travel was essentially flat. Travel motivated by tourism declined substantially, however. This is not surprising, for it is likely that such travel is far more price sensitive than either business or VFR travel.

Overnight transborder travel by U.S. residents increased for all three types of travelers, as did same-day transborder travel by U.S. tourists and pleasure travelers. Surprisingly, same-day business and VFR travel declined for U.S. residents. Although this is an unexpected result, it may be that some U.S. travelers chose to lengthen their trips as a result of exchange-rate induced decreases in the costs of staying in Canada.

Summary and Conclusions

Major changes have occurred in the market for transborder travel and tourism during the decade of the 1990s. Two important factors that have affected this market are the long-term decline of the Canadian dollar relative to the U.S. dollar and the 1995 Air Services Accord that changed the rules governing airline service between Canada and the United States.

This paper examines the impact of these changes using the law of relative prices. It argues that the relative price of transborder travel has increased for Canadians but declined for Americans due to changes in exchange rates. Accordingly, U.S. travel to Canada should have increased and Canadian travel should have declined. This finding is consistent with observed travel behavior. Additionally, the paper argues that exchange rate movements should impact same-day travel and overnight travel differentially. These predictions are also confirmed by available data.

Table 4
Canada-U.S./U.S.-Canada Travel by Trip Purpose
(Thousands of roundtrips)

	1990 Number	1996 Number	1999 Number	% change 1990-99
Canadian resident overnight travel to U.S.	17,262	15,301	14,116	-18.2
Pleasure/tourism	10,586	8,810	7,365	-30.4
Business	1,972	2,422	2,685	36.2
Visit family & friends	2,701	2,653	2,755	2.0
Other	2,003	1,418	1,311	-34.5
Canadian resident same-day travel to U.S.	53,171	37,398	28,081	-47.2
Pleasure/tourism	34,159	23,198	14,879	-56.4
Business	3,567	2,899	1,857	-47.9
Visit family & friends	4,703	3,235	3,125	-33.6
Other	10,741	8,066	8,220	-23.5
U.S. resident overnight travel to Canada	12,252	12,909	15,180	23.9
Pleasure/tourism	7,012	7,392	8,709	24.2
Business	1,729	1,970	2,352	36.0
Visit family & friends	2,602	2,221	2,717	4.4
Other	909	1,325	1,402	54.2
U.S. resident same-day travel to Canada	22,482	25,563	29,450	31.0
Pleasure/tourism	10,958	13,018	14,163	29.2
Business	1,967	1,778	1,539	-21.8
Visit family & friends	5,385	3,895	4,088	-24.1
Other	4,172	6,872	9,660	131.5

Source: U.S. Department of Transportation, North American Trade and Travel Trends, p. 20

Driving Characteristics of the Young and Aging Population

Transportation Division
Statistics Canada
John Nicoletta

Introduction

Many jurisdictions that regulate road traffic in Canada differentiate drivers by age categories. In particular, two groups, the young driver and the aging driver, are frequently required to submit to extra training and/or testing. Until recently, the only statistics available in Canada were of an ad hoc nature collected by individual jurisdictions or by household surveys. The current state of such statistics was examined in an extensive literature review that was conducted as part of this study. The review examined different sources of information relating to driving characteristics, provincial safety reports, U.S. safety administrations as well as other international data sources. A summary of the literature reviews has not been included but can be made available on request.

In 1999, the Canadian Vehicle Survey, sponsored by Transport Canada, was introduced by Statistics Canada to measure and describe road vehicle use in Canada. The Canadian Vehicle Survey provides quarterly and annual estimates of the amount of road travel, broken down by type of vehicle and variables such as age and sex of driver, time of day and season. The survey includes small passenger vehicles[1] (such as cars, vans and pick-ups), buses and trucks, but this paper will examine only the statistics that pertain to small passenger vehicles.

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[1] Vehicles with gross vehicle weights of less than 4,500 kilograms and not used as a bus.

This paper used the Canadian Vehicle Survey data for reference year 2000 to explain road use characteristics of the young and the aging driver groups on a national basis. The analysis examined differences between the two age groups of interest and the remainder of the population. The driver groups are specifically: 24 years and under, 25 to 54 years, and 55 years and over. The focus of the study was on when and why drivers choose to make their trips and how the driving population compared to the population as a whole. The driver characteristics were compared to Canadian Motor Vehicle Traffic Collision Statistics published by Transport Canada as a means of putting driving exposure into perspective. Detailed collision statistics and special tabulations are currently available up to 1999. This paper may be updated at a later date to include 2000 collision statistics. A list of all data sources is in Appendix A.

Comparative Analysis of Young and Aging Drivers

All data on distance driven were derived from the Canadian Vehicle Survey conducted by the Transportation Division of Statistics Canada. Currently, the only complete year of information is for the reference year 2000. Data are only presented for light vehicles (vehicles with gross vehicle weights below 4,500 kilograms).

There were a total of just over 281 billion vehicle-kilometres driven on Canada's roads by light vehicles, during 2000.[2] These vehicles drove an average of 17 thousand kilometres per year.

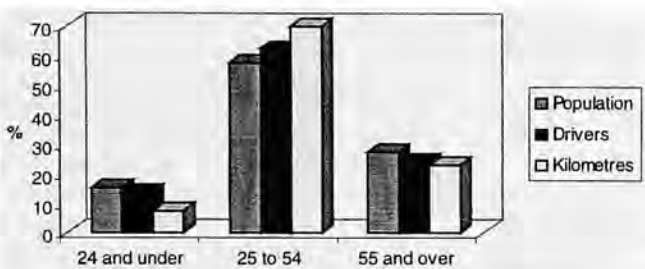
Canada's total population has steadily increased over the past ten years at a rate of almost 1% annually, reaching over 30.8 million in 2000. The population 16 years and older has been experiencing higher growth averaging 1.3% increases since 1991. This population group (persons eligible to drive) has represented between 78 – 80% of Canada's total population since 1991.[3]

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[2] A vehicle-kilometre is a unit used to measure the distance traveled by a licensed vehicle on a road.

There were a total of 20.6 million licensed drivers in Canada in 2000, approximately 67% of the total population.[4]

Chart 1: Percentage of Population, Licensed Drivers and Kilometres Driven



Sources: Statistics Canada, Estimates of Population, CANSIM II Table: 051-0010
Transport Canada, Canadian Motor Vehicle Traffic Collision Statistics, 2000
Statistics Canada, Canadian Vehicle Survey, Transportation Division, 2000

Population and drivers followed a more similar pattern than kilometres driven

The total population and number of drivers aged 55 and over was almost double that of those aged 16 to 24 years, yet the older age group drove over three times the distance of younger drivers. The older age group made up 27% of the total population 16 years and older, while persons aged 16 to 24 accounted for 15%.

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[3] Population statistics derived from Estimates of Population by Marital Status, Age and Sex for Canada, the Provinces and Territories, CANSIM II Table 051-0010, Statistics Canada.

[4] Number of Licensed Drivers by Gender and by Age, Canadian Motor Vehicle Traffic Collision Statistics, 2000, Transport Canada.

Similarly for licence data, older drivers had almost double the share of licences (24%) compared to younger drivers who accounted for 13% of the total licences. In contrast, persons aged 55 and over drove almost 23% of the total 281 billion kilometres driven as opposed to the younger age group who accounted for only 7% of the total kilometres.

Males dominated every driver age group

With the exception of the population distribution of the 55 and over age group, males dominated in every age group for licensed drivers, kilometres driven and collisions. The highest proportion of male drivers within an age group was in the older group, where there were a significantly lower number of female drivers. When it came to driver licences, this age group favoured male drivers at 56%, the single highest percentage in any of the three groups for drivers. This, in spite of the fact that females aged 55 and over represented 55% of the group's total population.

Collision statistics compared between age groups followed similar patterns to that of licence data. All age groups were male dominated with the higher percentage split in the older age category. Almost 59% of drivers involved in collisions in the older age group were males. Again, this was the highest percentage of all three age groups.

Over the past ten years, there has been an average of 156 thousand collisions each year on Canada's roads.[5] The collision statistics used in this paper include collisions where at least one person was injured or killed and where at least one of the vehicles involved was a light vehicle.[6]

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[5] Source: Canadian Motor Vehicle Traffic Collision Statistics, Transport Canada, 1991 - 1999.

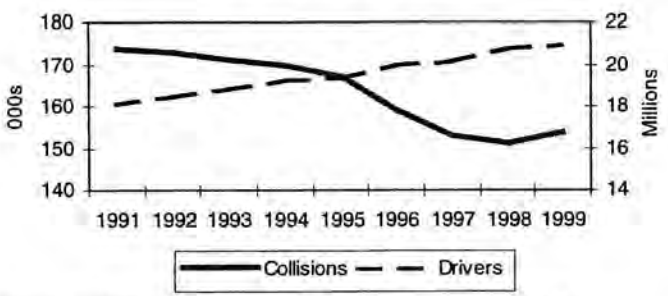
[6] Light vehicles include passenger cars and trucks less than 4,536 kilograms.

In 1999, there were a total of 147,000 collisions involving close to 237,000 drivers in Canada.[7]

Collisions took opposite direction from population and drivers

Unlike population and licence statistics, collisions followed a different pattern. As population has increased we have seen the number of licensed drivers also increase. This was not the case with collisions. As both population and licensed drivers increased over the past ten years, collisions have declined. This could be a result of increased safety regulations, imposed training on younger drivers, improved safety features of vehicles (ABS, air bags etc.) and strict laws on drinking and driving.

Chart 2: Number of Collisions and Licensed Drivers, 1991-1999



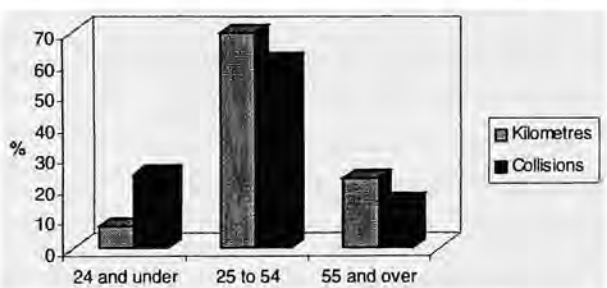
Sources: Transport Canada, Collision Statistics, Special Tabulations, 1999
Transport Canada, Canadian Motor Vehicle Traffic Collision Statistics, 2000

[7] Excludes drivers where driver age is unknown.

More younger drivers involved in collisions

Population and driver licence data favoured the older drivers by almost a 2:1 ratio over younger drivers. With collisions, however, the pattern was reversed. There were 50% more younger drivers involved in collisions than older drivers,[8] yet, the 55 and over age group drove more than three times the kilometres than younger drivers. Drivers in the younger age group were the only age group to account for a higher percentage of collisions than percentage of distance driven when compared to the totals.

Chart 3: Percentage of Kilometres Driven and Drivers Involved in Collisions by Age Group



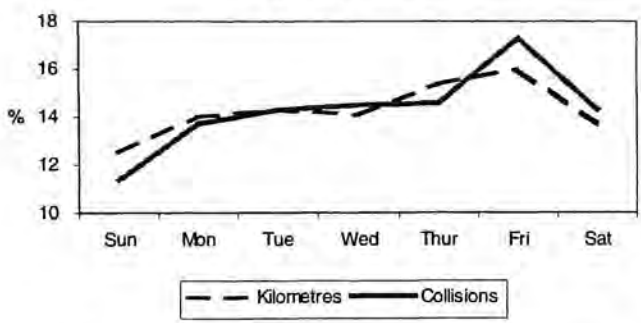
Sources: Transport Canada, Collision Statistics, Special Tabulations 1999
Statistics Canada, Canadian Vehicle Survey, Transportation Division, 2000

[8] Data for collisions by age includes all drivers of light vehicles providing that at least one person (driver, passenger or pedestrian) in the collision was injured or killed. Drivers from different vehicle types, such as heavy trucks are excluded from these collision statistics.

Fridays remained dominant day for traffic and collisions

Friday, the busiest day of the week for distance driven, was also the day of the week that the highest percentage of traffic collisions occurred. Volume could have a direct effect on the number of collisions. However, the number of collisions on Fridays accounted for a slightly higher percentage than the percentage of distance driven. Throughout the rest of the week, collisions and kilometres driven followed almost an identical trend.

Chart 4: Percentage of Kilometres Driven and Collisions by Day of Week



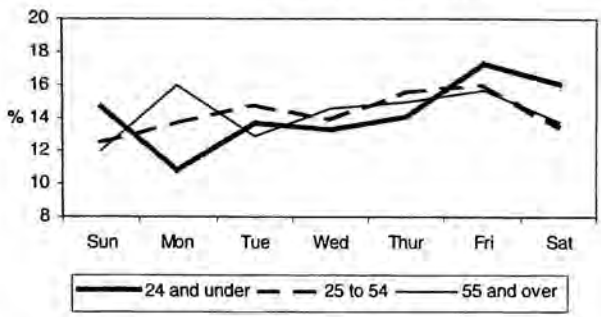
Sources: Transport Canada, Collision Statistics, Special Tabulations, 1999
Statistics Canada, Canadian Vehicle Survey, Transportation Division, 2000

Younger drivers drove more on weekends than older drivers

The majority of distance driven by the younger age group occurred during the weekend (Fridays, Saturdays and Sundays, 48%). The busiest three-day period of driving for persons aged 55 and over were Wednesdays, Thursdays and Fridays (45%). The least amount of driving for the younger age group occurred on Mondays (11%). Interesting enough, this was the same day that the older age group incurred the highest percentage of driving in terms of distance (16%).

The next highest day for distance driven by the older age group also fell on Friday, the busiest day of the week.

Chart 5: Percentage of Kilometres Driven by Age Group and Day of Week, 2000



Source: Statistics Canada, Canadian Vehicle Survey, Transportation Division, 2000

Collisions involving younger drivers moved in opposite direction

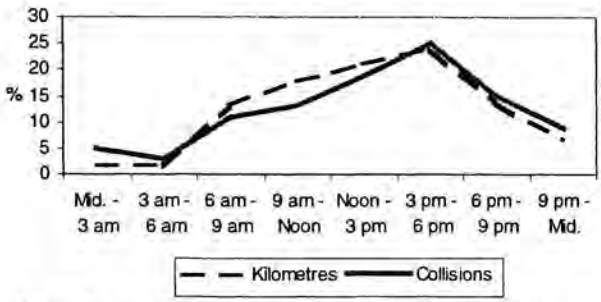
Younger drivers were involved in the majority of their collisions (46%) during the weekend (Fridays, Saturdays and Sundays) while older drivers followed a similar pattern to those aged 25 to 54 whose collisions (41%) were lower during the same three day period.

Highest percentages of driving and collisions occurred during the same times during the day

As was the case with day of the week, both collisions and distance driven also followed very similar patterns when it came to time of day. It would be expected that the majority of accidents would occur when driving was at its highest levels. Almost one quarter of all driving and collisions occurred during the hours of 3 p.m. and 6 p.m.

Noon to 3 p.m. was the next busiest period accounting for approximately 20% of both distance driven and collisions.

Chart 6: Percentage of Kilometres Driven and Collisions by Time of Day



Sources: Transport Canada, Collision Statistics, Special Tabulations, 1999
Statistics Canada, Canadian Vehicle Survey, Transportation Division, 2000

Younger drivers followed similar pattern of those aged 25 to 54

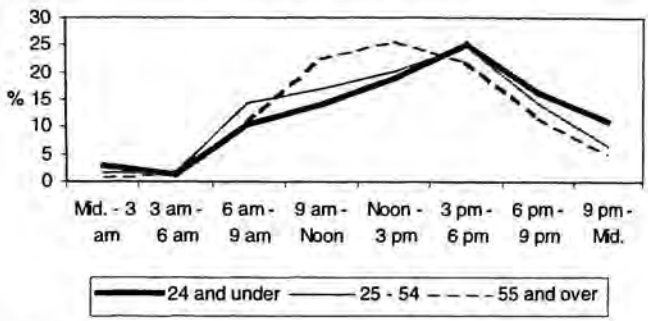
The highest time period for distance driven by younger drivers followed a similar pattern to that of drivers aged 25 to 54 years. The majority of distance driven by younger drivers fell between the hours of noon and 6 p.m., the same time period when young drivers encountered the majority of their collisions. Older drivers, on the other hand, drove more between 9 a.m. and 3 p.m.

Time collisions occurred followed similar pattern for all age groups

The time of day that collisions took place followed a similar pattern for all age groups. Similar to that of total collisions, all drivers were involved in the majority of collisions between 3 p.m. and 6 p.m., followed by noon and 3 p.m. The lowest percentage of any driver group involved in collisions took place overnight (between 9 p.m. and 6 a.m.), when the older age group was involved only 7% of the time.

There were more young drivers involved in collisions during the late hours of the evening and early morning than any other age group (19% between 9 p.m. and 3 a.m.).

Chart 7: Percentage of Kilometres Driven by Time of Day and by Age Group, 2000



Source: Statistics Canada, Canadian Vehicle Survey, Transportation Division, 2000

Table 1
Percentage of Drivers Involved in Collisions, by Time of Day, by Age Group, 1999

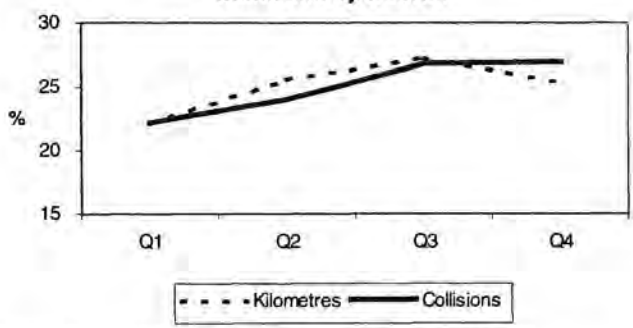
	16 - 24	25 - 54	55 and over
		%	
Mid. - 3 am	7	3	1
3 am - 6 am	4	2	1
6 am - 9 am	9	13	8
9 am - Noon	9	13	20
Noon - 3 pm	17	19	26
3 pm - 6 pm	25	27	28
6 pm - 9 pm	17	15	12
9 pm - Mid.	12	7	5
Total	100	100	100

Source: Transport Canada, Collision Statistics, Special Tabulations, 1999

Seasonal data reflected similar patterns between collisions and driving

Over 27% of the total kilometres driven were driven in the third quarter of the year (July, August and September). Furthermore, the least amount of distance driven was performed in the first quarter of the year (January, February and March) when Canadians would encounter inclement weather conditions. Although the pattern was quite similar with collision statistics, one might have expected that the same inclement weather conditions would cause significantly more collisions. This however was not the case. In fact, collisions and kilometres driven, in the first quarter, both represented 22% of their respective totals. Although there were 22% more kilometres driven in the third quarter compared to the first quarter, there were also 20% more collisions.

Chart 8: Percentage of Kilometres Driven and Collisions by Quarter



Sources: Transport Canada, Collision Statistics, Special Tabulations, 1999
Statistics Canada, Canadian Vehicle Survey, Transportation Division, 2000

Younger and older drivers followed similar seasonal pattern

All age groups drove more in quarters 2 and 3 than quarters 1 and 4, with the young and older age groups favouring the former period slightly more.

Table 2
Total Kilometres Driven by Quarter, by Age Group, 2000

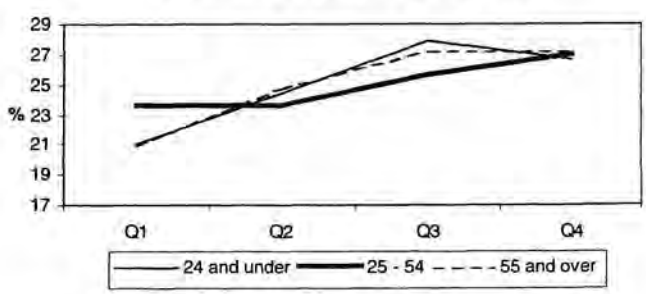
	24 and under	25 to 54	55 and older	Total
		%		
Q1	23	22	24	22
Q2	26	25	26	25
Q3	27	27	27	27
Q4	24	26	23	25

Source: Statistics Canada, Canadian Vehicle Survey, Transportation Division, 2000

Collisions by all age groups followed similar seasonal pattern

The percentage of drivers involved in collisions followed a similar pattern, between age groups, to that of the annual breakdown. Some differences could be seen, however, in the first and third quarters. In the first quarter there were fewer younger and older drivers involved in collisions than drivers aged 25 to 54 while the opposite was true in the third quarter.

Chart 9: Percentage of Drivers Involved in Collisions by Quarter and by Age Group, 1999



Source: Transport Canada, Collision Statistics, Special Tabulations, 1999

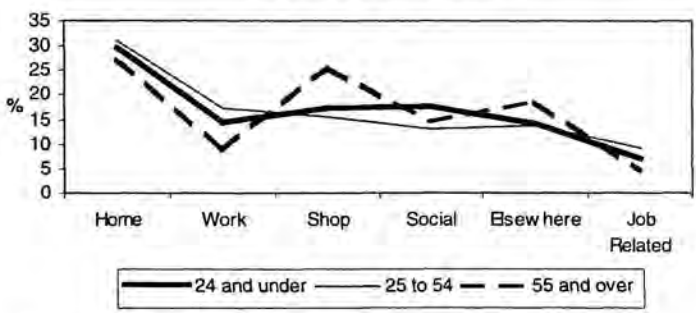
Majority of kilometres driven were destined for home

Over 30% of the total distance driven returned home. Trips to go shopping or run errands accounted for the second highest amount of kilometres driven at 18% followed by trips for work purposes with 15% of the total distance traveled.

Older drivers drove more to shop and less to work

Returning home was the main destination for driving for all age groups. This accounted for approximately 30% of their respective distances driven. Younger drivers followed a very similar pattern to that of drivers aged 25 to 54 where the remaining trip destinations were more evenly distributed.

Chart 10: Percentage of Kilometres Driven by Trip Destination and by Age Group, 2000



Source: Statistics Canada, Canadian Vehicle Survey, Transportation Division, 2000

Older drivers, however, drove more to shop and this accounted for over one quarter of their distance driven. For older drivers this was almost as high a destination for driving as returning home.

Conclusions

- Older drivers drove more than younger drivers, which was not surprising, given that the older age group accounted for relatively double the population and number of licensed drivers. More interesting was that although the older age group drove three times the distance than the younger age group, there were 50% more younger drivers involved in collisions.

- While Canada's population and number of licensed drivers have been steadily increasing over the past decade, the number of collisions on Canada's roads has declined.

- Collisions and vehicle-kilometres followed similar patterns despite vehicle-kilometres increasing and collisions declining.

- Males dominated every age group for number of licensed drivers, collisions and distance traveled. The older the population gets, the more males accounted for licences, collisions and more particularly for kilometres driven.

- Both distance driven and number of collisions followed similar patterns by day of week and by time of day. Fridays were the busiest day of the week and late afternoons were the busiest time of day for distance traveled and collisions.

- Younger drivers drove more on weekends with Friday being the busiest day while older drivers drove more on Mondays. Fridays were also the busiest day in terms of collisions, which may explain the high proportion of younger drivers involvement.

- In terms of why people drive, older drivers drove more to shop and less to work than younger drivers. Younger drivers, like the majority of the population, drove more for social and recreational purposes than to work or shop.

Appendix A

Data Sources

1. Estimates of Population, by Marital Status, Age Group and Sex, Canada, Provinces and Territories, Annual, 1991 – 2000, Demography Division, Statistics Canada, CANSIM II Table: 051-0010.

2. Number of Licensed Drivers by Gender and by Age, Canadian Motor Vehicle Traffic Collision Statistics, Transport Canada, 2000.

3. Canadian Motor Vehicle Traffic Collision Statistics, Transport Canada, 1999.

4. Canadian Vehicle Survey, Transportation Division, Statistics Canada, 2000

Note:

The views and opinions expressed in this paper are those of the author and do not necessarily reflect those of Statistics Canada. I would like to thank John Ross, Wendy Christoff, Mike Fahey and Shannon Foley for their valuable assistance, comments, corrections and criticisms. I would also like to thank the Motor Vehicle Traffic Collision Statistics section of Transport Canada for their assistance and all collision statistics special tabulations used in this paper.

Using GIS to Monitor the Impact of Changes in Policy and Industry Structure

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INTRODUCTION

Geographic Information Systems (GIS) are technical mapping applications that can be applied to the transportation function. These systems are driven by complex database sets that are linked to computer mapping software. Integrated geographic database sets are large and can combine data on a broad basis such as a geographic region, county or country, or as specific as a single point location. The database sets are multi-dimensional containing demand and supply parameters of the region or the specific location such as a city, town, production facility, terminal, or a customer. The application of GIS to evaluate logistics and supply chain dynamics will strengthen the role of the decision-makers. GIS has been applied to various applications such as environment, marketing, site location, real estate, and economic development among others. GIS systems can monitor and evaluate trends and changes in distribution systems. This

provides increased knowledge of change and the factors of change so that the decision-maker can plan accordingly.

This paper illustrates the usefulness of GIS to monitor the impacts of changes in policy and in industry structure. I will show how GIS can be used to examine the impact of changes in transportation policy on the Canadian grain handling and transportation system. Another benefit of GIS is that it can be predictive. I will show how GIS can be used to analyze the impacts of mergers between grain companies.

MONITORING IMPACTS OF POLICY CHANGES

On May 10, 2000 the Federal Government of Canada announced that it would reform the Western Canadian grain handling and transportation system effective August 1, 2000. The announcement was the culmination of the review of the grain handling and transportation system in a post WGTA environment that began with the recommendations by Honourable William Estey and "operationalized" by Arthur Kroeger. The reform package, in brief, was as follows:

- **Revenue Cap**: As of August 1, 2000, CN and CP will be subject to a cap on their revenues from grain traffic. For the 2000/01 crop year the cap is set at $810 M on a 30 M tonnes movement.

- **Rural Roads:** The federal government will provide $175 M over the next five years to compensate for the expected decline in rural roads that is anticipated to occur because of these reforms.
- **The Role of the CWB:** The CWB will tender the logistics of at least 25% of its shipments to Canadian ports in 2000-01 and 2001-02 and tender at least 50% of its shipments in 2002-03.
- **Final Offer Arbitration:** For disputes under $750,000 Final Offer Arbitration will have a simultaneous offer system with a summary process. A simplified process will be introduced for disputed freight charges of less than $750,000 that will shorten the process to 30 days or less.
- **Enhanced Competition:** Measures to enhance competition between railways such as joint running rights and regional railways will be examined in the review of the Canada Transportation Act.
- **Branch Lines:** The Canada Transportation Act will be amended to facilitate the transfer of grain dependent branch lines to communities. Railways will be required to pay affected communities $10,000 annually for three years for each mile abandoned. After a segment of a branch line is transferred to a short line railway, the railway must operate the remaining segment for at least three years.

- **Monitoring:** The Government will establish a mechanism put in place by a private sector third party to monitor the impact of the reforms and the overall performance of the grain handling and transportation system.

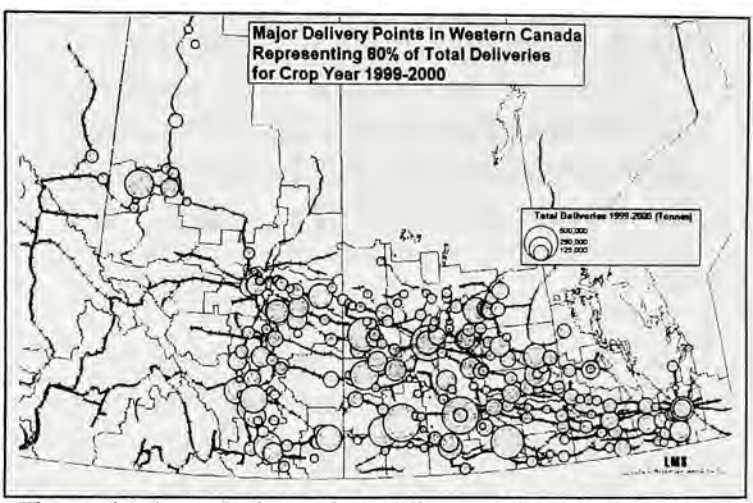
This section of the paper illustrates **how GIS can be used to monitor the impacts of the reforms** and the overall performance of the system. Transport Canada has established performance indicators and hired an independent third party to monitor the evolution of the system. [1] GIS is used to develop performance indicators for the base year, 1999-2000, for the following components of the monitoring program:

1. Industry Overview
2. System Efficiency
3. System Performance

[1] See www.tc.gc.ca for complete information on the monitoring program.

Example GIS: Industry Overview:

Slide 1: Number of Elevators accounting for 80% of Total Producer Deliveries



The monitor is required to evaluate different performance indicators, such as the concentration of deliveries over time. Thus the monitor and others need to understand if the volume of deliveries is concentrating in fewer locations over time. The indicator to evaluate this trend can be illustrated by showing those locations across western Canada that accounted for 80% of deliveries.

The Monitor needs to understand shifts in crop production across the Prairies because this may change where deliveries are made in the

system. GIS can illustrate the shifts in crop production over time. In order to evaluate the change in crops we compared the change in acres over time using crop district acres analyze using **location quotients.** [2] For a comparison of crop production shifts over the 1990's readers are referred to a study by Thompson and Spearin. [3]

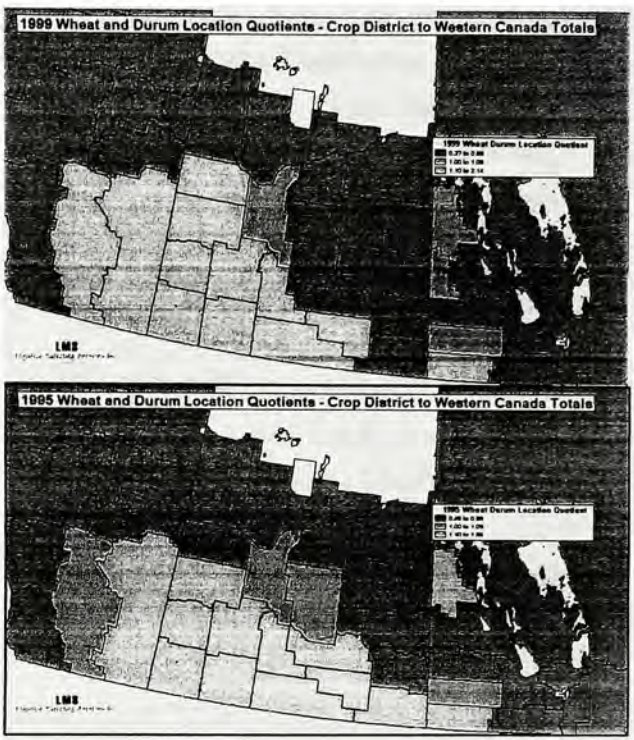
- A quotient less than 1 indicates a lower level of intensity for the crop district relative to the prairies.
- A quotient approximately around 1 indicates the same level of intensity at the crop district level as at the prairie level.
- A quotient greater than 1 indicates a higher level of intensity.

The following two slides show the crop district location quotient maps for wheat and durum in the 1995 and 1999 crops years.

Slide 2 & 3: Wheat & Durum

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[2] For example, the location quotients for what and durum is calculated as the share of wheat and durum acreage at the crop district level relative to the share at the prairie level.
[3] S J Thompson and D Spearin, "An evaluation of the Western Grain Transportation Reform Package", CAES Meetings, Chicago, 2001.



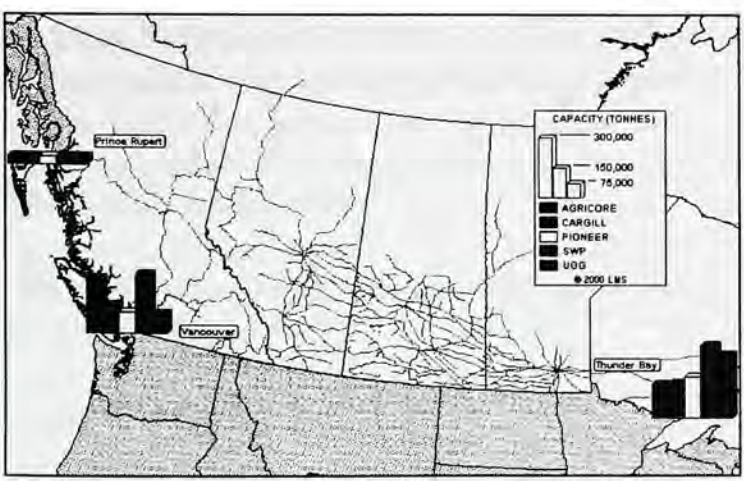
Since 1995 and particularly after the change in freight rates, production of **wheat and durum** in the prairies has shifted westward.

MONITORING THE IMPACT OF CHANGES IN INDUSTRY STRUCTURE

GIS can also be applied to create What If Models to **predict** the impacts of change. The following slides illustrate the use of GIS to evaluate grain mergers between companies and the resulting shifts in volumes and competition both at the ports and inland.

GIS can show where current infrastructure by grain company capacity at the port of export. Changes in capacity may alter competitiveness of grain companies that are tendering for CWB grains at the port.

Slide 4: Port Capacity by Company



Mergers in the country would alter inland terminal draw areas and further rationalize the system. GIS can illustrate where grain would flow and be collected between companies. GIS can show overlap of sites or where there is an apparent lessening of competition across Western Canada if certain companies merged. The Canadian Competition Bureau must approve large-scale mergers. The impact of the merger on competition is examined extensively in the review. Using our GIS-based model, we analyzed two merger scenarios. In each case we calculated the resulting handling volume at highthruputs and estimated possible volume shifts between railroads.

The base data shown in Table 1 shows estimated grain deliveries and markets shares based on capacity. The following examples used data from Canadian Grain Commission for the reported capacity and deliveries for the crop year 1999-2000 as published August 1, 2001.

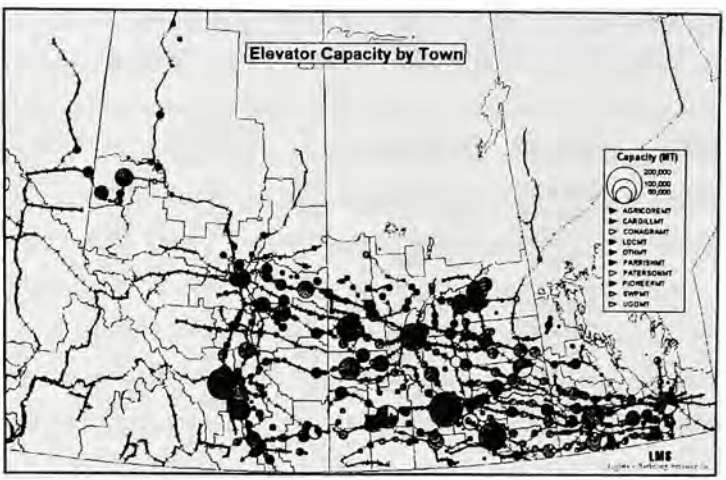
Table 1: Industry Allocation of Deliveries, Capacity, Locations

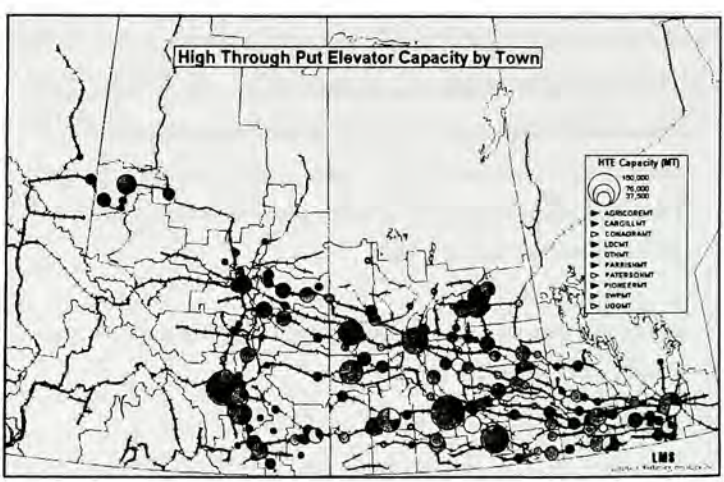
RECIEVER	1999-2000	Capacity(MT)	%	Number of Elevators	%	Number of High Thru Puts	%
Agricore	6,893,000	1,555,970	23%	243	29%	49	23%
Cargill	3,064,000	523,230	8%	54	6%	17	8%
Conagra	675,000	125,420	2%	4	0%	4	2%
LDC	1,000,000	311,980	5%	13	2%	11	5%
Other	2,268,000	566,990	8%	25	3%	15	7%
Parrish	1,200,000	251,110	4%	23	3%	12	6%
Paterson	1,400,000	289,240	4%	49	6%	7	3%
Pioneer	3,556,000	540,630	8%	82	10%	20	10%
SWP	8,290,000	1,844,600	27%	250	29%	48	23%
UGG	4,465,000	817,870	12%	105	12%	26	12%
Grand Total	32,865,000	6,827,040		848		209	

Source: CGC, LMS 2001

In our analysis we assumed that in order to create efficiencies to the system only the larger highthruput elevators would be kept open and that this would represent the future state of country inland terminals. Thus, there would only be 209 delivery positions as compared to the 848 positions as of August 1, 2001.

Slide 5 and 6 compare the relative change in elevator capacity from Current to Future large sites.

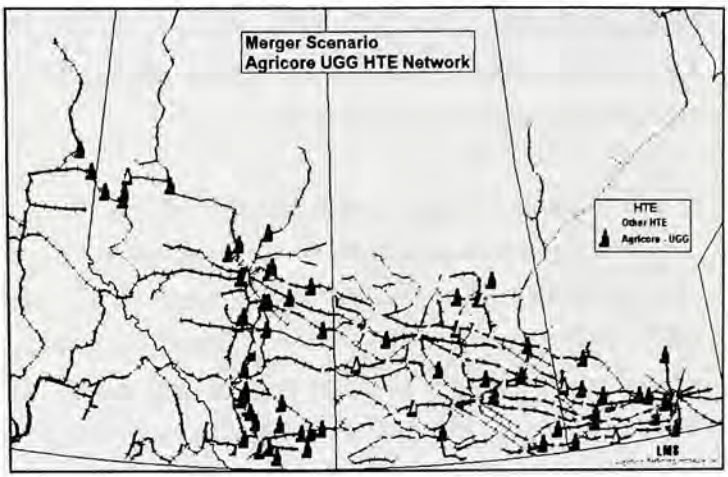

Elevator Capacity by Town
Capacity (MT)
200,000
100,000
50,000
AGRICORE MT
CARGILL MT
CONAGRA MT
LDC MT
OTH MT
PARRISH MT
PATERSON MT
PIONEER MT
SWP MT
UGG MT
LMS


High Through Put Elevator Capacity by Town
HTE Capacity (MT)
150,000
75,000
37,500
AGRICORE MT
CARGILL MT
CONAGRA MT
LDC MT
OTH MT
PARRISH MT
PATERSON MT
PIONEER MT
SWP MT
UGG MT
LMS

Smaller elevators would close, leaving larger sites clustered around the major source points. The above slides also show by colour code the individual company locations and relative capacity in each location if there are two or more companies.

If grain companies merged, rationalization would occur as the companies eliminated duplicate sites. We also evaluated where tonnes could be shifted between rail carriers once companies merged to indicate competitive shifts. We used GIS to identify those elevators within 60 km of each other located on the competing railroad. Of the 209 Highthruput locations, there are 116 sites that are within the 60 km competitive area. We used 60 km as a benchmark which represents 30-35 minutes extra driving time. Any number, however, could be used. In our comparisons we used delivery data allocated only to highthruputs to predict volumes that can be competitive to another rail company.

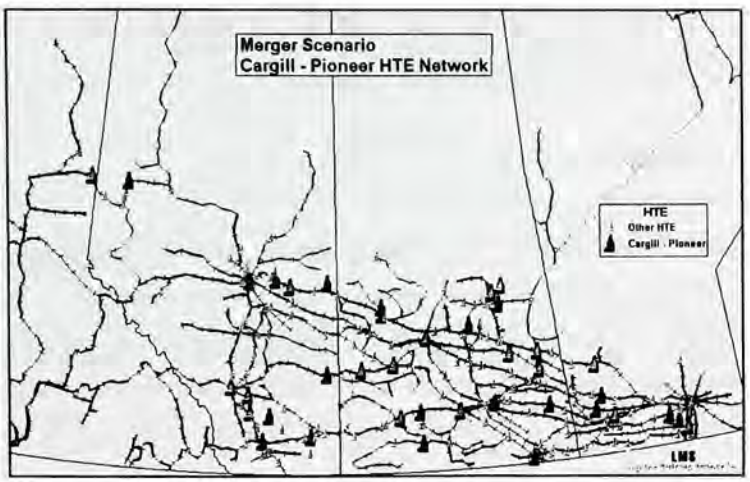
Slide 7: Shows Merger Scenario between Agricore and UGG.



The merger between Agricore and UGG was announced in late 2001. The above slide shows the new network of highthruputs in relation to rail and other grain companies. Using GIS we estimated some outcomes of this merger:

- Total Highthruputs 75
- Estimated Volume 5.5 million tones
- Highthruputs Capacity and Locations of UGG and Agricore:
    - CN 455,000 tonnes , 31 sites
    - CP 686,000 tonnes , 32 sites
    - Tonnes that could shift 2,900,00
    - Volume split evenly between CN-CP

Slide 8 shows the merger scenario of Cargill and Pioneer.



The above slide shows the new network of highthruputs in relation to rail and other grain companies if Cargill and Pioneer merged. Using GIS we estimated some outcomes of this merger:

- Total Highthruputs 36
- Estimated Volume 3.2 million tones
- Highthruputs Capacity and Locations of Cargill and Pioneer:
    - CN 340,000 tonnes, 21 sites
    - CP 246,000 tonnes, 15 sites
    - Tonnes that could shift 2,000,000
    - Volume is split 1/3 to 2/3 between railroads

GIS can also be further integrated into cost databases to show other operating synergies of mergers. The following are examples of GIS at a point in time and any new changes since August 2001 would change some of the findings.

Conclusion

We have illustrated some applications of GIS for transportation functions and there are many more that are not described in this paper. GIS can be used to synthesize information and allow interested parties to monitor the impacts of policy change. GIS can also be used as a predictive tool in the evaluation of mergers and acquisitions.

Commercial Ports and Urban Activities
Conflicting Perspectives

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Introduction

The spatial and function separation of commercial ports and urban activities is a controversial issue in many of the world's major ports. As commercial port operations move downstream in search for deeper water and additional landside storage, under-utilized or abandoned central city port areas are being rejuvenated for water-related urban activities, including retail, residential and recreational pursuits. Waterfront rejuvenation began in North American, where "in the 1960s and 1970s, the United States and Canada were the cradles of the waterfront-redevelopment movement."[1]

The most emulated waterfront redevelopment project is Boston's Faneuil Hall and Qunicy Market. This project created a prototype of the "festival marketplace" (an explicitly recreation-oriented "people place") that has been reflected in other waterfront redevelopment schemes. Douglas Wrenn described Baltimore's Harborplace, modelled after Faneuil Hall, as:

> a shopping experience, even if it is first an experience of the sights and sounds of the marketplace, of ships in the harbor besides which it sits, of the colorful pavilion-like quality of the buildings themselves, and of the street performers and musicians who add to the fair-like atmosphere.[2]

Numerous North American waterfront projects have been developed including: Boston's Charlestown Navy Yard, Battary Park City in New York, Laclede's Landing in St. Louis Missouri, The Embarcadero in San Diego, and Fisherman's Wharf in San Francisco. Canadian ports have witnessed similar developments including: Historic Properties in Halifax, Market Square in Saint John, *Le Vieux Port* in Montreal, Toronto's Harbourfront, and Gastown in Vancouver.

Not only is urban-oriented development occurring on the land-side, but there are increasing numbers of recreational boaters operating in commercial shipping channels and harbours. Given significant differences in relative size and handling characteristics of commercial ships and recreational boats, conflicts in these restricted waters are bound to occur.

This paper considers the evolution of Canadian ports and the effect of their downstream re-location on urban waterfront development and the increasing conflicts between commercial shipping and recreational boating.

Pressures for Waterfront Renewal

The opportunity for urban waterfront renewal was created by three interrelated factors: changes to cargo-handling technologies (containerization, specialized bulk handling terminals, and intermodalism), spatial needs of modern ports (increased storage space and deeper water), and the economic impact of declining port-related employment. The division between the central city and its commercial port was reinforced by the port's downstream migration. A classic example is London's relocation of all its commercial operations to its downstream terminus at Tilbury. Similar examples can be found in almost all major ports, such as Rotterdam and the almost complete conversion of Sydney Harbour to a recreational boating and cruise ship facility. Sydney's commercial terminals are relocating to nearby Botany Bay.

There has been growing public awareness of the value of the water's edge. Improving the waterfront often served as a catalyst for revitalizing adjacent city centres. Saint John's Market Square is a prime example. Although urban planners understand the importance of an urban focussed waterfront, port authorities typically do not, "port authorities often tried to hold onto the [waterfront] property, proposing new marine uses, such as a superliner terminal in New York or new general cargo facilities in London."[3] Water front land is a non-renewable resource. Port authorities typically try to retain their waterfront holdings for cargo-handling. Their resistance to converting waterfront lands to urban activities has paid dividends in recent years with the rise of cruise ship traffic. These large passenger ships typically seek berths close to city centres to better serve their onboard clients.

Canadian Port Redevelopment

The linkage of port and city is a historical reality. During the 20th century this linkage has been increasingly severed. Ports required both large land areas for storing cargo carried on increasingly bigger ships and deeper water with extensive vessel manoeuvring areas. As land acquisition costs soared in the urban areas adjacent to modern ports, port authorities were forced to develop downstream alternatives.

The separation of commercial docks and the city began in Saint John in the late 19th century and in Halifax in the early 20th century. As railways developed and required more land for their activities, the port of Saint John first moved to the west side of the harbour and later into Courtney Bay (shipyards and other related port activity). Similarly in Halifax, railway land requirements led to the development of Ocean Terminals and railyards to the east of the traditional waterfront. The larger land area requirements for containerisation in the 1970s forced both Maritime ports to develop container handling facilities by infilling older finger piers. Saint John's long term plan for cargo-handling in the west harbour involves converting under-used finger piers into marginal wharfs and developing further downstream towards Partridge Island at

the harbour entrance. Halifax is considering major new container terminals either in Bedford Basin or across the harbour at the former Canadian Forces Base Shearwater.[4]

At Montreal, growing urban pressures in *Le Vieux Port* coupled with demands for waterfront access and retention of scenic views of the St. Lawrence River led the port to abandon its initial work on a container terminal and move downstream to the Racine Terminal. The Montreal Port Authority subsequently acquired the former provincial port of Contrecoeur as the site of its next container terminal located about 40 km downstream.

The Oshawa Port Authority has found itself facing a potential major residential and recreational development on the west side of its harbour. As recently pointed out by the port manager, the *Oshawa Harbour Urban Design Study* "was prepared without any input from the port."

In one of Canada's more controversial waterfront development projects, the former Toronto Harbour Commissioners (THC) converted under-used port lands near the city centre to other urban activities. The port had seen its fortunes wane as its international shipping declined due to ship size limitations in the St. Lawrence Seaway. By the mid-1960s, Toronto's commercial port activities had moved eastward to land-filled industrial sites near the Don River leaving the central city waterfront area filled with decaying facilities. In the 1970s, THC's operating revenues were not covering expenses and its debt increased. Financial difficulties forced the THC to develop a new strategy - developing residential and commercial projects on their lands closest to the city's downtown. An agreement between THC, the City and a private developer led to the construction of Harbour Square, a dense urban complex of a hotel and several residential towers. In subsequent years, the THC launched other projects, the most dramatic being the World Trade Centre comprised of three 26-storey office towers, two residential towers (25 and 32 storeys) and several low-rise connecting buildings.

The Vancouver Port Authority (VPA) has operational problems due to extensive urban development in Burrard Inlet. In the 1960s, the port developed a deep water coal terminal at Roberts Bank to the south of the

city. In the 1990's, rapid container throughput growth led to the development of a new container terminal (Deltaport) at Roberts Bank. In the earlier planning stages, VPA had a challenge in raising its share of the capital funds for Deltaport. One revenue generating solution involved the long term lease of 42 hectares of under-used port land near the city centre. VPA called for site development proposals based on the provision of a two berth cruise ship terminal and a variety of urban-oriented facilities such as a convention centre, hotels, offices, retail and residential. In 1994, the VPA accepted a proposal to construct a $750 million waterfront gambling casino combined with a 1,000 room hotel-convention centre. For its share, VPA was to receive a $60 million cruise ship terminal and a $30 million payment for the right to develop the project on port lands. Political concerns and a public outcry over the proposed casino led to the subsequent shelving of the project.

Today, the VPA faces renewed threats to its various container and bulk handling facilities in Burrard Inlet. Political pressures are rising to convert port-related industrial sites into residential and recreational uses. One local politician has called for the removal of the port from Burrard Inlet to make it into an inland recreational sea. The costs and complexities of re-locating the port's terminals from Burrard Inlet are staggering.

Port Land-side Survey

Conversion pressures on Canadian ports from nearby urban muncicpalities is occurring in many locations. A recent survey of the 19 major commercial ports designated as Canada Port Authorities (CPA) under the *Canada Marine Act* showed that 70 percent of them are experiencing urban pressures to convert commerical waterfront land to other uses. The most common alternative use cited was public access to the waterfront, followed by demands for residential use (high rise and townhouses), parks, recreational walking trails, and waterfront roads. Some of the port managers' comments about water front conversion include:

> The most significant pressure is from adjacent municipalities and their Official Community Plans. These excercises tend to be driven by public opinion, hence parks and access to the waterfront become high priority, high profile issues.
>
> [There is] a complete lack of understanding by the communities that their port serves the interests of 6 million Canadians, not just them, and their actions/requests can have a severe detrimental effect on families/communities 2-3,000 km away.

These comments echo an earlier study that found urban planners and municipal councils more interested in waterfront rejuvenation as a support to city centre revitalization while port managers focussed on redevelopment for commercial cargo-handling and shipping services.[5] Urban planners tend to seek the "highest and best" uses for land. In the community *versus* ports debate, there needs to be a clear understanding of local *versus* regional concerns as well as short *versus* long term implications. The country's national transportation system cannot afford a myopic view that supports a localized, short-term but politically popular process that is detrimental to long term cargo-handling security.

The recent *Canada Marine Act* changed the financial basis of commercial ports. CPAs are no longer eligible for federal support, but rather are expected to be financially viable and borrow needed funds from commercial lenders. They cannot use federal ports lands as collateral for their loans, only the revenues generated from the use of these lands.[6] This change has led many CPAs to seek redevelopment opportunities for under-used sites to generate revenues to support capital project.

Port redevelopment plans include recent proposal calls in St. John's to develop the harbour's tourism potential and Halifax's Seawall project to revitalize under-used transfer sheds and marginal wharfs. Other Canadian ports are involved in local plans to increase waterfront access and convert port lands, including developing a harbour front walking

trail in Saint John, the Reichmann's proposed waterfront Technodome project in Montreal, Vancouver's quest for a third cruise terminal and ancillary activities, and the continued threat (evident during the recent Olympic Games bid) to convert the Toronto Port Authority's (TPA) remaining industrial lands to residential and recreational uses.

Waterfront Rejuvenation

Rejuvenation has occurred on portions of waterfront lands in Canadian ports. In some cases, the port authority was involved in leasing land, in other situations, waterfront land was transferred to other agencies (either public or a public-private partnership) for development.

In Halifax, the 1976 creation of the Waterfront Development Corporation sought to revitalize the downtown waterfronts of Halifax and Dartmouth. The primary focus was the restoration of Historic Properties - a shopping, dining, and office complex extending along the central waterfront to encompass the Dartmouth ferry terminal and the Maritime Museum.

Public-private partnership was the key to developing Market Square on Saint John's central waterfront. It was designed as a catalyst for the revitalisation of much of Saint John's decaying urban core. This mixed use complex involved a partnership of federal, provincial and municipal governments with a private developer. Modelled after Boston's Faneuil Hall, Market Square is a low-profile, people-oriented project atop a re-built waterfront pier. The site contains a hotel, convention centre, residences, retail, library, and provincial museum. Although Market Square had a positive impact on revitalizing Saint John's uptown area leading to the further development of retail facilities, an aquatic centre, and the Harbour Station hockey arena, it was not a success for the private developer. The public-sector partners achieved their goals of revitalization and recouping their investments through taxes, while the private developer was eventually bankrupted over the high carrying costs of the project's 66 year lease.[7]

Concerns about maintaining public access to Toronto's waterfront led the federal government in1972 to acquire 40 hectares of waterfront land in the west end of Toronto Bay for an urban park. In 1978, the federal government created the Harbourfront Corporation to develop the site on a cost recovery basis. Harbourfront's plan for mixed land uses including residential, commercial and recreational was seen as a significant shift from the initially proposed waterfront park. Over time, as Harbourfront's financial burden grew and government subsidies declined, they focussed on urban land development constructing several high-rise buildings on the site. Public concerns about the growing wall of tall buildings along the waterfront led the City to impose a development freeze. In 1989, a recommendation of the Royal Commission on the Future of Toronto's Waterfront led to the dismantling of the Harbourfront Corporation and designating the remaining waterfront land as parks.

Commercial Shipping *versus* Recreational Boating

In many ports in the developed world, there is the growing potential for conflict in harbour and channel use between commercial shipping and recreational boating. This conflict is particularly exacerbated by the significant differences in size and handling characteristics of these two types of water craft. One can witness the difficulties larger container ships experience travelling through Halifax harbour towards the Fairview Terminal in Bedford Basin on a pleasant summer weekend. Many smaller craft dart across the larger ship's bow forcing the pilot to blow the steam whistle almost continuously to make passage. Similar incidents can be seen on the west coast where BC ferries are forced to make emergency stops as larger recreational boats meander across the ferry's bow.

One pilot has commented that it is extraordinary that automobile drivers are licensed before being able to drive on the highway, but boaters, who manoeuver larger, expensive, and more difficult to handle water craft, are often free to do so with little or no training nor licensing

requirements. Larger ships, due to their size, weight, momentum and limited manoeuverability, particularly in narrow channels and restricted harbours, are often unable to get out of the way of smaller boats. In addition, large ships often have many blind spots on their bridge leaving smaller craft near them vulnerable, "to a pilot, one of the most horrifying experiences is watching a small craft disappear from sight under the wide flaring bow of his or her ship when it is underway."[8] Typically, larger ships try to set a course and avoid deviating so that recreational boaters will know what the commercial ship is doing.

Port Water-side Survey

A recent survey of water-side conflicts found that 40 percent of Canadian ports experience problems. The types of water-side conflicts vary from Halifax's difficulties with weekend sailors to ferry and laker interactions with recreational boaters in Toronto harbour to jet-skiers jumping the wakes of larger ships in the Fraser River. A number of other water-related problems were identified in the survey including the pollution potential on fishing grounds, conflicts among different types of recreational water users (jet skiers *versus* rowers), sailboat racing, para-sailing routes and so forth.

A number of strategies have been developed by the CPAs' Harbour Masters to reduce these conflicts. These steps vary from Halifax's educational video showing the pilot's restricted view from the bridge of a large container ship, to presentations at marinas and yacht clubs, to posting notices in these facilities of harbour regulation offenders, to posting regulations on the internet, to scheduling times for different recreational craft uses in restricted waters, to banning recreational boaters in the inner harbour, to requiring permits for specific water-related events such as sailboat racing.

Waterfront Development and Harbour Issues

The redevelopment of waterfront lands continues to be controversial. The *Canada Marine Act* requires Canada Port Authorities to be

financially self-sufficient, contribute annual stipends to the federal government based on their gross revenues, and increase their property tax payments as Payments in Lieu of Taxes (PILT) to adjacent municipalities. The need for revenue generation is forcing many CPAs to focus on non-port related land development. In turn, this adds another challenge for port managers. Their primary role continues to be providing efficient cargo throughput. Dealing with land-side urban development may cause them to stray from their primary mission. In an increasingly competitive situation, can Canada's commercial ports allow themselves to be diverted into secondary, potentially controversial and risky undertakings? Should commercial ports find other ways of dealing with this development opportunity?

The *Canada Marine Act* created barriers to the transition of under-used port lands to non-port related activities. Various federal approvals are required to change such uses, including re-negotiating the CPA's letters patent. The *Act* requires CPAs to develop a land use plan; possibly to designate surplus port lands. However, as CPAs do not normally gain from the revenues generated from the sale of such lands, it is doubtful any port lands will be declared surplus. To promote waterfront land rationalization, there may be a role for revenue sharing between CPAs and the federal government on the sale of port lands.

One of the main problems facing waterfront landowners (in many cases, the federal port authority) is the multiplicity of jurisdictions affecting their property. The federal government has jurisdiction over all water lots and the submerged lands below the ordinary low water mark while the provinces control all land use above low water. Typically, municipalities have been delegated provincial planning authority to control land use zoning, including the waterfront lands. Although the federal government is constitutionally exempted from abiding by provincial legislation, previous Ministerial directives to the Canadian ports required adherence to municipal planning requirements.

Waterfront rejuvenation is an expensive and complex process - one that requires considerable amounts of up-front capital (normally public loans or grants) and time (to convince the development industry to take

a risk on property with a previously poor image and to reflect swings in building and economic cycles).[9] Planners and developers understand the complex and political nature of urban development while port authorities may not. In the US, the Port of Oakland experienced financial difficulties in its foray into the land development business, leading to the sudden departure of the port's general manager. The key is how to blend the commercial strengths of port managers with the land development skills of urban planners to achieve appropriate and sensitive waterfront rejuvenation to rationalize the use of this increasingly scare land resource.

Waterfront land rejuvenation in Toronto continues to be controversial. Earlier, the THC shifted its focus from commercial port operations to waterfront land development. This land development thrust was identified by the Royal Commission on the Future of the Toronto Waterfront in its recommendation that:

> The federal government should enact amendments to the *Toronto Harbour Commissioners Act, 1911* necessary to consolidate all THC terminal activities on approximately 40 hectares (100 acres) of land .... The balance of THC lands should be transferred....[10]

The port lands were subsequently consolidated in the western portion of the industrial district in the eastern harbour. In late 1991, the THC negotiated the transfer of lands considered to be surplus to port requirements to the Toronto Economic Development Corporation (TEDCO). TEDCO had been created as a separate municipal corporation in 1982 to create industrial jobs, particularly on under-utilized or surplus city property. As the THC relied on the lease revenues from the transferred lands to cross-subsidize its port operations, the agreement called for TEDCO to provide an operating and capital subsidy to support the port's remaining operations, if necessary. In addition, TEDCO took the lands "as is" with the burden of environmental clean-up (particularly soil remediation) prior to future

development. The THC, now the Toronto Port Authority, was left with a mere 55 acres of land for its operations.

Toronto's waterfront plans continue to be controversial. The recent bid for the Summer Olympics proposed virtually shutting down the Toronto Port Authority (TPA) to convert the inner harbour to recreational purposes. Commercial cargo destined to/from Toronto was to be handled elsewhere (Oshawa and Hamilton were suggested). Toronto's recent water front plan, "Making Waves: Principles for Building Toronto's Waterfront" proposes a $1.5 billion urban redevelopment that conflicts with TPA's commercial needs. The plan proposes to make the port lands a major focal point for a new mixed use community rather than an industrial port.[11] Rather than converting its current limited land holdings into urban uses, the TPA is seeking the return of 600 acres of industrial land from TEDCO along with further financial support. The TPA recently filed a Notice of Action suing the City of Toronto and specific municipal officials to regain the lands and other funds.[12]

Other port cities face similar disputes. In the Vancouver case, some adjacent municipalities are increasing their industrial property assessments to gain further property taxes from the port and its terminals. This revenue grab coupled with calls to convert Burrard Inlet to a recreational sea threaten the continued viability of the port. Alternatives must be provided for the possible relocation of various bulk and break-bulk terminals in Burrard Inlet. Possible alternatives include relocating these terminals to Prince Rupert (a significant labour and regional economic adjustment) or to new and expensive to provide facilities adjacent to Roberts Banks. Also in the Vancouver area, the Fraser River Port Authority is finding that as pulp and paper mills shut down, their waterfront industrial lands are being converted to higher value residential uses. This change in land use limits the port's ability to reuse these industrial lands for future cargo-handling activities.

On the water-side, conflicts between commercial ships and recreational boaters continue. However, steps are being taken by Transport Canada to enhance harbour regulations under the *Canada*

Marine Act to allow the CPAs' Harbour Masters to better control the situation.

Conclusions

A major challenge facing Canadian ports is municipal pressure to convert under-used waterfront lands from cargo-handling to non-port urban activities. Several Canadian waterfront projects have been undertaken with the port authority involved in the land-side development. Continued revenue requirements for CPAs is causing ports to shift their focus to land-side non-port related activities, despite restrictions in the *Canada Marine Act*. There is a need for an alternative approach to waterfront development in major Canadian port cities - one in which both CPAs and the federal government share in the revenues generated from the urban development of these surplus lands.

Improving the process of waterfront development requires improved communication and understanding between port authorities and city planners. Canadian ports serve an essential cargo-handling function that serves local, regional , and national needs. The local communities may not fully understand or appreciate this broader port function. Improved dialogue among the various parties involved is needed to ensure that Canadian ports continue to effectively serve the maritime transportation industry while releasing surplus lands for alternative waterfront development.

There are obvious conflicts in restricted channels and harbours between larger commercial ships and recreational boaters. Many of the steps being taken by CPAs and their Harbour Masters should minimize these conflicts.

Acknowledgement

I wish to acknowledge the assistance of Dirk Paul, Past Commodore of the Trident Yacht Club for his contribution to this paper during our many discussions of these issues on several Lake Ontario sailing trips.

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THE SHIPPING CONFERENCES EXEMPTION ACT: A STEP TOWARDS THE US REFORMS - BUT ARE WE MOVING IN THE RIGHT DIRECTION?

Joseph Monteiro and Gerald Robertson*

Introduction

The exemption of shipping conferences from the competition laws or antitrust laws has been the most controversial issue in ocean liner shipping since the 1990s. Despite amendments to conference laws in several jurisdictions, many critics continue to maintain that it is an archaic piece of legislation that is increasingly out of cinque with current developments in deregulation and free trade. The most recent attacks against the conference system are based on findings by a group of World Bank economists who have drawn attention to the costs of the conference system, claims by shippers' groups who are frustrated that the conference system does not benefit shippers, and litigation by the European Commission against anti-competitive behaviour by conferences. Nevertheless, the supporters of the conference system argue that time is needed to learn if the current reforms will work. Regardless of these views, as often occurs in controversial issues that cannot be resolved, the changing market structure and environment will ultimately determine if this exemption is relevant any longer for international liner trade.

Part I of this paper will examine, the *Shipping Conference Exemption Act, 1987* (SCEA), factors leading to the amendments, the recent amendments to SCEA introduced in Bill C-14 and its implications. In Part II, the major reforms of the *US Ocean Shipping Reform Act of 1998* will be examined together with its impact. In addition, the major US and Canadian reforms will be compared. In Part III, we shall briefly review if we are moving in the right direction. Finally, a few concluding remarks will be made.

I. The Shipping Conference Exemption Act, Factors Leading to

the Amendments, the Amendments and its Implications

a) The Shipping Conferences Exemption Act

SCEA formerly the *Shipping Conferences Exemption Act 1979* consists of 29 sections whose administration rests with the Canadian Transportation Agency. These provisions are described hereafter.

Exemptions from the Competition Act: SCEA exempts certain shipping conference agreements or interconference agreements from the *Competition Act*, subject to certain restrictions or prohibitions. It allowed the use of tariffs by member lines set by the shipping conference or interconference. It permitted the use of loyalty contracts provided that: all contracts may be terminated by either party at any time after 90 days notice, the differential between contract and non-contract rates would be a maximum of 15 percent of the contract rate, rebates would not be prohibited by agreement among conference members, and there would be no requirement that a shipper transport 'all' its goods by the conference. It permitted the conference to establish the terms and conditions respecting the use of service contracts. It allowed for the allocation of ports in Canada among members, regulation of times of sailings and the kind of services which shipping conference members were allowed to supply for the transportation of goods, and legalized pooling arrangements, whether of revenue or of cargoes. It also allowed shipping conferences to regulate the admission of new members and the expulsion of members from the conference thereby sanctioning closed conferences.

Restrictions on the exemptions: The restrictions on the exemptions are: 1) Failing to file agreements with the Agency; 2) Failing to provide for independent action on tariffs; 3) Engaging in or conspiring, combining, agreeing or arranging to engage in predatory pricing described in section 50(1)(c) of the *Competition Act*;[i] 4) Engaging in three specific predatory practices by shipping conferences i.e., the use of fighting ships; the refusal to transport goods for a shipper for his use of a non-conference vessel; and, the prevention or limitation of the use of port or other facilities and

services relating to the transportation of goods by an ocean carrier in Canada or elsewhere, because that carrier was not a member of a shipping conference; and 5) agreeing on multimodal rates.

Investigations: Notwithstanding the exemptions noted earlier, these exemptions have no effect on the investigative powers of the Commissioner of Competition. As the Commissioner can on his own initiative, commence an inquiry concerning the operations of shipping conferences and their effects on competition, and was to do so on direction from the Minister of Industry. Such inquiries are under the *Competition Act* and the Commissioner may take any action under it. The Commissioner, like any other person, may file a complaint to the Agency. The Agency after investigating the matter may make an order if it finds that the conference agreement or practice has specified undesirable effects. The order may require the parties or members of the conference to remove the offending feature of the agreement or stop the practice or any other order that the Agency considers necessary. The Commissioner has to be notified by the Agency of every complaint filed under s. 13(1). Furthermore, any evidence obtained in an inquiry under the *Competition Act* may be brought by the Commissioner to the Agency. This however does not affect the operation of the *Competition Act* in situations where the agreement (s) or practice of a conference or a member is not exempted under s. 4 of SCEA.

Availability of information: With a view to providing information (i.e., non-confidential), members of a conference are to maintain an office in Canada where they operate and make available to the public for inspection or purchase copies of all documents filed and in force (other than service contracts) with the Agency. Further, copies of all current tariffs and any revisions or notifications filed with the Agency are to be made available at all their principal offices for inspection. In addition, section 21 makes provision for a shipper group (i.e., Canadian Shippers' Council designated by the Minister of Transport). Members of a shipping conference are obliged to meet with a shipper group when requested in writing and to provide information sufficient for the satisfactory conduct of the meeting.

SCEA also empowers the Governor-in-Council to make regulations requiring the production of information reasonably available by members of a shipping conference to the Agency, at such times and in such form as is necessary for their effective supervision. In addition, confidential information made so available shall not be made available to any competitor.

Filing and administration: SCEA requires all members of shipping conferences to file a copy of their contracts and agreements or interconference agreements including a description of oral agreements, a copy of every service contract, changes in membership, tariffs, a copy of each loyalty contract and amendment to loyalty contracts in considerable detail with the Agency. The tariffs to be filed do not have to provide the rates on any service contract. Further, written notice of a proposed increase in a tariff shall be given to the Agency and to the designated shipper group thirty days before it becomes effective; and in the case of a surcharge or increase in surcharge fourteen days before it becomes effective. Furthermore, written notice of any proposed amendment to a loyalty contract or tariff other than a rate increase shall be given to the Agency not later than the date on which the proposed amendment becomes effective. All the documents that have to be filed are to be certified as true. The documents filed by the shipping conference with the Agency may be destroyed five years after they are no longer in effect and necessary for administration.

The Agency may direct an ocean carrier of a shipping conference to deposit with it a sum of $10,000 as financial security to ensure that the carrier would comply with SCEA and could order seizure and detention of any vessel of the ocean carrier for failure. In case of conviction of an offence under SCEA or the *Competition Act* and failure to pay any fine due to conviction, the deposit or sale of any deposited security could be used to pay the fine. Shipping conferences that failed to comply with any obligation or regulation under SCEA could be fined upto $1,000 for each offence on summary conviction. Further, when the offence is committed or continued for more than one day it shall be considered as a separate

offence. The time limitation for proceedings in respect of an offence for failure to comply is within three years from the time of the proceedings.

b) Factors Leading to the Recent Amendments in SCEA

The US Reforms: In May 1999, the US introduced major reforms relating to ocean shipping. On the one hand, Canadian Ports interpreted this development as a reason for amending SCEA as it would lead to cargo diversion to US ports. On the other hand, Canadian shippers viewed it as an opportunity for change due to the ineffectiveness of SCEA.

International Developments: In the EEC, the Council adopted a second regulation on shipping conferences relating to consortia in 1995 and adopted a stricter interpretation of the EEC regulations. It has outlawed multi-modal rate agreements, stabilization/capacity and discussion agreements and restrictions on service contracts. It has prosecuted a number of conferences and imposed substantial fines.

Major Industry Developments: Major developments have occurred in the shipping environment since the exemption to shipping conferences was first introduced in 1970. First, major developments in technology occurred: containerization, multimodal transportation and emergence of mega-sized carriers. Second, new forms of organization occurred: superconferences, consortia and joint ventures, global carrier alliances and shippers' alliances. Third, new forms of agreement have emerged: discussion and open agreements, bridging agreements, stabilization agreements and space chartering agreements. Fourth, new forms of service have emerged: multimodal, landbridge, and global services. Finally, the structure of the liner industry has shifted in favour of non-conference carriers and against conference carriers.

Initiative By Transport Canada: In early 1999, Transport Canada invited comments on SCEA. In light of these comments, Transport Canada prepared a Consultation Paper in late 1999 containing four options. The options ranged from retaining the status

quo to abolishing the exemptions. The option that it recommended was retaining the exemption for conferences while amending SCEA to include: a shorter notice period for independent action; a mandatory right to offer a service contract by a member of a conference; an end to tariff filing; electronic filing of documents; and a sunset clause. In response to submissions on its Paper, Transport Canada introduced Bill C-14, *An Act respecting shipping and navigation and to amend the Shipping Conferences Exemption Act, 1987 and other Acts*, into the House of Commons on March 1, 2001. On March 24, 2001, the Standing Committee of Transport and Government Affairs held hearings on Bill C-14.

c) The Amendments in SCEA (Bill C-14)

The amendments in SCEA[ii] can be categorized into those relating to: competition; efficiency; and administration.

Competition: The basic amendments relating to competition are: a reduction of notice period required for independent action on tariffs to five days from the present fifteen days and provision for adopting independent action on the same day; and a specific provision for mandatory individual service contracts. Mandatory individual service contracts were to be achieved by indicating that the terms and conditions established by a Conference will not have the effect of preventing a member of a conference from entering into a service contract and there will be no need for the member to give notice to the Conference of the service contract or to divulge the substance of the contract.

Efficiency: The basic amendments pertaining to efficiency are measures to provide for: filing documents electronically; deleting the requirement to file tariffs and individual service contracts; and making available tariffs electronically to the public at a reasonable price.

Administration: The basic amendment regarding administration is an increase in the fine for non-compliance to $10, 000 for each offence. Other amendments are designed to accommodate the above changes and to provide for reorganization of certain sections.

d) Anticipated Implications of the Amendments in Bill C-14

The first, a reduction of the notice period, has competitive implications since it permits shipping lines to respond to competitive action of independents and provides for a reduction of time during which a conference can dissuade a individual shipping line from taking independent action. The second, individual service contracts, has competitive implications since: it enables an individual member of a shipping line to offer a service contract at rates that differ from the conference; it is a mechanism by which shippers can arrive at agreements that are more tailored to meet their individual needs which may not have been acceptable by the entire conference; it can be used as a mechanism to compete with independent carriers; and it will enable Canadian carriers to provide agreements similar to their US counterparts. Both amendments have the effect of weakening the conference system and reducing its power because it permits an individual member of a conference to deviate from tariffs agreed to by the conference or by allowing the member to provide service contracts that may not have been approved by the conference. In addition, the proposed amendment has the effect of reducing the scope of exemption to liner shipping from the *Competition Act*, since individual members are not granted an exemption from the Act, as the exemption applies to the Conference and not to a member.

Electronic filing and electronic availability is intended to reduce the time needed for filing and easier access; and deleting the need to file is intended to remove unnecessary costs as tariffs are not enforced by the Canadian Transportation Agency.

II. The US Reforms, Its Impact and a Comparison to Canadian Reforms

a) The Major Reforms in the Ocean Shipping Reform Act of 1998

The reforms to the Ocean Shipping Reform Act of 1998 (OSRA) went into effect on May 1, 1999. These reforms can be classified into those related to: competition; efficiency; and administration.

Competition: First, the purpose clause of the Act has been

expanded to promote the growth and development of United States exports through competitive and efficient ocean transportation and placing a greater reliance on the marketplace. Second, the notice period required before a member of a conference can take independent action has been reduced to five days from the previous ten day requirement. Third, ocean common carrier agreements can no longer regulate or prohibit the use of service contracts though they can discuss and agree on any matter related to service contracts. An ocean common carrier agreement: cannot restrict a member or members from engaging in negotiations with one or more shippers; cannot require disclosure of the terms and conditions of a service contract, other than those required; and cannot adopt mandatory rules to negotiate and enter into service contracts. However, an agreement may provide authority to adopt voluntary guidelines (that must be confidentially filed with the FMC) regarding service contracts if it explicitly states that these guidelines need not be followed. Except for certain commodities, the essential terms of each service contract shall continue to be filed, however, only those terms related to origin and destination of port ranges, the commodities involved, the minimum volume or portion, and the duration shall be published. Fourth, the requirement that a service contract be made available to a similarly situated shipper has been eliminated. Fifth, no conference or group of two or more carriers may offer service pursuant to a service contract that is a unjustly discriminatory practice relating to rates or charges or give any undue or unreasonable preference or advantage or impose any undue or unreasonable prejudice or disadvantage with respect to any locality, port, or persons due to those persons' status as shippers' association or ocean transportation intermediaries. Sixth, a shipper can combine with another shipper to obtain a service contract. Seventh, an intermodal agreement by two or more ocean carriers and a non-ocean carrier are permitted if it is not in violation of the antitrust laws and is consistent with the purposes of OSRA.

Efficiency: The reforms relating to efficiency include: tariff filing elimination with the FMC; electronic publication of tariffs;

electronic availability of tariffs to the public at a reasonable price; and service contracts now based on percentage.

Administration: First, section 3 on definition was amended: to delete the definition on fighting ships and non-vessel-operating common carrier; to add a new definition on ocean transportation intermediary; and to modify the meaning of: controlled carriers, deferred rebate, forest products, loyalty contracts, marine terminal operators, service contracts and shipper. Second, the section on penalties was also modified. Section 13(a) also specified that the amount of any penalty constitutes a lien upon the carrier's vessel; section 13(b)(4) also indicated that the FMC can request revocation of clearance for vessels for failure to comply with a subpoena; and the limitation on penalties indicated that neither the Commission or any court shall order the payment of any differences in the amount set forth in any tariff or service contracts for transportation services agreed between specified parties. Third, ocean transportation intermediaries and NVOCCs must be licenced and the latter's bond has been increased. Finally, numerous other administrative amendments were also made for example, appropriations authorized for the Commission, quorum to exercise its powers and date for prescription of regulations.

b) A Comparison of the US Reforms and the Canadian Reforms

The Canadian reforms to a considerable extent mirror the reforms adopted in OSRA as these reforms were one of the factors considered in the design of the Canadian amendments. The basic similarities will first be briefly indicated followed by the basic differences, however it should always be remembered that the remainder of the two laws are not necessarily the same.

Both sets of reforms provide for: a reduction in notice period on independent action on tariffs to five days; a provision for mandatory service contracts by individual members; an elimination of tariff filing and provision for electronic filing of documents with the regulatory body; and, an availability of tariffs electronically to the public at a reasonable price. Thus at a general level, the basic

reforms are very similar.

There are a few major differences between the US and Canadians amendments. In the US amendments: 1) a service contract (SC) now has two new prohibitions (described in section (a) above); 2) a shipper can combine with another shipper to obtain a SC; 3) an agreement for multimodal rates among intermodal carriers is permitted if it is not in violation of the antitrust laws and is consistent with the purposes of OSRA; and 4) a loyalty contract is not provided antitrust immunity.

In addition, there are a number of differences in detail with respect to the provision of mandatory service contracts by individual members. Under, the Canadian proposals service contracts by individual members of a conference do not have to be filed, whereas the essential terms of these contracts (which have been reduced) have to be filed in the US. The confidentiality requirements of these service contracts in the Canadian reforms and US reforms are different. Under the Canadian amendments, a conference agreement cannot require a member to divulge the substance of a member's individual service contract nor is there any requirement for a member not to disclose it. Whereas under OSRA, an ocean common carrier agreement may not require disclosure of the terms and conditions other than those required. Further, a agreement may provide authority to adopt voluntary guidelines. In practice, how the confidentiality requirement works has largely been influenced by voluntary guidelines proposed by the Conference. For example, the TSA has mandated confidentiality for shippers but complete disclosure among carriers other than the shipper's name. This has raised doubts as to whether the confidentiality provisions will benefit the shipper in the long run.

c) The Impact of US Reforms After Two Years - The FMC Findings

On an overall basis, the FMC Report stated that after two years of operation, OSRA is generally achieving its objective of promoting a more market driven, efficient liner shipping industry.[iii] Regarding, the most important specific reform (individual service contracts)

carriers indicate that 80% or more of their cargo currently moves under SCs rather than conference tariffs. The Report also noted that discussion agreements have replaced conference agreements as the venue for carrier discussion. Further, the FMC Chairman stated that "it does not appear that discussion agreements, and voluntary guidelines in particular, are defeating the reforms put into place by OSRA."[iv] Finally, it was reported that two commissioners were concerned about carrier antitrust immunity allowed under the law.[v]

III. Are We Moving In The Right Direction?

A number of developments have occurred that suggest that we should speed up the changes that are inevitable even if the direction we are moving is correct so as to gain the full benefit of regulatory reform. These developments will be briefly reviewed hereafter.

OECD Workshop: The OECD workshop on Reform in Maritime Transport met in Paris in May 2000 to consider their discussion paper that recommended the removal of immunity from the application of antitrust laws to common rate fixing by conferences together with discussion and capacity stabilization agreements.

Shipowners (American President Lines Ltd., Council of European and Japanese Shipowners' Associations, and Korean Shipowners Association) and some governments (Japan and U.S.) supported the continuation of the exemption arguing that the current system was working and the exemptions were needed to ensure stability of services or because their government had recently amended their conference legislation. Shipper groups opposed the exemptions indicating that their needs were not always met and that the liner industry was no different from other industries that operated effectively without price fixing agreements. They also indicated that the increased use of capacity and stabilization agreements were designed to remove price competition. The Canadian Shippers' Council, the European Shippers' Council and the International Federation of Freight Forwarders Associations (FIATA) supported abolition of the exemption while the Australian, New Zealand, Netherlands, Canadian and Mexican governments, together with the

European Commission and the National Transportation League indicated that some reforms were needed. The discussion ended in a stalemate. One reason why some countries have decided to retain the immunity was the reluctance to act unilaterally which could result in conflicts of international law. The OECD Deputy-Secretary indicated that further dialogue was necessary and further work will be undertaken on common pricing, the impact of discussion and stabilization agreements and the effects of the removal of antitrust immunity.

On November 6, 2001 an interim report was published by the OECD indicating the further work completed. It stated "This review has not found convincing evidence that the practice of discussing and/or fixing rates and surcharges among competing carriers offers more benefits than costs to shippers and consumers and recommends that limited anti-trust exemptions *not* be allowed to cover price-fixing and rate discussions. It also finds that capacity agreements should be carefully scrutinized to ensure that they do not distort the markets in which they are present."[vi] The report recommended the principles of: freedom to negotiate; freedom to protect contracts; and freedom to co-ordinate operations, as a second-best way to move forward on the matter of organisation of liner markets.

A month later, following a recent meeting of the OECD in Paris on December 4, 2001, unofficial sources say that the EC will review its bloc exemption for liner shipping from antitrust laws. The OECD still thinks that the best solution is to get rid of antitrust immunity but because of opposition has recommended a middle course.

World Bank Study: A recent quantitative study indicates that "Trade liberalization and the breakup of private carrier agreements would lead to an average reduction in liner transport prices by one-third and to cost savings of up to $3 billion on goods carried to the US alone."[vii] Trade liberalization was defined to include cargo reservation schemes and monopoly rights granted to ports and auxiliary services. Private carrier agreements primarily include rate fixing practices of maritime conferences which enjoy an exemption from competition rules. Consequently, it proposes that the General

Agreement of Trade in Services provision dealing with business practices be strengthened through the creation of two obligations: an end to antitrust immunity to collective agreements, and the right of foreign consumers to challenge the anti-competitive practices by shipping lines in the national courts of countries whose citizens own or control these shipping lines.

CTA Review Panel: The CTA Review Panel recognized the declining share of container cargo carried by shipping conferences compared to non-shipping conferences. It indicated that it favours removing artificial barriers to competition, as the guarantee of cost efficiency among carriers and of service and price to users. In principle, therefore, the Panel favours eliminating the exemptions provided by SCEA. Recognizing the international dimensions of the issue it recommended that "the government make clear its commitment to eventual elimination of the liner conference exemptions from competition law and that it actively pursue multilateral agreement among international partners to do so."[viii]

Changes in Market Structure and Environment: Fundamental changes (technological, structural, organizational) have occurred in liner shipping, and ultimately it will be these changes that will force governments in various parts of the globe to react. For example, in Canada if the proportion of cargo transported by shipping conferences falls considerably below the threshold likely to raise concern under the Competition law, then the shipping conference exemption is not needed for it is unlikely that the conferences will violate the competition law even if they do not file for exemption.[ix]

Concluding Remarks

The exemption of shipping conferences from the competition laws or antitrust laws continues to be the most controversial issue in liner shipping. A number of nations, including Canada, have introduced amendments to shipping legislation to enhance competition and to reduce the cartel powers of shipping conferences. While the changes adopted by most nations are a move in the right

direction, from a competition perspective there is widespread belief that regulatory reforms are proceeding too slowly.

It is becoming increasing difficult to continue to justify the comity doctrine for an outmoded and wasteful regulatory regime. The wastefulness of the present regulatory regime was recently substantiated by a World Bank Study which indicated the enormous gains that would accrue to the US through trade liberalization and breakup of private carrier agreements.

It is believed that multilateral action could more easily bring about an elimination of the exemption, now that a number of the major trading jurisdictions have similar conferences laws. Eliminating the exemption could lead to greater competition among ocean liner carriers and ultimately to increased efficiency, lower prices, improved services and greater international trade to the benefit of trading nations. I believe the time is right to take multilateral action to eliminate the exemption, and that US, the EEC and Canada should take such action if agreement cannot be reached by all nations.

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* *The views expressed are those of the authors and not necessarily those of the Competition Bureau.*

APPENDIX 1 - Amendments in Detail

- Subsection 2(2) of SCEA has been amended to provide for electronic filing.
- Subsection 4(3)(a) has been amended to provide for a reduction of notice period for Independent Action to five days from the present fifteen days and is specifically part of this section rather than left to a date to be fixed by the Governor in Council as in the present SCEA.
- Subsection 4(3)(b) provides for adopting Independent Action on the same day as the first Independent Action is taken.
- Subsection 4(3)(c) provides for the publication of a new rate or service five days after the notice is received by the Conference. (Formerly this was fixed by the Governor in Council. Further the order of subsections 4(3)(b) and (c) have been reversed in the amendments).
- Subsection 4(3.1) has been added to indicate that the terms and conditions established by a Conference will not have the effect of preventing a member of a conference from entering a service contract and there will be no need for the member to give notice to the Conference of the service contract or to divulge the substance of the contract.
- Subsection 6(1)(b) has been amended to indicate that there is no need for filing of individual service contracts.

- Subsection 6(1)(d) has been deleted so that filing of tariffs with the Canadian Transportation Agency will no longer be needed.
- Subsections 6(1)(e) and (f) relating to filing of loyalty contacts and amendments have been merged into subsection 6(1)(d). (Reference to tariff has been deleted from subsection (f)).
- Subsection 6(2) relating to contents of a tariff have been deleted. This section however has basically been moved to subsection 19(3) in the amendments.
- Subsections 7(d) and (e) relating to time for filing of loyalty contracts and amendments have been merged into section 7(d). (Reference to tariff has been deleted from subsection (d)).
- Section 18 provides for the maintenance of an office in Canada by a conference where they operate. Previously, it also included a clause for inspection of documents which is now contained in section 19.
- Section 19 provides for availability of certain documents, inspection of certain documents and the contents of a tariff. It specifically excludes service contracts which were also not allowed in the present Act. This section basically is a rewrite of sections 18 and 19 in SCEA and an addition of the previous subsection 6(2).
- Subsection 24(1) has been revised to provide for an increase in the fine for non-compliance to $10, 000 (Previously it was $1,000).

Endnotes

1. The predatory pricing offence under subsection 50(1)(c) pertains to engaging in a policy of selling products at prices unreasonably low, having the effect or tendency of substantially lessening competition or eliminating a competitor, or designed to have that effect.

2. Section (3.1) of Bill C-14 was amended by the Standing Committee on Transport Government Operations on May 3, 2001 and passed by the House of Commons on May 10, 2001. The Bill was assented to on November 1, 2001 and came into force on January 30, 2002. The additions include adding: 'negotiating or' to the word 'entering' so as to clarify what a member can do with a shipper; and 'having to' to the verb 'divulge' to improve the grammar. The word 'substance' has been replaced by 'terms and conditions' which is more consistent and precise with the language in section 4(1)(c) of SCEA, 1987.

3. The Impact of the Ocean Shipping Reform Act of 1998, Federal Maritime Commission, September 2001, p. 5. The Report found that of the SCs surveyed, a high percentage (98) of the SCs were by individual carriers.

4. Commissioner Antony Merck indicated that when the market is tight there is adherence to the the guidelines and when it is not commercial men operate in their own interests. He expressed

concern about the way discussion agreement members 'universally and uniformly apply surcharges'. See R.G. Edmonson, "FMC releases final OSRA report," **Journal of Commerce**, September 27, 2001.

5. Commissioner Delmond J.H. Won stated "When natural competitors are allowed to sit together at the table, then true competition cannot exist." Commissioner Joseph E. Brennan added that "the commission has a responsibility to watch this very carefully." See R.G. Edmonson.

6. **Liner Shipping Competition Policy Report**, OECD, DSTI/DOT(2001)1, November 6, 2001, p.2.

7. Carsten Fink, Aaditya Mattoo, and Ileana Cristiana Neagu, "Trade in international maritime services: How much does policy matter?," **Journal of Economic Literature**, November 13, 2000 [submitted]. This finding is not surprising given that conference rates are at least 15 percent higher than rates of independent carriers. Nevertheless, the study provides useful estimates of potential gains if the conference system and the monopoly power of ports are abolished. The former would cause prices to decline by 25 percent resulting in cost savings of $2 billion and the latter would cause transport prices to decline by 9 percent resulting in a further cost savings of $850 million.

8. **Vision and Balance**, Report of the Canada Transportation Act Review Panel, June 2001, p. 146.

9. Even in the US, conference agreements fell to 19 in June 2001 from 35 in 1998. The FMC report states that "the liner shipping industry has been experiencing dynamic structural changes over the past several years." See p. 6 of the above cited report (footnote 3).

THE OPEN SKIES AGREEMENT BETWEEN THE UNITED STATES OF AMERICA AND CANADA - THE RESULTS. DOES IT SUGGEST THE NEED FOR A WIDER PACT AND A MORE LIBERAL AIR PACT?

Joseph Monteiro, David Krause and André Downs*

Introduction

On February 24, 1995 the signing of the Open Skies Agreement by the President of the United States of America, Bill Clinton and the Prime Minister of Canada, Jean Chretien was heralded as a new historic aviation accord. It was a major breakthrough in bilateral relations and a first for the two nations in liberalizing air travel. Not surprisingly, news of this accord made headlines in all the national newspapers as a tribute to its importance and significance. It signalled the dawning of a new era in bilateral negotiations for the world.

In this paper, we shall first briefly review the major elements of the 1966 bilateral agreement between Canada and the US and the 1995 Open Skies Agreement. Second, we shall present the statistical data on transborder services. Third, we shall examine the results, and then review the findings of other studies and recent developments. Finally, we shall present the pros and cons for a wider Agreement with a few concluding remarks.

I. The Bilateral Agreement of 1966 and the 1995 Open Skies Agreement

a) The Canada-US Bilateral Agreement of 1966: The bilateral agreement of January 17, 1966 between the Government of Canada and the United States formed the basis for air services provided between Canada and the United States of America until 1995. It contained a Preamble, 20 Articles and 2 Schedules. From the competition perspective, the two noteworthy features of the

Agreement were: new routes; and rates. The Agreement provided for 25 routes. Fourteen were awarded to airlines from Canada and twenty-one to airlines from the United States of America. The airlines of each party were to have fair an equal opportunity to operate air services, without unduly affecting the services provided by the other airline, having regard to the requirements of the public and the provision of capacity to meet traffic demands. Restrictions such as capacity, frequency or type of aircraft on the routes were determined by both parties (Schedule I and Article XII). The rates charged by the designated airlines of either contracting party were to be reasonable, subject to dual approval by the aeronautical authorities of both parties and were to be filed with them 30 days before the date of effect. Each party was to ensure that the rates charged conform to the rates filed and that no airline rebates directly or indirectly any portion of such rates. Mechanism was also provided for settling disagreement on rates and resolution by arbitration as a last resort (Articles XIII and XV).

This bilateral agreement reflected the policy of the past where international scheduled air service was not to be competitive or the policy was not to be in conflict. As a result, service on each city-pair in the bilateral agreement was restricted to one designated carrier from each country.

b) The 1974 Amendment to the Bilateral Agreement of 1966: On May 8, 1974 an international bilateral package of three agreements was signed between External Affairs Minister Mitchell Sharp, Transport Minister Jean Marchand and the United States Ambassador to Canada William Porter. Mr. Sharp signed an exchange of notes amending the 1966 Air Transport Agreement which provided for 46 new routes for the US and Canada. The new routes provided the airlines with the opportunity for providing new services. Mr. Marchand signed the new Charter Agreement and a Preclearance Agreement. It provided for pre-clearance facilities in several Canadian cities for US bound travellers in addition to the existing

facilities.[i] A new air charter agreement with the U.S was also signed.[ii] The new liberal agreement included a formula permitting U.S. carriers having charter rights to share with Canadian carriers in the Canadian originating markets to the U.S. The 1966 Agreement as finally amended provided for 83 separate direct transborder routes. Of these routes, interflag competition was authorized on nineteen, thirty-eight were reserved for US airlines and twenty-six for Canadian airlines. Designation of more than one carrier on a route required the permission of the other government and either government could propose fares on these routes. Determination of capacity was left to the each airline.

c) The 1995 Open Skies Agreement: On February 24, 1995, the historic *Open Skies Agreement* with the US was signed. It consists of a Preamble and 24 articles (Grant of Rights; Designation and Authorization; Revocation and Authorization; Fair Competition; Pricing; Tariff; Airport Access; User Charges; Customs Duties and Charges; Commercial Opportunities; Computer Reservation Systems; Application of Laws; Safety; Aviation Security; Statistics; Consultations and High Level Meetings; Resolution of Disputes; Index and Titles; Amendment of Agreement; Multilateral Conventions; Termination; Registration with ICAO; Definitions; and Entry into Force). In addition, it contains five annexes (Scheduled Air Transportation; Slots and Access to Washington National Airport; Charter Air Transportation; Continuation of Designations and Authorizations; and Transition Phase). The two important features of the Agreement were: first, removal of restrictions on air travel; and second, pricing freedom.

Under the first feature: Canadian and US airlines were able to provide unrestricted cross-border services (i.e., without conditions on capacity, frequency and size) from any point in Canada to any point in the US (Annex I). However, US service to Montreal and Vancouver would be phased in over two years and the US service to Toronto would be phased in over three years (i.e., after 1995). In addition, Washington National Airport was provided access from Canadian airports with customs pre-clearance facilities (Annex II). However, US carriers were not to provide non-stop service from

Washington National Airport until a Canadian carrier starts operating to this airport. Further, Canadian and US airlines could now operate unrestricted cross-border cargo services, with the exception that US service to Montreal, Vancouver and Toronto would be limited for the first year (Annex I). In addition, all restrictions regarding aircraft size and package size on all US all-cargo service licences were removed and carriers were prohibited from providing all-cargo service with aircraft exceeding 35, 000 pounds to more than one destination in the other country for courier companies. The Agreement did not affect the operation of charters and they would continue to operate as in the past or could become scheduled services.

Under the second feature: the Canada-US fare approval process was liberalized (Article 5). Air carriers would be allowed to set their own fares on transborder services and it would no longer have to be filed with the regulatory agencies in the two countries. Fares could be disallowed subject to a dual process for reasons of predatory prices, unreasonably discriminatory prices, unreasonably high prices due to abuse of dominance and artificially low prices because of government subsidy only if agreed to by the countries' authorities.

In addition, to give greater effect to the above liberalization the agreement provided for the availability of slots and sharing of codes (Annex II and Annex V). Canadian carriers will be provided with limited number of slots at O'Hare in Chicago (10) and at La Guardia in New York (14). Further, additional slots at congested US airports can be acquired under domestic 'buy-sell' rules and are subject to the same system of allocation as applicable to US carriers. Furthermore, Canadian and US airlines could share codes openly (i.e., an airline could ticket them under their own code and carry them on other airlines), however, during the three-year phase-in period, the agreement restricts code sharing between US and Canadian carriers on flights carrying code-shared passengers between Toronto, Montreal or Vancouver and any U.S. point behind or beyond a US gateway. Finally, as in the earlier agreement an international

arbitration panel consisting of three members from each country and one from a third was set up to resolve violations of the agreement (Article 17).

II. The Statistical Data on Transborder Services.

The statistical data indicated hereafter have been compiled from or published by Transport Canada, Statistics Canada or other sources. It covers the number of new transborder services provided, airports with more than two transborder services, the volume of transborder passengers and cargo, the HHI index in certain markets and airfares. Additional details can be found in the above sources.[iii]

a) New Services: The signing of the Open Skies Agreement on February 24, 1995 brought a rapid increase in the number of 'new' transborder services. Before the signing of the Agreement, the total

Services Added Since the Signing of the Open Skies Agreement in 1995					
Airport	01/02/95-31/12/96	01/01/97-24/02/98	25/02/98-31/12/98	01/01/99-31/12/99	01/02/95-31/12/99
Toronto	17/14/31*	12/-2/10	0/0/0	3/0/3	32/12/44
Vancouver	5/10/15	3/5/8	0/1/1	-4/1/-3	4/17/21
Montreal	2/6/8	1/-1/0	1/0/1	1/1/2	5/6/11
Calgary	2/6/8	2/-1/1	0/1/1	1/0/1	5/6/11
Ottawa	2/2/4	1/3/4	1/0/1	2/-1/1	6/4/10
Edmonton	0/1/1	0/0/0	1/0/1	2/-1/1	2/1/3
Halifax	1/0/1	0/2/2	0/0/0	0/0/0	1/2/3
Winnipeg	0/0/0	0/0/0	0/0/0	1/0/1	1/0/1
Other	0/2/2	0/2/2	0/2/2	0/0/0	0/6/6
Total	29/41/70	19/8/27	3/4/7	5/1/6	56/54/110

Source: Compiled from Transportation in Canada, Annual Report (various issues 1996-1999). *Canadian/U.S./Total. At the end of 2000, 22 new services were started - 1 (Edmonton); 3 (Montreal); 4 (Vancouver); and 14 (Toronto).

number of transborder services were 76 of which 40 were offered by

Canadian carriers and 36 by US carriers (this excludes the six services dropped that were equally divided by the two carriers). By December 31, 1999, the number of services offered was 186 of which new services were 110, an increase of 144%. The new services offered by Canadian vs US carriers were roughly even (i.e. 56 and 54). Most of the new services originated from the airports of Toronto (44) and Vancouver (21) with approximately the same increase from the airports of Montreal, Calgary and Ottawa (11, 11 and 10).

The New Agreement also brought about 'more services' and 'increased choice' of services. Seven of the major cities served fifty-nine transborder markets with two or more services as of December 31, 2000 compared to seventeen on February 23, 1995. In addition, these cities were served with as many as 3 to 13 carriers compared to 1 to 8. This is shown in the table.

Major Canadian Airports serving Transborder markets with two or more services and carriers(1995-01)

Canadian Airports	Transborder Airports with two or more carriers		Airlines Serving Airport in Transborder Flights	
	Feb. 23, 1995	Dec. 31, 2001	Feb. 23, 1995	Dec. 31, 2001
Calgary	1	5	4	9
Edmonton	0	2	3	5
Halifax	0	2	1	3
Montreal (D&M)	3	8	5	9
Ottawa	0	3	3	6
Toronto	9	27	8	13
Vancouver	4	12	8	13

Source: Compiled from Transportation in Canada 2000, Annual Report, 2001.

b) Volume of Passengers and Cargo: There was a sharp increase in the volume of passengers travelling after the signing of the Agreement. From a one percent decline in the number of passengers travelling on transborder services in 1994, the percent increased to 8.8 percent and 15.6 percent in the next two years. Between 1994 and 1999, the number of passengers increased from approximately 13.6m to 19.6m or the total increased by 44 percent. Further, the number

Transborder Passenger Traffic For Scheduled, Regional and Charter Operations 1991-1999 (million)						
	Canadian Carriers		US Carriers		Total Carriers	
Period	Passengers	Market share	Passengers	Market share	Passengers	% Annual Change
1991	5182	42.3	7057	57.7	12239	–
1992	5619	42.2	7688	57.8	13307	3.6
1993	5634	40.9	8146	59.1	13780	3.6
1994	5908	43.3	7735	56.7	13643	-1
1995	6482	43.7	8367	56.3	14849	8.8
1996	7850	45.7	9317	54.3	17167	15.6
1997	8883	49.5	9069	50.5	17952	4.6
1998	9490	50.6	9266	49.4	18756	4.5
1999	9903	50.4	9759	49.6	19662	4.8

Source: Transportation in Canada, Annual Report (various issues 1996-1999)

of passengers carried by Canadian carriers increased from 43 percent to 50 percent by 1999, indicating a strengthening of the position of Canadian carriers.

The increase in the 'volume of passengers' after the signing of the Open Skies Agreement is more impressive for the airports in which service increased the most. For some markets the increase was quite staggering registering increases of 130.1% and 116.2% in the case of Ottawa and Vancouver (see table hereafter).

Transborder Traffic at the Largest Transborder Airports (1994-1999) ('000)					
Year	Toronto	Vancouver	Montreal	Calgary	Ottawa
1994	3791.1	1207.1	1659.4	704.2	322.9

1995	4179	1527.5	1882	790.1	397.9
1996	4959.7	2164.9	2092.3	1010.7	572.5
1997	5008.3	2347.3	1978.3	1101.8	614.2
1998	5412.1	2614.2	2117.4	1152.4	644.1
1999	5664.1	2609.3	2294.9	1157.3	742.9
% Δ	49.4	116.2	38.3	64.3	130.1

Source: Air Passenger Origin and Destination, Canada-United States Report, Catalogue No. 51-205-XPB.

This increase in volume also occurred with regard to transborder 'air cargo'. "Transborder air cargo was up sharply in 1995 -- to approximately 700 million revenue tonne-kilometres -- an increase of 25 percent over 1994."[iv] Between 1994 and 1999 transborder cargo increased by 28% compared to domestic cargo which increased by 13%. After the first year, it increased by 24%.

Cargo Carried By Canadian Air Carriers 1993-1999 (tonnes)			
Year	**Transborder**	**Domestic**	**Total**
1993	68238	422147	653493
1994	70882	443601	683585
1995	87663	416171	687577
1996	80, 389	447313	723286
1997	77387	513719	813558
1998	94176	487583	815711
1999	90584	501284	826415

Source : Canadian Civil Aviation, Statistics Canada, Catalogue 51-206.

c) Value of Cargo: From 1995 to 1999, the 'value' of air cargo in transborder trade soared to $37.7 billion increasing by $15.07 billion. Not only did the share of air cargo in total transborder trade increase but the increase in the total value was greater than the increase in total

value of air transportation of cargo to other countries.

Value of Air Trade in International Trade (Billions of dollars)				
Year	Canada/US		Canada/Other Countries	
	Air Total	Air Share (%)	Air Total	Air Share (%)
1993	15.31	5.8	15.62	16.8
1995	22.77	6.4	23	17.8
1997	29.08	6.8	28.36	19.9
1999	37.7	7.2	34.13	22.5

Source : Transportation in Canada 2000, Annual Report, 2001, p. 152.

d) A Measure of Concentration: A measure of concentration, the Herfindhal-Hirschman Index,[v] indicates that from January '95 to January '98 concentration rose in all transborder markets, Toronto and Montreal. However, it declined for the largest twenty markets and for Vancouver. The decline in July 1998 was due to seasonal characteristics of flight data.

Herfindhal-Hirschamn Index (Based on Total Weekly Flights)

	January 1995	January 1996	January 1997	January 1998	July 1998
All Transborder Markets	1996	2013	2104	2185	1850
Toronto	2437	2483	2975	3298	2788
Montreal	2633	2399	2479	2660	2394
Vancouver	2586	1826	1562	1967	2170
20 Largest Trans-border Markets	6483	5884	5934	5673	5200

Source: Michael Pustay, "Competition and Concentration in Canadian-US Transborder Aviation Markets," CTRF Proceedings, Vol. 34, 1999, pp. 31-44.

e) Fares of Transborder Services: Air fares are one of the important statistics, unfortunately transborder fares are not made public by Statistics Canada. The only available statistics are a combination of

transborder fares and international fares. This is presented in the table for the initial period after the Open Skies Agreement. The

International Air Fares

Year	Discount	Economy	Total
1994 (Q4)	324.20	393.20	369.90
1995 (Q1)	302.10	384.70	344.90
1995 (Q2)	328.20	392.10	372.60
1995 (Q3)	368.60	445.60	414.40
1995 (Q4)	269.90	391.60	317.60
1996 (Q1)	264.40	352.20	301.60
1996 (Q2)	303.80	369.70	338.00
1999 (Q2)	317.80	601.10	364.20

Source: Data Provided by Bradley Snider, Aviation Statistics Centre, Transportation Division, Statistics Canada.

statistics indicate a decline in the fares till the second quarter of 1996 and a decline for the discount fares and total fares over the entire period. This finding was also noted by Statistics Canada which stated "The sharp decline in air fares in 1995 was the result of many factors. Perhaps the most important factor was the Open Skies Agreement between Canada and the United States, which created many more competitive, non-stop transborder services. Many of these new transborder services were launched with introductory discount fares, which may have had a temporary effect on average prices."[vi] After 1996, prices in general have risen as after the second quarter the number of competitors and concentration in the major transborder markets did not change appreciably.

III. Do the Results and Subsequent Developments Suggest the Need for a Wider Agreement?

A. The Results

a) What Does the Statistical Data Reveal?: The statistical data reveals that the number of new services and the number of carriers serving

more than one airport increased after 1995 resulting in staggering increases in the volume of passengers travelling on transborder routes particularly in the first two years after the signing of the Open Skies Agreement. In addition, the volume and value of transborder air cargo increased sharply after 1995. Concentration rose from January 1995 to January 1998 in all transborder markets, though in certain markets it declined. The initial impact of the Open Skies Agreement was to lower prices however after mid 1996 prices started rising. We shall examine some of the findings from other studies.

b) A Brief Description of the Findings of Other Studies[vii]: Lund and Kohn (for 1994-1996) in their study indicated that the number of non-stop routes has increased steadily, further they found that adding new nonstop services has stimulated traffic and pulled passengers from connecting flights to direct flights in great numbers. In addition, their statistical findings indicate that for city pairs (11) where new non-stop services were added the number of passengers travelling increased significantly (i.e., 84%) compared to city pairs (19) where no new non-stop services were added.

Pustay in his article pointed out that concentration as measured by the Herfindhal Hirschman Index (HHI) has increased in many transborder markets from January 1995 to January 1998, nevertheless, consumers have benefited from the substantial increase in transborder services. Further, the levels of concentration in the transborder market have remained quite high, above 1800, regardless of the market definition (i.e., transborder market, transborder service at individual airports or transborder service in individual city-pairs).

Statistics Canada reports have conducted several analyses of the data. Roland Hébert in his study (1998) indicates that the level of service provided by carriers and the number of Canadian passengers travelling from Canada to the United States has grown faster in business markets than in leisure markets after the signing of the Open Skies Agreement. Various indicators such as the number of

passengers, seat availability and number of flights confirm his findings. His findings also indicate that Air Canada and Canadian Airlines have been targeting the more profitable business class as suggested by seat availability and number of flights. Gudz and Massicotte in their study (1997) point out that "A comparative analysis of Canadian international travel prior to and following the agreement ('92-6) shows that although the overall level of travel has increased since Open Skies, the proportion of Canadian international trips using U.S. gateways has remained relatively stable." Jimmy Ruel (2002) indicates that "The agreement has led to substantial growth in markets of less than 25,000 passengers per year since 1995. ... and their number of passengers has increased dramatically."

Dresner and Oum in their study (on liberalizing bilaterals) indicate that Canadian facilitating bilaterals have had a significant positive effect of increasing the number of 'direct' visitors to Canada (approximately 20% both direct and total). The authors suggest that Canada can avoid the diversion caused by US liberal bilaterals by further liberalizing its facilitating agreements or by liberalizing those agreements that still have both pricing and capacity restrictions. Further, US liberal bilaterals have had a moderate but statistically negative effect on the share of 'direct' visitors to Canada reducing Canada's 'direct' visitors from that country by 3.1percent.

B. Other Recent Developments

a) Canada Transportation Act Review Panel, 2001: The Review Panel did not make any specific recommendations with regard to the US-Canada Open Skies Agreement. However, one of its recommendations that would have a bearing on the Agreement is that "the government enter into negotiations with the United States and Mexico to create a North American Common Aviation Area in which carriers from Canada, the U.S. and Mexico would compete freely. As a back-up option if negotiations do not succeed, the Review Panel recommended that the government negotiate with other countries for the reciprocal granting of modified sixth freedom rights and of rights

of establishment for foreign-owned domestic carriers."[viii] Under the first part of this proposal, Canadian, Mexican and U.S. carriers could compete in each other's domestic market. This would certainly have a much greater impact on injecting competition in the Canadian domestic market and in transborder services in the North American hemisphere than exists today.

b) Unofficial Policy Views of the Minister of Transport Canada: The Minister of Transport Canada, David Collenette, does not support the provision of cabotage rights to foreign airlines. He stated that "Cabotage ... is not the answer for competition in this country."[ix] Perhaps, his views are based on his beliefs that the US are unlikely to agree to provide such cabotage rights. Regardless, of the basis for his views or the past experience, there is a belief that there is still room for further negotiations,[x] a belief confirmed by Mr. Collenette's spokesman. Commenting on the Review Panel Report, Mr. Collenette said "he didn't think a North American free trade zone for aviation would fly. The likelihood of that is slim. If we're talking about an agreement where there's going to be cabotage, the Americans have shown no appetite for that,.."[xi] However, before a final decision is made the Minister indicated that the Panel's recommendations will be further studied and consultation will be undertaken before any legislative amendments are made.

IV. Do We Want Minor Modifications to the Agreement or Major Changes?

One observation made by the Review Panel is that the U.S. is reluctant to give any access to its lucrative domestic market by foreign carriers without offsetting concessions. Granted that this hurdle can be overcome, one of the basic challenges facing policy makers is whether we want minor modifications or major changes in transborder aviation policy.

a) Minor Modifications to the Agreement: What do we mean by minor modifications? Minor modifications would include changes

such as extending the Agreement whereby indirect flights will be able to carry connecting passenger from the same country; coterminalization of cargo; extension of code sharing, eliminating disapproval of fares, and extension of sixth freedom rights (i.e., tag on cabotage rights - i.e., Chicago-Toronto-Montreal or Austin-Chicago-Toronto)) or indirect cabotage rights (i.e., NY-Toronto-Vancouver-Seattle).

b) Major Changes to the Agreement: What do we mean by major changes? Major changes would provide unrestricted cabotage rights between United States, Canada and Mexico together with extension of code sharing and elimination of disapproval of fares. Later, Agreement would be extended to include nations such as Chile and other South American countries should NAFTA be widened.

c) The Pros and Cons of Minor Modifications or Major Changes: The Pros: First, permitting indirect flights to carry connecting passengers from the same country or coterminalization of cargo is that it permits the carrier to achieve certain economies. For example, suppose a carrier was carrying cargo from Chicago to Calgary and Edmonton. Under the existing Open Skies, the U.S. carrier would have to make two trips one from Chicago to Calgary and the other from Chicago to Edmonton. The U.S. carrier would not be able to make one trip Chicago-Calgary-Edmonton even if it had excess capacity under the old Chicago-Edmonton flight. Even if excess capacity did not arise because of the airline's ability to utilize different size planes, the airline would not be able to avail itself of any economies of scale arising from utilizing bigger planes that could be made possible by coterminalization.

Second, the extension of code sharing could also result in competition and certain economies. Code sharing, (i.e., the use of an airline's designator code by another airline in computer reservation systems and timetables and on tickets), enables interline carriers to

show up as on flight in the computer reservation system giving it higher display preference than competing interline flights. One study indicates that travel agents prefer to make bookings from carriers that appear first on the screen and on the first line on the screen. Extending code sharing would reduce the competitive disadvantages faced by other carriers. It could also result in economies resulting in closer alignment of schedules, gate access, service levels, baggage handling and frequent flyer programs.

Third, eliminating disapproval of fares would basically simplify the regulatory process. If the concern is that foreign carriers may engage in dumping of surplus air seats that could result in predatory pricing, the appropriate agencies to deal with such matters are the antitrust authorities. Further, eliminating disapproval of fares could remove a constraint on a foreign carrier from engaging in price competition.

Fourth, limited cabotage rights such as tag end cabotage and indirect cabotage could succeed in bringing about price competition in a few transborder markets. However, the extent of competition would be limited to these few markets and its use as a mechanism to introduce competition in domestic markets is likely to be constrained. Further, it may be argued that a partial way around cabotage can exist in practice today as a passenger can request a flight from Toronto to Vancouver not only using a direct flight by a Canadian carrier but also using a competitive US carrier via a intermediary stop in the U.S. eg. Chicago, if it is cheaper to fly using this alternative flight path, i.e., Toronto-Chicago and Chicago-Vancouver.

The Cons: First, national security considerations may require maintaining cabotage. Second, providing cabotage rights to foreign airlines could hurt Canadian airlines. Third, labour unions generally object to granting cabotage rights to foreign airlines as it could mean a loss of jobs to Canadians. Finally, opponents of providing unrestricted cabotage rights may point out that it could violate the Chicago Convention on Bilateral Rights. However, none of these reasons are particularly convincing today.

The above pros and cons and the evidence of the initial impact of the Open Skies Agreement examined in the previous section may help tilt the balance in favour for a more liberal approach to Open Skies. However, it does not resolve whether minor modifications or major changes should be adopted. In providing an opinion on this matter, it should be remembered that regardless of the merits of one vs the other, the practicality of the alternatives should be considered.

First, major changes which include unrestricted cabotage rights to countries in the Agreement would provide benefits resulting from open competition between the countries in 'all' markets not just a few selected markets where cabotage rights are permitted to foreign airlines. Second, most believers in free trade indicate that it is becoming increasingly difficult to provide justification why the airline industry should be protected from foreign competition while all the other industries are being subject to full open competition under free trade not partial competition. Third, major changes would also provide for a more consistent approach in theory and practice to all sectors under the NAFTA and would permit the application of common underlying principles to all transport sectors to which different degrees of protection apply. Notwithstanding, the benefits from major changes one of the key drawbacks is that such Agreements are particularly difficult to negotiate and the difficulty increases with the number of countries. For example, even the Open Skies Agreement took more than ten years to negotiate.

Concluding Remarks

A more liberal view to limited cabotage with the U.S. was adopted in the past by the then Transport Minister, Don Mazankowski. In 1983, he stated that "Limited reciprocal cabotage rights remain an essential element of the open transborder aviation system that Canada envisions establishing with the United States,..."[xii] The views of the Minister were supported by Marvin Cohen, a former Chairman of the US Civil Aeronautics Board who stated "..it

is time for the US government to re-examine its cabotage restriction. ... Conceptually, aviation is 200 years behind the rest of the US economy. Mercantilist principles govern our thinking about airlines but we are capable of changing this. We can look at aviation through 20th century eyes."[xiii] Unfortunately, the Open Skies Agreement did not provide for limited cabotage rights.

The opportunity to correct for this has now arisen as the adequacy of the Open Skies Agreement between Canada and the U.S. has once again been raised. The benefits resulting from the Open Skies Agreement have been well documented and clearly point in the direction of further liberalization. In addition, there is need to provide a consistent approach for all sectors in the NAFTA. The issue is do we want minor modifications or major changes and are we prepared to shed our old mercantilist's philosophy.

The issue of changes to the Open Skies Agreement (i.e., modified sixth freedom) resurfaced recently as a result of the failure of Canada 3000 and the possibility of re-regulation of the airlines. Air Canada's chief, Robert Milton, put forward this proposal which received some support from Washington. In response, spokesman for Mr. Collenette, indicated that Ottawa would be willing to discuss it as well.

Contemporary thinking suggests major changes should be adopted,[xiv] however, the reality of whether it can be accomplished cannot be ignored if the Minister's premonition is right. While we may wish to disassociate ourselves from the fact that we once supported a mercantilist's philosophy, pragmatism suggests that minor modifications should be accomplished as a first stage in our quest for major changes.

* *The views are those of the authors and not necessarily those of the Competition Bureau, Industry Canada. We would like to thank Mrs. Catherine MacDonald of the Canadian Transportation Agency for providing us with copies of the bilateral agreements.*

ENDNOTES

1. On August 1, 1974, the Minister of Transport, the Honourable Jean Marchand awarded the rights agreed to in the agreement: 14 to AC and 1 each to CP Air, Nordair and Pacific Western Airlines. Twenty-eight new routes were awarded to US carriers.

2. From April 1, 1978, U.S. carriers would be entitled to operate 25 percent of the forecasted charter seats from Canada to Hawaii and Florida and 40 percent of the forecasted charter seats from Canada to California, Arizona, Nevada, Puerto Rico and U.S. Virgin Island. This agreement created the opportunity for competition not only between the domestic charter and scheduled carriers but also between these carriers and U.S. carriers.

3. Air Passenger Origin and Destination, Canada-United States Report, Catalogue No. 51-205-XPB; Transportation in Canada, Annual Report, Transport Canada, TP 13198E; and Pustay in footnote 7.

4. Transportation in Canada 1996, Annual Report, Transport Canada, TP 13198E, 1966, p. 33.

5. The HHI is the sum of squares of individual carrier market shares. A monopoly would have a HHI of 10,000 and a perfectly competitive industry would have a HHI that approaches 0. Most anti-trust guidelines suggest that an HHI over 1000 may raise concern. However, no reasons are provided for the choice of this number.

6. Canadian Civil Aviation 1995, Statistics Canada, Catalogue No. 51-206-XPB, pp. XX.

7. R. Lund and H. Kohn, "Success of New Non-stop Services in Aviation Transborder Markets," CTRF Proceedings, Vol. 33, 1998, pp. 129-141; Michael Pustay, "Competition and Concentration in Canadian-US Transborder Aviation Markets," CTRF Proceedings, Vol. 34, 1999, pp. 31-44; J. Nolan, J. Ritchie, and J. Rowcroft, "Open Skies and Open Gates," CTRF Proceedings, Vol. 33, 1998, pp. 119-128; M. Dresner, C. Hadrovic, and M. Trethewny, "The Canada - US Air Transport Bilateral: Will it Be Freed," CTRF Proceedings, Vol. 23, 1988, pp. 64-76; I. Gasser and D. Vellenga, "Scheduled Air Services between the United States and Canada," CTRF Proceedings, Vol. 24, 1999, pp. 510-522; M. Pustay, "The 1995 Canada-US Air Services Agreement: A Preliminary Analysis," CTRF Proceedings, Vol. 31, 1996, pp. 222-236; M. Dresner and T. Oum, "The Effect of Liberalized Air Transport Bilateral on Foreign Visitor Volume and Traffic Diversion: The Case of Canada," CTRF Proceedings, Vol. 32, 1997, pp. 180-210; and articles cited in the references above.

8. See Vision and Balance, Report of the Canada Transportation Act Review Panel , June 2001, p. 123.

9. Alan Toulin, "Extend NAFTA to the skies panel says," National Post, Thursday, July 19, 2001, pp. A1-10.

10. For example, the Embassy spokesman stated "We are interested in exploring more open skies so we're studying the report," Alan Toulin, "US raises prospect of wider skypact," National Post, July 20, 2001, pp. C1-8. See G & M, Dec. 8, 2001, p. B5

11. Keith McArthur, "Extend free trade to air: report," The Globe and Mail, Thursday, July 19, 2001, p. B3

12. Jennifer Dorsey, "Cabotage is the point of contention," Canadian Travel Courier, December 5, 1983, pp. 7/15.

13. *Id.* p. 15.

14. Studies on this issue and statements by Air Canada support bilateral provision of cabotage rights. Unilateral provision of such rights while easier to accomplish has not been generally acceptable. In resolving this matter, one would have to balance the

benefits of introducing domestic competition with the loss of benefits and leverage that could arise if the other country refuses to provide cabotage rights. The Competition Bureau in its recommendation to the Review Panel recommenced reciprocal provision of cabotage rights; and bilateral or unilateral elimination of modified 6th freedom rights. Finally, the Review Panel is opposed to unilateral action to allow foreign entry.

NAV CANADA Unions' Merger with the Canadian Autoworkers

1.0 Introduction

In 1996, Canada became the first nation to fully commercialize its air navigational system (ANS). Other solutions had been considered. New Zealand had placed its ANS under a government controlled corporation, but the Canadian approach sought to further distance the operation from political interference, which some stakeholders felt was a major source of poor performance.

1.1 Origins of Commercialization

In the federal budget tabled in February of 1994, the government stated its intention to study the potential for commercialization of the ANS as part of a comprehensive transportation strategy, which included commercialization of port facilities or transfer to provincial control, transfer of airports to local operating authorities, and the privatization of the Canadian National Railroad and Air Canada.

In part, the government was responding to the views of its stakeholders. The air traffic controllers' union, the airline pilots' unions, the Air Transport Association of Canada which represents air carriers, and the Canadian Business Aircraft Association had lobbied for the ANS to be run as a business. The idea had also been proposed by a Royal Commission on National Passenger Transportation[1] and a Ministerial task force.

At the time, the ANS employed more than 6000 people, including 2300 air traffic controllers, 1000 Flight Service Specialists, and 1100 electronic technicians. Transport Canada (TC) maintained 105 Flight Service Stations and 55 control towers, s radio aids to navigation,

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[1] *Royal Commission on National Passenger Transportation.* Volume 1, pp. 126-127.

radar and data processing systems.[2] The system provided services for the world's second largest country, and for a considerable portion of the North Atlantic. Annual expenditures were $800 million.

Operations were funded by an Air Transportation Tax levied on passenger tickets. This raised about $550 million in 1994. Revenues from fees on international flights generated another $50 million. The remainder of the expense was funded from general tax revenues.

The general view of the user community was that the system was underfunded and would not keep up with future requirements. Fiscal restraint in the federal government gave little comfort that new appropriations would be found as soon as they were required. At the same time, there was a feeling that government procurement, staffing, training, and labour relations processes were far too cumbersome and added unnecessary cost to the system.

1.2 Structure of the Corporation

The term "commercialization," as is it used by the Canadian government, refers more to a series of desirable traits than to a specific structure. A commercialized ANS would manage resources and people efficiently, be responsive to user needs and be able to rapidly adopt new technologies, would make decisions on commercial principles, and would have access to capital markets. Several models were discussed, including a Special Operating Agency of government, a Crown Corporation, a government owned - company operated enterprise, a mixed enterprise, a not-for-profit corporation, and a fully privatized enterprise.

In the end, a not-for-profit corporation, reporting to a stakeholder Board of Directors was chosen. NAV CANADA was incorporated as a non-share capital corporation. Excess revenues must be reinvested in the corporation, used to pay down debt, or repaid to the users in the form of decreased fees. The Board is composed of five members

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[2] *The Study of the Commercialization of the Air Navigation System in Canada*, Appendix A, p. 5.

nominated by the industry, two by unions, three by the federal government, and four by the board itself, plus a Chief Executive Officer.[3]

1.3 NAV CANADA Unions

At the time of transfer, the employees involved in operations were represented by a number of small employee bargaining agents. The Canadian Air Traffic Control Association (CATCA) represented the air traffic controllers. The Air Traffic Specialist Association of Canada (ATSAC) represented Flight Service Specialists, who provide a range of services from weather briefing and flight planning to arrival advisory and ground vehicle control at airports without towers. Operational Support Specialists (OSS), who provide data support at the Area Control Centres, and electronic technicians were represented by their own unions.

Some managers at NAV CANADA suggested that it would be appropriate for these groups to merge at the time of transfer to form a single bargaining unit for NAV CANADA employees. This approach did not find much support among the unions, which were preoccupied with transition issues and, perhaps, distrusted management's intentions. In any case, such a merger would have faced a number of institutional impediments.

2.0 The Canadian Auto Workers Union

The Canadian Auto Workers Union (CAW) is a major force in unionized labour in Canada. It is the bargaining agent for workers in a broad range of industrial sectors. In aviation, it represents mechanics and ground workers at some airlines.

The Canadian Auto Workers was formed in 1985, when the Canadian workers broke away from the United Auto Workers. This rift

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[3] *Commercialization of the Air Navigation System*, page 8.

reflected national differences in approach to bargaining and divergent views of the role of unions.[4]

By the 1970s, Canadian workers had achieved wage parity with unionized auto plants south of the border. This shifted the focus to domestic issues such as job policies and industrial strategies, legislated wage controls, labour laws and employment standards. The Canadian membership was less inclined to accept the transformation of the labour relationship implied by globalization. This nationalist sentiment was reinforced by the protracted debate surrounding the Free Trade Agreement between Canada and the US. Canadian leaders increasingly saw political militancy as an appropriate role of the union.

The Canadian union membership was also less inclined to accept settlements that included concessions and felt that the UAW too easily acquiesced to management demands for a new labour relationship. As the relative power of US labour declined, Canadian autoworkers increasingly saw more value in domestic rather than transborder wage comparisons.

Since its formation, the CAW has played an important part in national and provincial politics, including coordinating job actions and other forms of militancy and funding advertising campaigns against political parties that opposed its nationalist agenda. Some political pundits have suggested that its flamboyant leader, Basil (Buzz) Hargrove, has designs on forming a political party that is more left-leaning and militant than the New Democratic Party, which was once a strong social democratic "third party," but has had only token representation in recent years in the increasingly balkanized federal parliament.

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[4] This topic is described in greater detail in Gindin, Sam (--) Breaking Away: The Formation of the Canadian Auto Workers (CAW web site www.caw.ca)

The CAW is also known for taking a hard line at the bargaining table, and it is not overly concerned about whether its members are in a legal strike position or not. As Hargrove summed up the CAW approach in a recent speech:

> So we told the employers, that's not how we operate. We're going to the bargaining table and we don't care if the workers have the right to strike or not, we will find a way to put the heat on you to defend the interests of our members, so you had better bargain now.[5]

The CAW is not without its detractors in the house of labour, however. It has been accused of raiding other union memberships, and was recently expelled by the Canadian Labour Congress for a period.

3.0 First Contract Issues – ATSAC

The Flight Service Specialists (FSS) had been represented by ATSAC since they had decertified from the Public Service Association of Canada (PSAC) in the early 1980s. This move had been prompted by the sentiment that the needs of the small employee group were ignored and perhaps used as bargaining chips for larger employee groups in PSAC.

There had been a number of discussions about merging with CATCA, but these tended to founder over concerns of Visual Flight Rules (VFR) controllers, who worked in airport control towers. The work of a VFR controller is similar in many respects to the advisory service provided by FSS, but pay levels are considerably higher. The two groups were separated by a historical peculiarity. FSS had evolved from a technical trade referred to as the Radio Operator (RO) group in the civil service. However similar the duties had become over the

[5] Speech Of CAW President Buzz Hargrove To CAW Joint Council December 8-10, 2000.

years, air traffic controllers are classified in the AI group, and little progress had been made in merging these categories.

The ATSAC membership had been without a new contract since the early 1990s, when the existing contract had been extended through legislation. Since that period, it had been extended twice, and was due to expire in 1998. By this point, salaries had been frozen for seven years. Like all NAV CANADA employee groups, the FSS expected to "catch up" some wage increases in salary negotiations.

Notice to bargain was filed in January 1998 under the Canada Labour Code. This was new territory for ATSAC – as a former civil service union, it had negotiated its contract with Treasury Board, and this framework is different in many respects.

The ANS Act, by which NAV CANADA was created, contained references to essential services that would have to be maintained in the event of a work stoppage.[6] In the corporation's view, the details had to be negotiated before employee contract negotiations. ATSAC's position was that these could be negotiated at the same time. The union's view prevailed, but it made interim agreements with NAV CANADA on the provision of essential services.[7]

The key issues for ATSAC included:

- catching up to AI wage levels (tower controllers),
- reducing work week to the match the AI contract,
- all overtime at double time,
- an improved severance package,
- a shorter averaging period for shift schedules,

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[6] Statutes of Canada 1996, Chapter 20, *An Act respecting the commercialization of civil air navigation services*

[7] The parties could not agree on specific provisions and referred the matter to an arbitrator.

- a grievance procedure compatible with the Canada Labour Code, and
- entrenchment of various past practices that had not been included in the previous contract.

NAV CANADA wanted to achieve some fundamental changes in the new contract:

- a variable length shift plan called "shift logic," which would have matched workforce more closely to demand, but also made it difficult for employees to trade shifts, since they would be of differing lengths,
- eliminating a change to sick leave provisions and replacing these benefits with a short term disability plan which would provide no benefits for the first two days away from work, but would add five casual days off per year,
- abolishment of past practices not in the existing contract and
- pay raises not to exceed 10 per cent over three years without equivalent increases in efficiency.

For the ATSAC membership, the key issues were increased wages, and no change to the sick leave package or the shift scheduling mechanism. The sick leave issue bears some explanation. Most FSS units underutilized their sick leave, and employees carried it over from year to year. In the ATC system, however, there were legendary abuses of the sick leave system to maximize overtime pay. The exact extent of the practice is a matter of debate, but its existence was not. It amounted to an "on-demand" leave program at some of the larger units, and management clearly wanted the issue addressed. The ATSAC members felt that they should not be disadvantaged by a system put in place to discipline behaviour in another employee group. All parties realized, however, that management would eventually like to harmonize the provisions in contracts across employee groups.

The contract negotiations went on for 50 meeting days. The company negotiators apparently did not believe that the shift scheduling issues

were that important to the rank and file members. The union negotiators considered it a "lock-out issue, " because the long averaging period sought by the company would allow it to "seasonalize" work, requiring more work time from employees in the summer season, when leave was in greatest demand.

4.0 First Contract Issues – CATCA

The Canadian Air Traffic Controllers Association had a membership of approximately 2,100[8] and had supported commercialization. The wage and hiring freezes that had accompanied federal budget control measures through the late 1980s and early 1990s convinced many members that they would not fare worse under a professional management that would value their services on operational criteria rather than political expediency.

Like ATSAC, CATCA members had seen their contracts extended during the period of commercialization, and sought a significant "catch up" in their first agreement under NAV CANADA. A wage freeze from 1994 to 1997 applied to both economic and incremental increases.[9] The major issue for controllers was equalizing with international comparators – in other words, seeking parity with US and European controllers.[10] The hourly pay of Canadian controllers ranked 12 of 14 countries studied.

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[8] This included 1,755 operational controllers of whom 1173 worked in 7 area control centres, 562 in 44 air traffic control towers and 20 in the stand-alone Ottawa terminal control unit. Figures from Burkett.
[9] When NAV CANADA assumed control of the ANS, it returned all employees to the increment level they would otherwise have been at as of November 1996. This was not retroactive and cost the employer approximately $10 million (Burkett).
[10] Exchange rates also play a factor. The Canadian dollar, which had traded at 1.16 to the US dollar in January 1990, was trading at 1.53 to the dollar by the end of 1998 (Bank of Canada figures).

In bargaining, CATCA also discovered that management sought considerable changes to the work rules. It wanted greater flexibility in scheduling (the "shift logic" mentioned previously), changes to the sick leave package that would make abuse more difficult, and increases to the hours of work.

The consultant study conducted for the employer in 1997 indicated an average of 12.4 days per annum of sick leave across the system with a 15-day average at the major operational facilities. NAV CANADA also asserted that more than 90 per cent of uncertified sick leave days were taken one day at a time, and the majority were taken on the day before or at the end of a scheduled work shift, effectively increasing the employees paid time off.

The shift schedule that had been inherited from the government produced 222 available days of work per year per controller, but because of scheduling issues, this generated between 203 and 215 available working days. This compares with the US, where controllers have a 40-hour work week generating 261 available work days per controller per year, less annual leave lieu days and sick leave.[11]

The union found management far less sympathetic to its salary demands than it had hoped. NAV CANADA sought to reduce its cost of operations significantly by closing redundant facilities, reducing administrative overhead and, unsurprisingly, holding the line on salary increases. As the corporation switched from funding operations through a ticket tax to user fees, air carriers proved extremely sensitive to any cost increases.[12]

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[11] In the United Kingdom, controllers work a 40-hour work week, generating 225 days of work annually. Other examples include Germany (231 available days), Australia (210 available days), and New Zealand (243 available days) (Burkett).

[12] For more detail on the user fee consultation, see Kaduck, Fee-setting in Canadian Domestic Air Navigation Services.

The union felt that ability to pay was not the issue, because user fees flow through, as the airlines obtain full cost recovery from the passengers. It calculates that, regardless of the level of any surcharge, it would only have to be increased by $1.00 (based on 1997 passenger loads) in order for NAV CANADA to fully recover the cost of a 30 per cent increase.

5.0 Bargaining and Ratification

The two contracts were negotiated during the same period, and events related to one contract tended to affect the other. The CATCA contract was particularly contentious because the wage expectations of controllers were fundamentally unacceptable to management, which had no interest in historical discussions. It held that wages could only rise more than 10 per cent if there were efficiency gains to the corporation to offset the additional amounts. Its shift logic and sick leave provisions were resisted strongly by the union.

A tentative agreement was reached on March 21, 1998. The union won substantial economic gains (in the area of 22 per cent over 3 years), but made significant concessions in the area of shift scheduling, hours of work and sick pay arrangements. Base pay increases of 4, 3 and 3 per cent applied to all employees, and a 12 per cent was provided in the form of an increased operational facility premium (OFP), which was allocated to largely to employees in the Area Control Centres (ACCs). The OFP for an ACC employee would rise from $6,967 to $28,711 by the year 2000.[13] The CATCA Board of Directors split 7-5 in favour of recommending the tentative agreement, but it was overwhelmingly rejected by the membership.

Eventually, the matter was referred to a conciliator, Kevin Burkett, who convinced the employer to submit a revised comprehensive proposal. This proposal addressed a number of the economic concerns expressed by the union and raised the average increase to 29 per cent over the three-year term. It did not modify the productivity

[13] Figures from Burkett.

concessions contained in the tentative agreement. The new union bargaining committee, however, was unwilling to discuss productivity enhancements and the employer representatives were equally unwilling to discuss further economic concessions.

In May 1999, Burkett presented the federal government with a report. He found that if international comparators were used, as both parties agreed they should be, a substantial catch-up salary increase was justified, but also that significant improvements in unit-wide productivity should be achieved. He rejected the union claim that the shift logic sought by the employer compromised safety, but he rejected the employer sick leave program, which would have denied pay for the first sick leave day of absence. He found this inappropriate in a work environment in which controllers are required by statute not to work if they are impaired or taking medication that might impair their performance.

According to union spokesmen, NAV CANADA wanted to negotiate down from the suggestions contained in the report. The union considered the report recommendations the minimum acceptable set of conditions.

The government was faced with a dilemma. The absence of a new contract made the conditions for a strike ambiguous. The union claimed that it had a right to strike, and to withdraw all but essential services. NAV CANADA maintained that services had to be maintained, even if the union went on strike. The process for determining what services had to be maintained was the subject of a Canadian Industrial Relations Board (CIRB) hearing that was scheduled to take 81 days, but was nowhere near completion.

As Parliament approached its summer recess in June 1999, the government prepared legislation that would remove the air traffic controllers' right to strike. This protected the government against a job action in the summer that would have required Parliament to be reconvened. Faced with the threat of having its right to strike removed permanently by legislation, CATCA signed a contract that

was essentially, in the jargon of the labour movement "Burkett-plus." This was achieved largely through the advice the union received from the CAW's negotiator, Gary Fane.

The ATSAC negotiations took place in the shadow of the CATCA bargaining, but were somewhat more advanced by the spring of 1999. By the time the Burkett report was issued, ATSAC was already in the midst of its ratification process, but when the Burkett-plus deal was announced, the sentiment turned strongly against the negotiated contract. The general belief was that more could be gained by rejecting the contract, as the controllers had. Faced with this sentiment, ATSAC President Ron Smith cancelled his ratification tour and approached CAW President Buzz Hargrove "for help with this employer."

The failed ATSAC collective agreement led to a new round of negotiations. While CATCA had brought CAW on board only after the conciliator's report had been delivered, ATSAC wanted CAW involvement in the negotiation stages. Fane was instrumental in getting a conciliator who proved to be sensitive to union concerns, and in narrowing the scope of negotiations to a few key items. ATSAC, with CAW backing, did not concede to the imposition of "shift logic" or an unfavourable sick leave program.

6.0 The Road to Merger

While the Burkett report and the CATCA settlement were the catalyst for a merger between CAW and ATSAC, the seeds had been sown long before. Smith had first met CAW's Fane in 1997, at the CATCA convention, where there had been some sentiment in favour of a CAW-CATCA merger.

For Smith, however, the logic of a CAW-ATSAC merger became more compelling as the employer-employee relationship clarified. For one thing, NAV CANADA took a legalistic approach to reconciliation of grievances. As unresolved grievances built up, management made increasing use of lawyers, rather than resolving

the issues through consultation with the union. Unlike CATCA, ATSAC is not a wealthy union. It has less than half of the membership and pay levels are considerably lower.[14] Legal fees were an increasing concern.

The Auto Workers union was also very familiar with the Canada Labour Code, under which the new negotiations took place and its deep pockets made it clear to the employer that it could easily absorb the costs of the conciliation process. Most importantly, however, the profile of the CAW and its high-level connections made it a credible bargaining agent. When ATSAC proposed the merger, it was endorsed by more than 90 per cent of ATSAC members.

For CATCA, financial issues played a minor part in the merger. The union did, however, want the strength and credibility of a larger organization. Two mergers were discussed. The possible candidate was the National Air Traffic Controllers Association (NATCA) in the United States. A merger referendum was organized with both of these organizations on the ballot. As the referendum approached, however, it became clear that NATCA would have to make constitutional changes to allow a merger to take place, which could not be completed in time for the referendum. The process, however, was already well advanced, and CATCA members were eventually asked to vote on a single issue, whether the union should merge with the CAW. This was ratified by a slim majority of 52 per cent.

7.0 Observations and Conclusions

The stated goal of NAV CANADA management to merge the numerous unions it inherited from the civil service into a single employee group was a rational enough proposition. Whether it would

[14] In 1979, there were close to 1,800 RO group employees in the bargaining unit. Currently, ATSAC represents approximately 800 Flight Service Specialists (NAV CANADA employees) and 200-300 Coast Guard Radio Operators. There was considerable sentiment that this did not provide a strong enough base for a national union.

have seemed as appealing with the CAW representing the majority of its operating employees is an open question.

It can be reasonably assumed that the CAW will try to establish the kind of pattern bargaining that is used in the auto sector, using the ATC negotiations as the benchmark for other bargaining units.

The credibility of CAW with air traffic controllers will be tested in this collective agreement. The 52 per cent merger ratification is hardly a ringing endorsement. The CAW was not part of the CATCA contract negotiation process, as it was with ATSAC, and members will have to assess whether it is effective or not. In the absence of any counterfactual evidence, this assessment will be based at least partly on how it manages the expectations of the membership.

The involvement of CAW in the ATSAC negotiations brought significant experience and political leverage to the table. The financial strength of the Auto Workers also increased ATSAC's strength.

Until the essential services agreement with the controllers is concluded, the balance of power at the bargaining table is difficult to assess. The CIRB board is unlikely to release its report before early 2002. If the right to strike is preserved, CATCA will increase its bargaining power, but is unlikely to use the weapon indiscriminately. Not only would this likely draw government action, the union would gain little public favour by shutting down the ANS. There are a myriad of ways that controllers can slow the system down short of a full strike, however.

A dysfunctional form of bargaining has emerged in which employees are rewarded by rejecting the agreements of their bargaining teams and seeking further concessions. This erodes the credibility of union leadership at the table, and creates an incentive for the employer to hold back concessions for fear that the union will get "a second bite at the apple." The presence of the CAW is likely to improve this situation. Its "no concession" policy and willingness to take job

actions will increase its credibility at the bargaining table. It also brings significant bargaining experience, deep pockets and a level of political influence that has never been seen in past ANS negotiations.

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ROTARY WING AVIATION IN CANADA

Joseph Monteiro and Benjamin Atkinson*

Introduction

Rotary wing services or helicopter services play a small but important role in aviation in Canada. It provides a vital lifeline to locations inaccessible by other forms of transport. It is essential for emergency medical services and is often a deciding factor in life and death to individuals who have been involved in serious accidents and have to be moved to medical facilities immediately. Its services are also non-substitutable to industries such as offshore oil and gas, forestry, mining and resources in remote areas. Its importance and non-substitutability in certain situations are thus undeniable.

In this paper, the structure of the Canadian helicopter industry will be examined in Part I. In Part II, the regulations affecting this industry will be examined in the pre-deregulated era and thereafter. In Part III, the extent of competition in the helicopter industry will be briefly examined. Finally, a few concluding remarks will be offered.

I. Structure of the Canadian Rotary Wing Aviation Industry

a) The Structure of the Canadian Rotary Wing Aviation Industry

In 2000, more than 1000 rotary wing aircraft operated in Canada. The bulk of the aircraft fleet (i.e., eighty percent) consists of aircraft in Class A Group, followed by aircraft in Class C Group (i.e., fourteen percent). The aircraft in the other classes (Class B, Class D and Class E) account for less than four percent of the fleet. Classes indicate the weight groups (kilograms) of the aircraft.[1] In the Class A Group, the most popular aircraft was the Bell Helicopter 06 followed by the Aerospatiale AS50 both of which accounted for roughly seventy-five percent of the aircraft in this group. In the Class C group, the Bell

[1] For rotary-wing aircraft, the maximum authorized take-off weight on wheels is: Group A: less than 2, 000 kg; Group B: 2, 000 to 3, 402 kg; Group C: 3, 403 to 8, 165 kg; and Group D: 8, 166 to 15, 876 kg.

Helicopters 12 (i.e., model 212/412) and UH1 (model 204B/214B) consisted of the backbone of the fleet accounting for approximately seventy-five percent of the fleet. In the Class D group, the Sikorsky 61 made up sixty-five percent of the fleet. These statistics are shown in greater detail in table 1.

The rotary aircraft indicated above were operated by about 170 aviation companies. Eighty-eight percent of these companies were small, operating less than ten helicopters; seven percent were medium sized companies that operated between ten to fifteen helicopters; and the remaining five percent were large companies operating sixteen or more helicopters (see table 2). Canadian Helicopters International, the largest helicopter company and the only one which has bases throughout Canada, accounted for 15.75 percent of the total number of rotary wing aircraft operated. The largest four Canadian helicopter companies accounted for 28.53 percent of all rotary wing aircraft and the largest eight companies accounted for 40.06 percent of all helicopters in Canada (see table 3). This suggests that the overall structure of the Canadian helicopter industry is not concentrated. The above statistics do not include helicopters of subsidiaries operated by these companies.

The above structure has resulted from a number of factors over time, the most recent were the sale of the domestic operations of the largest helicopter company in Canada, Canadian Helicopters International (i.e., CHI)[2] to a newly formed company Canadian Helicopters. The filing for protection from creditors by Northern Mountain (the second largest helicopter company) and the purchase of a substantial part of Northern's fleet by Vancouver Island Helicopters (the third largest). The shutting down of the operations of the tenth largest company, Peace Helicopters Ltd. of Edmonton. And finally, consolidation and mergers that have occurred in the industry. The helicopter industry believes that there is need for further consolidation to lower the number of operators and the number of helicopters.

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2 CHI purchased the largest helicopter company in the world in late 1999 before selling its domestic operations to concentrate on the offshore business.

This industry (levels 1-1V) had an operating revenue of $564m. in 1999 compared to $708m. in 1998 representing a 20 percent decrease. Total operating expenses for the two years were $530m. and $640m. or a decrease of 17 percent. Operating income decreased to $34m. from $69m. or 51 percent. After adjusting for other expenses and income taxes, net income decreased to $19m. from $27m. or 30 percent. A more complete picture of the helicopter industry can be obtained by examining the structure at the regional level and the type of activities that these companies engage in.

b) The Canadian Helicopter Industry by Region

(1) Newfoundland and the Maritimes: In Newfoundland (including Labrador) and the Maritimes, the traditional focus of helicopter activity is offshore oil and gas exploration and some government contracts. These activities generated an estimated 18, 305 helicopter hours flown in 1999 (see table 6) or 4.79 percent of the total. These hours flown in Atlantic Canada's offshore were provided basically by CHC and Cougar Helicopters together with Universal Helicopters in the Labrador.

Atlantic Canada's offshore helicopter activity has attracted attention for some time.[3] Since 1995, more than $700m. in exploration commitments have been announced for four regions within the Atlantic Canadian offshore (the Jeanee d'Arc Basin, Scotian Shelf, Sub-Laurentian Basin and the St. Pierre Bank). In 1999, Canada-Newfoundland Offshore Petroleum Board called for bids on ten parcels of land totalling more than 1.3m hectares in the Newfoundland offshore area. This area in which oil exploration occurs is considered as 'flourishing' with a positive, upward rate of growth. In particular, the Hibernia Project, the White Rose Projects, the Sable Offshore Energy Project, and the Terra Nova project have been major sources of demand for helicopter services. These and other oil and gas projects in offshore

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3 Mike Reyno, "Industry in a Hover", Helicopters Magazine, Issue 4, 2000, pp. 8-36 and Alan Cram, "East Coast Offshore Oil Sector Flourishing", Helicopters Magazine, Issue 2, 1999, pp. 38-39.

Nova Scotia will create a heavy demand for helicopter support services well into 2000 and represent a significant long-term opportunity.

(2) Québec and Ontario: In Québec, the traditional focus of helicopter service is: hydro; forestry; and mining. In addition, some of the service is devoted to emergency medical service in Ontario. These activities generated an estimated 62, 675 number of helicopter hours flown in Québec and Ontario in 1999 or 16.4 percent of the total hours flown. Of these hours flown approximately 73 percent were provided in Québec. In this Province the major helicopter operators are: CHC (Eastern Division); Heli-Inter Inc.; Les helicopteres Abitibi Ltee; and Heli-Max Ltée Ltd., whereas in Ontario the major helicopter operators are: CHC; and National Helicopters.

The helicopter business in Québec initially dominated the demand for helicopter services in this industry due to the James Bay hydro project in the 1970s. This demand has since witnessed a steady decline in this Province. Consequently, a consolidation has occurred in helicopter operations in Québec. Heli-Inter bought Heli-Excel Inc. in April 2000 and Heli-Manicouagan Inc. a few months later. This was followed by the purchase of Heli-Wasq.

(3) Saskatchewan and Manitoba: In Saskatchewan and Manitoba, the major sources for helicopter services arises from Forestry, and Hydro/Energy. These services were estimated to be 12, 229 hours flown in Manitoba and Saskatchewan in 1999 or 3.2 percent of the total hours flown with approximately 84 percent of this business originating in Manitoba. This demand for helicopter services in Manitoba has been steady compared to the historical decline in the demand for such services in Saskatchewan. These services are provided in Manitoba mainly by: Custom Helicopters Ltd. and Midwest Helicopters. In Saskatchewan the major helicopter service providers are: North Central Helicopters Ltd.; Transwest Air; CHC; and Highland Helicopters Ltd.

(4) Alberta and British Columbia: In Alberta, helicopter services have traditional been provided to the oil and gas and mining industry;

and in British Columbia the focus of helicopter activity is on forestry, mining, seismic activity, tourism and skiing. These activities resulted in an estimate of 201,210 helicopter hours flown in Alberta and British Columbia in 1999 or 52.65 percent of the total hours flown. Of these hours about 23 percent were provided in Alberta and 77 percent in British Columbia. In the former Province the major helicopter operators are: CHC (Western Division); and Aerial Reconnaissance Surveys Ltd. In the latter Province the major helicopter operators are: CHC (Western Division); Vancouver Island Helicopters; Alpine Helicopters, Highland Helicopters, Conair Group Inc., Yellowhead Helicopters Ltd., Prism Helicopters Ltd. and Helijet Airways.

Since the 1980s, British Columbia has accounted for the largest share of helicopter services demanded in Canada displacing the Province of Québec. It is therefore not surprising that the largest domestic helicopter operators in Canada have their head offices in Vancouver and Alberta (other than CHC (Eastern Division)). Historically, the demand in British Columbia originated from the forestry sector in activities resulting from logging, forestry management, forest fires and some seismic activity. In more recent time, the demand for helicopter services has also arisen from tourism, recreation and emergency medical services.

(5) Yukon and Northwest Territories: There are three major sources of revenue for helicopter operators in the Yukon and Northwest Territories: fires, mining exploration, and resupply. This revenue was generated from an estimate of 57, 019 helicopter hours flown in Yukon and Northwest Territories in 1999 or 14.92 percent of the total hours flown. Of these hours about 87 percent originated from the Northwest Territories. In these Provinces the major helicopter operators are: Great Slave Helicopters Ltd. and Remote Helicopters Ltd.; and Trans North Air. The demand for helicopter services in the Yukon has been steady since the mid 1980, however, in the Northwest Territories after a brief decline in the early 1990s it has increased.

(6) Foreign Areas: Canadian helicopter operators flew an estimated

30, 688 hours or 8 percent of total hours in foreign areas. In these areas the major helicopter operators are: CHC Helicopter Corporation; Cougar Helicopters; Abitibi Helicopters and Midwest Helicopters. The significant foreign markets in which CHC is directly involved in are: Ecuador, Azerbaijan, Saudi Arabia, Philippines, Myanmar, Thailand, Equatorial Guniea, Bangladesh and Bosnia. Further, through its international subsidiaries: Helikopter Services A.S., Stavanger, Scotia Helicopter Services Ltd., Aberdeen, Lloyd Helicopter Services Ltd., Adelaide and Court Helicopters Ltd., it provides services in Norway, United Kingdom, Ireland, Denmark, Australia, E. Timor, South Africa, Mozambique, Namibia, Angola, Nigeria and Brazil. The major foreign markets in which Cougar Helicopters and Abitibi Helicopters are involved in are Thailand, Albania, and Mexico, respectively.

c) The Canadian Helicopter Industry by Market Activity

The helicopter industry can also be examined by various types of market activity. Unfortunately, statistical data on the division of this market activity are not available from government sources. Market studies, however, do suggest that this market activity could possibly be divided into: Forestry (Heli-logging, combatting forest fires, pesticide spraying, and environment); Mining; Oil and Gas; Construction; Hydro;

Emergency Medical Services and Police patrolling; Reconnaissance and Surveys; Flight Training; Tourism and Skiing; and Offshore Supply. Most of this activity is specific to certain regions largely determined by their natural endowments. To provide some indication about the types of this market activity, the types of market activity undertaken by Canadian Helicopters will be considered as representative. (This is because it is the largest helicopter company which accounts for more than 15 percent of helicopter revenues generated within Canada. Further, it is assumed that the largest Canadian helicopter company would conduct its operations where a reasonable market exists, unless there are barriers to doing so). This is shown in the pie chart above, which is based on a four year average activity of Canadian Helicopter operations in the domestic market that has been calculated from their Annual Reports (1996-1999).

d) A Brief Comparison of the Structural Changes between 1986-1999

In April 1986, there were approximately 117 helicopter companies operating 747 rotary wing aircraft compared to 170 companies operating 1041 aircraft as of October 1999. The largest helicopter companies that existed in 1986 and 1999 are shown in tables 3 and 3A. In 1999, the largest companies accounted for 40 percent of total number of rotary aircraft compared to 45 percent in 1986.

A number of the companies that existed in 1986 and were popular names no longer exist today. The top three companies in 1986 - Okanagan, Sealand and Viking - are no longer on the list. Okanagan, Sealand and Toronto Helicopters merged to form Canadian Helicopter Corporation (i.e., CHC) in 1987. Two years later CHC acquired Viking. Thus the largest helicopter company in Canada, which was to dominate the scene for the next 15 years in Canada, and to become the largest helicopter company in the world in 1999 evolved from the largest three helicopter companies in 1986. The only two other companies that continued to remain on the list are Highland Helicopters and Alpine Helicopters. The other helicopter company, Northern Mountain Helicopters went out of business in 2000 and the majority of its fleet was purchased by Vancouver Island Helicopters Ltd., now the

second largest helicopter operator in Canada.

In 1999, CHC acquired Norwegian consortium Helicopter Services Group ASA (HSG) of Oslo (i.e., HSG), consolidating the offshore world helicopter industry. With this acquisition, CHC was ranked the largest helicopter company in the world and has largely grown to this position after acquiring more than 34 helicopter companies. A year later, CHC sold its domestic operation to a new company named Canadian Helicopters consisting of two divisions Western and Eastern. This company until late 2000 was the largest helicopter company in Canada with approximately 155 helicopters, 750 employees and annual sales of more than $90 million.

Overall, a number of mergers have occurred in the industry since the mid 1980s resulting in consolidation in the helicopter industry, a process that is still ongoing and is expected to continue. Based on these mergers one would have expected concentration to have increased, however, it has declined marginally since the mid 1980s largely as a result of new entry into the industry.

II. A Comparison of Regulations in the Pre-Post Deregulation Era

a) Regulations in the Pre-Deregulation Era

During the pre-deregulation era the basic laws applicable to the helicopter industry were contained in the: *Aeronautics Act*, and *the National Transportation Act*. Other regulations made pursuant to these laws that were relevant were the *Air Carrier Regulations, Base Protection Regulations* and *Class 4 Positioning Charges*. These regulations were administered by the Air Transport Committee of the Canadian Transport Commission and Transport Canada. The important facets of economic regulation in 1980, that is before the helicopter industry was deregulated were: 1) entry control of carriers by regulating licence applications[4] and nature of services through restrictions on class

[4] For a historical background which traces the beginning of economic regulation since 1951 see Commercial Helicopter Operations A Review of Economic Regulation, Operating Environment and Results, Air Transport Committee, CTC, 1983. See sections 16(1) and (3) of the *Aeronautics Act* and s. 9.1 of the *Air Carrier Regulations*. Suspension, cancellation or amendment is provided for in s. 16(8) of the *Aeronautics Act*.

of aircraft, area of operation, type of service e.g. charter, speciality, etc.;[5] 2) tariff filing which provides for the filing of short term and long term tariff charters,[6] its adherence to and its control in the event of complaints (i.e., tariffs are unjust and unreasonable, unduly discriminatory, or tariffs that give undue or unreasonable preference,[7] etc); 3) acquisition by helicopter companies of an interest in other transportation companies;[8] and 4) appeal of rates.[9] As a result, the helicopter industry was tightly regulated.

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5 See section 16(6) of the *Aeronautics Act*.

6 See sections 112(1), 112(3), 112(3)(a) of the *Air Carrier Regulations*. A 30 day notice period for tariff amendments was required, however reductions to match a competitor could be made in a day with permission.

7 See sections 113(2), 113(3) and 113(4) of the *Air Carrier Regulations*. Also see sections 112 to 114 of the *Air Carrier Regulations* pertaining to suspension or disallowance or any tariff or toll, substitution or prescription of another. Section 23 of the *National Transportation Act* pertaining to appeal of freight rates which may be prejudicial and section 20(4) of the *Air Carrier Regulations* pertaining to base protection.

8 See section 27 of the *National Transportation Act* and 22.1 of the *Air Carrier Regulations*.

9 See section 63 of the *National Transportation Act*.

In response to the needs of the industry, the Minister of Transport initiated a period of relaxed regulations on April 29, 1980 which took effect on August 1, 1980. As a result, already licenced helicopter charter and speciality service carriers were exempted from all but the financial requirements of licencing (including public convenience and necessity) so that they might provide services using helicopters in weight groups for which they were not authorized. Further, helicopter charter carriers were freed from the requirements to file long-term rates for charters of 30 days or more.[10]

b) Regulations in the Post-Deregulation Era

The process of deregulation for rotary wing aviation which began in 1980 was codified in the *National Transportation Act, 1987* for the entire aviation industry. A new licencing test based on safety and insurance requirements, entitled 'fit, willing and able' was established. Licences would no longer restrict competition by imposing limitations on type of service, (routes, class of service, base protection, positioning charges, etc.)[this does not apply to services to northern and remote areas s. 72(2)(b) and (4) of the NTA]. Regulation of tariffs were eliminated, however the National Transportation Agency would be able to investigate complaints about unreasonable fare increases (s. 80(2)) and carriers would be prohibited from charging fares in excess of those published and in effect (s. 83). The review of an acquisition by a Canadian transport undertaking by the Agency was retained and the review and appeal mechanism by the Agency was retained (ss. 64&65).

The amendments to the above Act (now the *Canada Transportation Act* i.e., CTA) in 1996 removed the last of the residual restraints on

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10 The results of this partial deregulation were reported in Commercial Helicopter Operations A Review of Economic Regulation, Operating Environment and Results, Air Transport Committee, CTC, 1983. Thereafter the CTC conducted public hearings into the economic regulation of this industry and published its findings in Report of the Panel on Helicopter Hearings, 1984. It made five important recommendations: 1) to extend the period of relaxed regulation; 2) to neither reinstate the Class 4 Position Charges and or the Base Protection Regulations; 3) to modify the public convenience and necessity test; 4) to extend the exemption from the requirement to file long term charter tariff rates; and 5) to exempt the long term charter tariff provisions from section 113 of the *Air Carrier Regulations*.

services to northern and remote areas. All domestic air service licences are now subject to the same entry and exit requirements for all operators. Further, the review of an acquisition by Canadian transportation undertakings by the Agency was deleted.

c) Recent Regulatory Developments

On July 5, 2000, amendments to the CTA went into effect. These amendments have a few implications for the helicopter industry. First, *scheduled* domestic helicopter monopoly service falls under the regulatory authority of the Agency where: passenger fares and cargo rate increases are unreasonable; or the range of fares and rates are inadequate; or fares and rates applied are not in tariffs; or unreasonable or unduly discriminatory terms or conditions are applied, in the event of a complaint. This, however, does not apply to helicopter charter or contract rates where parties agree to keep such fares, rates, charges, or terms or conditions of carriage confidential. Second, the amendments to the *Competition Act* relevant to the helicopter industry include: cease and desist powers in case of predatory behaviour; new powers to deal with anti-competitive behaviour; and powers to prohibit the use of exclusive clauses in confidential contracts for domestic service to encourage competition for corporate travel. Third, airline mergers are now subject to a formal three track merger process. It is expected that these amendments will not have a significant impact on the operations of the helicopter industry or regulatory intervention by the Agency.

III. The Extent of Competition in the Industry

An examination of competition would require a review of the competitors in the market and consideration of whether substitutable services exist both from within the helicopter industry and from other sources (eg. fixed wing aircraft, road, water) together with the consideration of barriers to entry into the helicopter industry.

To examine the extent of existing competition within the helicopter sector, the number of licences held by large and medium sized

helicopter operators (i.e, with ten or more helicopters)[11] in each province were examined and the bases at which they operated were tabulated. As can be expected, a large proportion of these operators are located in B.C. and Alberta. An examination of the bases in each province where they operated indicates that of the 127 bases where they operated 12 bases had two operators, 6 bases had three operators, and the remaining 85 bases had only one operator (see tables 8-9). Thus, direct competition from a base is limited to a few (18) bases. The statistics in the tables do not include the number of smaller operators that may have licences from the same base.

11 This covers fifty percent or more of the total market.

The extent to which operators from the same base or surrounding bases can compete depend on the substitutability in the product and geographic markets.[12] In considering product substitutability, there must be evidence that helicopter services are responsive to price changes from the same base. Helicopter service from the same base may not always be substitutable as operators may have aircraft of different sizes. For example, if one helicopter operator had Class A aircraft and another had Class C or Class D aircraft (or if the aircraft were VFR vs IFR), the two operators are not competitive from the same base since the hourly rate for the two aircraft are considerably different. Fixed wing aircraft hourly rates are also not comparable and it is doubtful whether they are substitutable since the other facilities needed by fixed wing aircraft are not available for rotary wing aircraft. Other modes of transport (for example road and water) are generally not competitive on a price basis as they are much cheaper than helicopter services if they are substitutable at all. In determining the latter, indirect evidence of substitutability will have to be considered. All helicopter services are not substitutable, for example helicopter services used for forestry are not substitutable with helicopter services used for emergency medical services, as specialized helicopters and crew are needed. Industry views, and behaviour of purchasers also indicate that it is not substitutable. An indication of this is that helicopter operators usually specialize in the provision of EMS services. Further, evidence of demand elasticities and cross-elasticities is needed in determining if the alternatives are substitutable. However, these elasticities are generally not available for this industry.

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12 Based on the *Southam* decision, the Judge indicated that several principles on the matter emerge. "(a) products can be said to be in the same market if they are close substitutes; (b) direct evidence of substitutability includes both statistical evidence of buyer price sensitivity and anecdotal evidence, emanating from buyers on past or hypothetical responses to price changes; (c) indirect evidence of substitutability may be garnered from certain practical indicia, such as functional interchangeability and industry views/behaviour; (d) statistical evidence of high-demand elasticity, if available, will be virtually conclusive that products are in the same market; (e) anecdotal evidence of price sensitivity, while less conclusive, can nevertheless be persuasive in tending to show that products are close substitutes; (f) the complete absence of either statistical or anecdotal evidence of high-demand elasticity does not show conclusively that products are not close substitutes; (g) even in the face of evidence disclosing low-demand elasticity, product substitutability may nevertheless be shown to exist, based upon indirect evidence such as functional interchangeability and industry views/behaviour."

The relevant geographic market determination involves consideration of whether the area is sufficiently insulated from price pressures from other areas so that its unique characteristics can result in prices differing significantly for any period of time from those in other areas. If helicopter services are available from nearby bases they have to be considered as substitutes. The evidence indicates that for immediate and short term work the market is 167 kilometres or less around the helicopters base or hub of operation. Whether these services are economical substitutes not only depends on the distance from the hubs but also the input costs in providing these services (for example if the price of gasoline is a significant portion of the cost then as it rises the less competitive will the services be from another hub). The evidence of users of the service and the industry is also important in delineating the geographic market.

Barriers to entry for example, licencing requirements, government regulations, exclusive contracts, etc. have to be considered. With deregulation most of the regulatory requirements of entry were removed. Short and long term contracts do exist in the industry which could act as a barrier to entry at least in the short term. There are no other significant barriers to entering this industry like fixed costs, economies of scale or scope, network economies, input supplies for example availability of helicopter pilots, etc.

Overall, while the market appears to be reasonably competitive, in any particular case the actual situation will have to examined in greater detail along the lines indicated above in arriving at any definitive conclusion.

Concluding Remarks

The helicopter industry continues to play a small but important role in the aviation industry in Canada. It provides varied services - such as heli-logging and cone picking, combatting forest fires, pesticide spraying; emergency medical services, reconnaissance and aerial surveys; flight training; supply and passenger services to remote areas and industries; and offshore supply services - which are generally non-substitutable. A number of developments have occurred in this industry, since the late 1980s.

First, Canadian Helicopter Corporation (CHC) acquired Helicopter Services Group ASA, creating the largest helicopter company in the world for offshore helicopter services whose head office is in Newfoundland. In addition, structural changes have also occurred with respect to the domestic helicopter industry. Companies that dominated the helicopter industry several years ago no longer exist. Of the largest eight companies that were in existence in the late 1980s, only two exist with the recent bankruptcy of Northern Mountain Helicopters.

Second, numerous mergers and acquisitions have occurred in this industry. These mergers and acquisitions are expected to continue according to industry analysts and further consolidation in the industry is anticipated. The speed with which these expectations will occur will largely depend on whether the decline in the demand for its services from the 1998 peak continues.

Finally, regulatory changes have also occurred. On July 5, 2000, amendments were made to the *Canada Transportation Act*. These amendments while relevant to the helicopter industry are unlikely to have a significant impact on the operations of the helicopter industry or regulatory intervention by the Agency.

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* *The views expressed are those of the authors and not necessarily those of the Competition Bureau. We would like to thank Mr. Henry Watt from the Resource Centre for searching for the background material on the industry and Mrs. Melanie Nera of the Canadian Transportation Agency for providing us with information on the current applicability of the air regulations to the helicopter industry.*

Table 1 - Rotary Wing Aircraft by Type in Canada - October 1999

Type of Aircraft	Class A	Class B	Class C	Class D	Class E	Total
AL02	1					1
AS50	185					185
B06	469					469
B47G	6					6
EN28	4					4
HH12	1					1
H269	17					17
H500	76					76
R22	38					38
R44	31					31
UH12	11					11
AL03		2				2
AS55		7				7
BK17		2				2
B407		12				12
EN48		1				1
GAZL		1				1
KMAX		2				2
MD60		1				1
B12			60			60
B222			6			6
S58P			3			3
S581			2			2
S76			22			22
UH1			58			58
AS32				3		3
H46				3		5
S61				16		15
H47					1	1
All Types	**839**	**28**	**151**	**22**	**1**	**1041**

Source: Fleet Report. Inventory of Commercial Aircraft in Canada. As of October 15, 1999, Statistics Canada, March 2000.

Table 3 - Rotary Wing Aircraft by Major Company - October 1999

Company	Class A	Class B	Class C	Class D	Class E	Total
Canadian Helicopters International	127	3	28	6		164
Northern Mountain Helicopters	41		9	2		52
Vancouver Island Helicopters	37	1	7			45
Highland Helicopters	36					36
Aerial Reconnaissance Surveys Ltd.	38	1				39
Great Slave Helicopters Ltd.	28	3				31
Alpine Helicopters Ltd.	14	1	16			31
Custom Helicopters Ltd.	17		2			19
Total of Above (1)	338	9	62	8		417
Total for Canada (2)	839	28	151	22	1	1041
(1)/(2)	40.3	32.14	41.05	36.36	0	40.06

Table 2 - Aviation Companies in Canada with Rotary Wing Aircraft - October 1999

# of Helicopters	1	2	3	4	5	6	7	8	9	10
# of Companies	44	27	29	14	13	6	10	2	4	4

Note: There were two companies with 11 helicopters; five companies with 13 helicopters; and one company with 15, and 18 helicopters. Those with more than 18 helicopters is shown in Table 3. Information tabulated from the Fleet Report. Inventory of Commercial Aircraft in Canada. As of October 15, 1999, Statistics Canada, March 2000.

Table 3A - Rotary Wing Aircraft by Major Company - October 1986

Company	Class A	Class B	Class C	Class D	Class E	Total
Okanagan Helicopter Ltd. (& Subs)	59		24	13		96
Sealand Helicopters Ltd.	16			8		24
Viking HelicoptersLtd. (& Subs)	53		4			57
Maple Leaf Helicopters Canada Corp.	35		4			39
Alpine Helicopters Ltd.	17		9			26
Highland Helicopters Ltd.	36		2			38
Les helicopteres ltd. Canada Ltée (& Subs)	33		2			35
Northern Mountain Helicopters Inc.	23		2			25
Total of Above (1)	272		47	21		340
Total for Canada (2)	627	10	89	21		747
(1)/(2)	43.4	0	52.8	100.0		45.5

Source: Fleet Report. Inventory of Commercial Aircraft in Canada. As of October 15, 1986, Statistics Canada

Table 4 - Charter Hours Flown ('000)- Helicopters

1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
306	335	304	312	325	378	380	327	287	315	363	392	416	354	434	382

Source: Air Carrier Operations in Canada. SC 51-002 and Canadian Civil Aviation. 51-206-XPB. See Table 2.1.

Table 5 - Total Flying Revenue ('000)- Helicopters

1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
224	248	194	251	249	347	327	305	300	389	523	516	521	540	708	564

Source: Air Carrier Operations in Canada. SC 51-002and Canadian Civil Aviation. 51-206-XPB. See Table 3.4.

Table 6 - Helicopter Hours Flown - Helicopters - (1984-1999)

Year	Nfld.	Mar.	Que.	Ont.	Man.	Sask.	Alta.	B.C.	Yukon	N.W.T.	Foreign	TOTAL
1984	24,537	9, 277	40, 291	24 ,051	11, 994	9, 094	45, 404	70, 248	8, 484	35, 673	24, 521	303, 574
1994	14, 665	3, 100	44,184	16, 659	10, 184	1, 851	45, 035	150, 392	6, 939	48, 332	29, 805	371,146
1999*	15, 095	3, 210	45, 478	17, 197	10, 318	1, 911	46, 357	154, 853	7, 261	49, 758	30, 688	382, 165

Source: Air Carrier Operations in Canada. SC 51-002 and Canadian Civil Aviation. 51-206-XPB.
* Estimated from total helicopter hours flown based on the percentage hours flown in each province for 1994.

Table 7 - Licensed Helicopter Pilots - (January 2000)

Year	Nfld.	Mar.	Que.	Ont.	Man.	Sask.	Alta.	B.C.	Yukon	N.W.T.	NES	TOTAL
2000	92	139	638	765	108	68	539	1, 232	24	39	181	3, 825

Source: Transport Canada.

Table 8 - Major Helicopters and All Helicopters Licenced or Head Office* in Various Provinces

Company	Nfld.	NB / NS	Qué.	Ont.	Man.	Sask.	Alta.	B.C.	Yukon	N.W.T.	Lab.	NU.
CH	1(3)	1(1) / 1(1)	1(4)	1(8)	1(1)	1(1)	1(6)	1(15)		1(4)	1(1)	1(2)
VH								1(10)				

Highland						1(1)	1(9)	1(11)*				
Aerial								1(1)				
Great Slave							1(1)			1(2)		
Alpine							1(3)	1(1)				
Custom					1(4)							1(1)
Delta							1(5)					
Universal	1(3)											
Helijet Airways								1(1)				
Heli-Max			1(2)	1(1)			1(1)					
Abitibi			1(1)				1(1)					
Canair								1(1)	1(1)			
National				1(3)								
TransNorth								1(2)	1(6)			
Helicraft			1(1)*									
Prism								1(2)				
Yellowhead							1(2)	1(3)				
Total Above	2(6)	1(1)/ 1(1)	4(8)	3(12)	2(5)	2(2)	8(28)	10(47)	2(7)	2(6)	1(1)	2(3)
All Operators	5	3 / 1	19	31	9	8	46	76	5	7	1	4

Source: Compiled from "Helicopters Magazine's 2001 Directory of Canadian Operators", Helicopters Magazine, Issue 4, 2000, pp. 57-69.
Statistics in brackets indicate the number of operators' bases in the province.

Table 9 - Bases of the Major Helicopters and the number of Operators at each Base

	Nfld.	NB/NS	Qué.	Ont.	Man.	Sask.	Alta.	B.C.	Yukon	N.W.T.	Lab.	NU.
Licences	4(1); 1(2)	1(1)/1(1)	8(1)	10(1); 1(2)	3(1); 1(2)	2(1)	9(1); 2(2); 5(3)	16(1); 4(2); 1(3)	5(1); 1(2)	2(1); 2(2)	1(1)	3(1)

Source: Compiled from "Helicopters Magazine's 2001 Directory of Canadian Operators", Helicopters Magazine, Issue 4, 2000, pp. 57-69. The statistics before the bracket indicates the number of bases and the statistics in the brackets indicate the number of carriers licensed at that base.

Airships to the Rescue: Re-supply and Emergency Response in Arctic Resource Development

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Introduction

The extraction of fossil fuels will form the basis of global energy needs for decades, regardless of advances in renewable energy sources. Moreover, petroleum resource development will be pushed further to the margins of human settlement, such as the Arctic. Interests in the extraction process in the north have also been increased by new discoveries of diamonds and precious metals. These activities represent a significant opportunity for areas of the Arctic. However, with these increased economic opportunities come potential environmental risks. The Arctic environment can, at times, appear harsh, but it is also very fragile. It has a slow and limited ability to heal itself from the impacts of civilization's activities – both intended and unintended.

Global warming may accelerate the economic exploitation opportunities of Arctic resources. Longer periods of ice-free water could provide better sea access, and extend operating seasons. At the same time, melting permafrost and a shorter winter could limit access to inland areas. In particular, the winter road system may become unusable. The combined challenges of increased resource development in the north, and the need to minimize the destructive "footprint" in this sensitive area, must be addressed.

The Challenge of Resource Development and Resupply

The challenges facing land-based mining development in the Arctic are extensive. Distances are great, and transportation infrastructure is limited. Presently, land-based establishment of sites and resupply of those sites is generally limited to a short window of opportunity. All bulky materials associated with a year's operation of the mining sites must be onsite by the end of the winter road season. This places significant pressures on those charged with logistics, and heightens the financial risks associated with "ramping-up" these developments.

The 2001 winter road season in the area around Yellowknife in Canada's Northwest Territories was shorter than usual. The season ran from roughly the beginning of March to mid-April, – a scant 6 weeks. In that period, 8,000 truckloads were dispatched from Yellowknife to the mining sites of Ekati, Lupin and Diavik. These sites range from 250 miles (400 km.) to 350 miles (560 km.) from Yellowknife. This placed a significant load on the ground transportation system, moving 160,000 tons of materials in a short time in inhospitable conditions. The demands for shipments by winter road in the area are expected to increase in the 2002 season.

Some potential mining sites are outside the feasible range of winter roads. For example, the base metal deposits at Izok Lake are unreachable by ground with any economic means of transport.

The largest single supply being moved to the mine sites is fuel. In addition to mining sites, many coastal communities are served by annual sea lifts. Communities' needs must be determined a year in advance in order for supplies to be brought in by barge. Large quantities of aviation and diesel fuel are shipped in 45-gallon drums. Some coastal communities can receive oil products in bulk.

The risk of oil spills is a major concern for Arctic development. At the present time, re-supply missions are the greatest threat to the

environment, but by and large, these are relatively small volumes. Once petroleum extraction gets underway in the north, large quantities of crude oil will be moved by pipelines and tankers.

The Challenge of Emergency Response

Handling of potential oil spills in the Arctic is a significant challenge. Moving large amounts of personnel and materiel to remote areas with virtually no existing infrastructure would be difficult under any conditions in the Arctic, but to do so quickly presses the limits of modern technology. For an offshore or coastal oil spill, the Canadian Coast Guard must be able to move materials such as skimmers, booms and collapsible bladders to the site or to the closest shore or ice pack edge. From there, equipment would be transferred to icebreakers or other vessels to move to the spill site. The time required to reach an oil spill could be measured in days or weeks, rather than hours.

The booms (designed to encircle the spill and contain it during the recovery process) are 50' structures in 8' to 10' sections. Approximately 10,000 feet of boom is required to contain a 2,500 tonne oil spill. While significant, this scale of spillage is dwarfed by the 40,000 tonne Exxon Valdiz spill of 1989 or the Erik's 30,000 tonnes off France in 1999. The 10,000' boom length has a shipping weight of about 30 to 35 tonnes.

Current plans call for the boom sections to be transported by small and medium sized aircraft. Repeated flights would be required to move 10,000 feet of boom and other required materials to the site.

Personnel accommodations are another challenge. The movement of 20-foot containers to provide housing for the cleanup crews is a logistic barrier. Problems of accommodations at remote sites set the upper limit of personnel at 20 – 30 individuals.

Collapsible floating bladders are used to store any recovered oil. The bladders remain in the Arctic until barges can be towed to the site. Contents of the bladders are then pumped to tanks on the barges, and the bladders are removed from the water. This procedure is required because of the inability to move large holding tanks to land areas adjacent to spill sites.

A Possible Response to the Challenges

Resource resupply and emergency response are just two examples of increasing needs in Arctic transportation. The Arctic's expanse and environmental sensitivity requires a system that is capable of moving a variety of cargoes over long distances, at rapid speeds, with minimal net energy and materials requirements, and with minimal environmental impact. This is a challenging problem! Surprisingly, the answer may be based on a technology with roots in the 18th Century and which flowered, briefly, during the first half of the 20th Century -- rigid airships.

The advent of a new generation of large (165+ tonne), cargo-carrying airships has the potential for a significant impact on resource development in the circumpolar region. Rigid airships, which were written off 60 years ago as dangerous and uncompetitive for passenger movements, are finding a new purpose filling the growing demand for airfreight service.

Developments in Airship Design

Disastrous structural failures occurred when the large airships are buffeted by storms, in maneuvering and docking. These failures are related to the trial and error construction methods were used. Wind tunnel tests are incapable of determining the actual stresses and torques that vehicles of this size encounter. As a result, the first generation of large, rigid airships (1910-1940) were under-built by a factor of three. The modern ability to perform computer simulations

has greatly reduced the design costs for airship, while enhancing the ability to predict and adjust for actual stress factors.

When the Hindenburg ended the first phase of commercial airships sixty years ago, nylon stockings were a luxury and Model-A Fords were cutting edge technology. The early Zeppelins were built with aluminum frameworks and flammable canvas covers. New composite materials, using carbon fibre and kevlar enable the construction of lighter, more robust and safer airships.

Advances in materials and engineering have overcome all the technological problems encountered by the first generation of rigid airships. Of course, the new generation of airships also employs non-inflammable Helium, rather than Hydrogen as the lifting gas. What has been missing is a strong business case and investors willing to take the necessary risk. This has now occurred and an international race is on between Germany, the U.K. and the U.S. to create the leading cargo carrying airship design.

Advantages of Airships and Current Design Options

There are four primary advantages to rigid airships. First, they are fuel-efficient. Relative to all other modes, airships require less energy to move a ton of cargo a given time/distance. Airships could use natural gas, which is more plentiful, cheaper, and cleaner burning than petroleum-based fuels. Moreover, the large surface areas of airships offer the potential for using solar power. This may seem more farfetched than the idea of a new generation of airships, but the cost and weight of photovoltaic cells are falling. A solar airship might not be cost-effective today, but research in this field is already well advanced.

The second advantage of rigid airships is that they can accommodate all sizes and types of freight. Rigid airships are constructed with a load-bearing frame that distributes the cargo weight evenly. While non-rigid airships (like the Goodyear Blimp) are limited to about 10

tonnes payload, a rigid airship can be built to carry up to 500 tonnes or more. Density of the cargo is not an important factor because bulky cargoes can be suspended outside the airship.

The third advantage of airships is that, like aeroplanes, they have minimal impact on the terrain. This is particularly important for transport in ecologically sensitive regions such as the Arctic, with movement being feasible up to 12 months of the year.

Speed is the fourth advantage of airships. Cruising speeds of 60 to 100 mile per hour compare favourably with surface transport, particularly over circuitous winter roads.

Just as advances in computer design and lightweight materials have made a new generation of large airships a commercial possibility, environmental concerns and potential markets have stimulated worldwide interest. The leading cargo airship designers are CargoLifter (Germany), Advanced Technologies Group (UK), and Zeppelin Luftschifftechnik (Germany)[i]. A number of blimp producers and related manufacturers, like Airship Industries (US), Lockheed-Martin (US), and Lightship Ltd (UK), are also capable of joining the race.

CargoLifter is scheduled to test its first commercial cargo airship in 2003 and bring it to the market in 2005. This semi-rigid airship is designed to carry 165 tonnes, and operate as a sky crane for the delivery of oversized, high technology equipment, such as hydroelectric turbines and oil refinery towers. CargoLifter has constructed a new hangar outside Berlin where two airships can be assembled simultaneously. This US$100 million hangar is a giant Quonset 35 stories high, 600 feet wide at the base and 1,180 feet long (large enough to play six football games simultaneously under its roof!).

Zeppelin has received certification for its 19-passenger NT model and has inaugurated its scheduled services in Germany. The

Zeppelin NT, which is the first rigid airship in 60 years, combines a light frame (1 tonne) with a pressurized envelope. This vehicle is scaleable and larger models are expected.

The Advanced Technologies Group (ATG) has flown a 1/7-scale model of its hybrid "SkyCat" design that is about 40 percent heavier than air. The SkyCat depends on a pressurized twin hull envelope for structure, and utilizes hovercraft technology for landing, mooring and take-off. When the airship lands, the hovercraft fans are reversed and the skirts serve like suction-cups to hold the vehicle while the cargo is unloaded. This is an important feature for Arctic emergency response because no additional ground-handling infrastructure would be required.

The catamaran design provides aerodynamic lift that enables the SkyCat to fly higher and faster than tradition airships. A unique feature of the SkyCat is a roll-on, roll-off deck for rapid cargo exchange. The first SkyCat, which is designed for 20 tonnes, is scheduled for testing at the end of 2002. ATG proposes two other scaled configurations of this vehicle, carrying 200 and 1,000 tonnes, respectively.

Airships' Roles in Resource Development, Resupply and Emergency Response

Fuel movement in the Arctic presents a hazard to the fragile environment, but the collection and removal of the innumerable empty 45 gallon barrels adds another dimension. For some sites, 75,000 litre "Green Tanks" are a desirable alternative. These tanks are double lined, reducing the risk of leakage. Their larger capacity also results in a substantially lower level of inaccessible wasted fuel left in the "empty" tank than is the case with an equivalent fuel load in 45-gallon drums. However, the 10' diameter "Green Tanks" are 40' long – not a potential cargo for the C130 cargo aircraft. These tanks could quite feasibly be brought in by airship, with a lower environmental risk than that posed by current fuel resupply methods.

Other bulky or heavy materials could be moved to the mine sites via airship, and this movement could take place 12 months of the year, removing or reducing the need to meet Arctic needs in a narrow winter road season or by a single annual sea lift. The need to store up to a year's supply of some materials in the Arctic with the corresponding risk of potential environmental degradation would be eliminated or reduced.

Re-supply of the Arctic endeavours must be reliable and cost-effective. Costs of movement by winter road are significantly higher than for truck freight in the lower latitudes. Calculations based upon some specific truck runs to the northern mine sites place the cost of winter road usage in the Yellowknife area at up to $.80 or $.90 per ton-mile. Similarly, airfreight rates that range from $.50 to $1.00 per ton-mile for southern routes, are considerably higher in the Arctic.

Cost estimates for operating airships in the Arctic are not readily available at this time, but costs for operating an 800-foot airship between Europe/Asia and North America are estimated at $.15 and $.25 cents per ton-mile. Even allowing for a substantial "Arctic Premium", movement by airship would be:

1. very cost-effective,
2. timely, moving at upwards of 100 knots (in a fairly direct route to the site), and
3. available throughout the year.

Many rich ore deposits in the Arctic have not been developed because of financial risk and environmental implications. Airships could overcome both concerns and create a new "foot loose" mining industry. The problem in many locations is that the size of the ore body may not be sufficient to initially justify the construction of a road. A cargo airship could airlift the mining equipment to the site, and bring out concentrated ore. If the mine proves large enough to justify a road, it could be built subsequently. If not, when the mine is

depleted, the airship could re-locate the equipment to a new site and repeat the process.

In the case of response to oil spills, airships are also ideally suited. Movement of 10,000 feet of oil-retaining boom (30 to 35 tonnes) would be very feasible. The booms and skimmers could be delivered with pinpoint accuracy, replacing many trips with small, overtaxed aircraft.

Also, delivery of the housing requirements of the clean-up crews could be undertaken by several configurations of the new airship designs. Spacious pre-fabricated accommodations could be in place quickly, allowing the crews to begin work in the early critical stages of a spill.

The current system of floating collapsible bladders to retain the recovered oil is the best choice at present. However, this results in the oil remaining in the spill area till recovered by barge. The ability to move large, leak-resistant tanks to the adjacent shore site could be considered. Oil could be pumped directly to land-based holding tanks, with greater safety and security, and some could be returned as ballast with the airships.

Economic and Operational Case for Airships

The economics of operating airships have been greatly improved. Flying an early Zeppelin airship was labour-intensive; the Hindenburg had a crew of 30. Non-rigid blimps have pioneered computer controlled hydraulic systems to minimize crew numbers (to three) and to enhance control.

Advances in meteorology and weather detection/reporting systems, such as satellites, provide the ability of airships to avoid unfavourable and to exploit favourable conditions. These advances have particular significance in the Arctic, where inaccurate

meteorological information can have devastating consequences, even for conventional transportation modes.

The ceiling for large cargo airships is approximately 5,000 feet elevation (the SkyCat will fly at approximately 10,000 feet) and, as such, mountain barriers directly affect airship operational range. The geography of the central Canadian Arctic will provide an expansive unfettered range for airships, and this environment is particularly desirable because airships can carry more weight in the colder (denser) Arctic air masses.

The emerging airship designs are truly multi-use vehicles. As such, they have the potential as well to be very cost-effective vehicles. Holding air cargo vehicles on standby is expensive, but airships should find regular duty in resource development and supply. If so, there will be ample justification for airships to not only be used in the Arctic, but to be based in the Arctic, enhancing their ability to be used in quick response emergency use applications such as environment clean-up and restoration.

Possible Barriers or Concerns

To this point, the potential for new airship designs in the Arctic has been extolled, but all advances have potential risks. First and foremost, of all designs discussed, only the Zeppelin NT is actually fully functional at this time. It is also the least ambitious design, and with its focus on passenger service, it is probably also the design with the least potential in the areas of cargo, re-supply or emergency response. (Its applications for eco-tourism are a different matter). Only the hanger and operational scale model of the Cargolifter has been built, and only a 1/7 scale of the SkyCat has taken to the air. While these designs are expected to be scaleable, the actual products have not appeared as yet.

There is also the legacy of the end of the first generation of airships. While the indelible images of the end of the Hindenburg may be

perceived by some to be out of proportion with the actual losses in that event, this is still what many think of when the topic of airships is broached. Even in this paper, we have cited the Hindenburg as a reference point. This barrier, albeit possibly psychological, may handicap investment and development of these new designs.

On a more tangible level, there are operational issues associated with the use of airships in the Arctic. For example, some may question the functionality of airships in the bitter cold of the Arctic. While theoretically the cold, dense air would actually be beneficial to an airship's lift capacity, the effects on the airframe and icing have not been tested to any extent.

Also, the effect of the Arctic winds on airship structure, navigability and the loading/unloading processes is as yet untested. Again, tests at lower latitudes point to greater stability than found with earlier designs, but the Arctic is an unknown.

For the Cargolifter design, ground crews will have to be on-site before the airship arrives. The ground crew will have to prepare the area for arrival of the cargo, and will have to sink four strong anchor points into the ground to facilitate the unloading process. During the unloading process, the Cargolifter will have to take on ballast to offset the loss of up to 165 tonnes of cargo. The source of this ballast may become an issue in the remote Arctic. In mining operations, the return ballast would ideally be ore concentrate or some other appropriate backhaul, but these are issues still to be considered.

The SkyCat is a heavier-than-air design and as such the ballast issue is less of a concern. It also doesn't require a ground crew to prepare anchor points. However, it must land to load or unload cargo. A short "runway" area must be found, and if backhaul is intended, that "runway" must be somewhat longer. Also, while on the ground, the SkyCat's vulnerability to the Arctic wind must be ascertained. The hovercraft landing system to anchor large scale SkyCats is appealing, but at this point, is only a theoretical possibility.

As the new airship designs move into production, other issues or concerns, some unique to the Arctic, may become evident. We will have to wait and see.

Final Comments

Transportation is especially problematic in many parts of the circumpolar area where no roads exist, or the damage caused by road construction (e.g. permafrost regions) is deemed unacceptable. Airships based in the north could provide logistical services to the entire Canadian Arctic and beyond.

In overview, if operational issues for use in the Arctic can be adequately addressed, airships could "level the playing field", providing a general improvement in the comparative advantages of areas with poor conventional transportation systems, or non-existent road links to ports and markets, such as the Arctic. Using airships to open mines in remote and sensitive ecological areas like the high Arctic would provide opportunities for employment and help make the north more economically self-sufficient.

The prospect of using airships to move a significant share of freight in the Arctic is not fanciful. Indeed, it may be almost inevitable. The necessary technologies either are already developed, or are within reach. Cost estimates, assuming existing technologies, indicate that the mode already would be competitive in many situations. As pressures increase to conserve energy and reduce environmental degradation, airships become increasingly attractive.

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[i] Further information on these ventures can be obtained at www.cargolifter.com www.zeppelin.com and www.airship.com

THE IMPACT OF CUSTOMS REFORMS ON THE INTERNATIONAL OCEAN CARRIER INDUSTRY

by

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Abstract

Customs authorities worldwide, including the Canada Customs and Revenue Agency (CCRA) are reforming their operations with a view to fully utilizing information-based assessment of compliance. The reforms are being driven primarily by the opportunities afforded by exponential developments in information technology/systems and growing recognition that customs administrations can carry out their primary and sovereign duty of preventing customs breaches without unduly impeding legitimate global trade. As major participants in international trade logistics, international ocean carriers must also respond to the challenges and opportunities created by customs reforms. This study is a preliminary element of ongoing research to examine the challenges, opportunities, and the responses, and to draw some insights that are relevant to ocean carriers that have their main ports of call in countries that are at the forefront of customs reforms; e.g., Canada.

Introduction

Originating in the form of the Customs Automated Data Exchange System (CADEX), which was implemented in 1988 as the first electronic data interchange (EDI) system that linked private industry to customs, Canada's customs reforms continue to evolve in pursuit of the ideal state: fully digital trade compliance processes. In this evolution, the mutations through which customs reforms have gone are mirrored in organizational and technological changes made by commercial entities involved in the logistics of international trade. These changes represent efforts to optimize their operations in light of challenges and opportunities that are jointly influenced by new customs compliance requirements and by information technology developments.

The commercial entities of interest in this paper are ocean carriers, and the findings can be applied to ocean carriers based in countries that are at advanced stages of customs reforms; e.g., Canada. The paper seeks to examine the question of how ocean carriers might respond to the new challenges and opportunities created by customs reforms.

The study is based on a dual data gathering methodology involving e-mailed questionnaires and a 6-month archival analysis of documents from a variety of sources. Two key insights drawn from the study are (i) while the initiatives that an ocean carrier can undertake may be reasonably construed as influenced by customs reforms, there may be other influences at work, and (ii) the need to focus on mission-critical activities and the availability of outsourcing options could render customs issues as low priority for some carriers.

The remainder of the paper is organized into 5 sections as follows. The first of these will outline the basic nature of customs reforms in general and in the context of Canada, as a means of depicting their relevance to ocean carriers. The section after that presents a brief overview of the relevant literature. That overview is followed by a description of the research methodology. The findings are then

discussed in the paper's penultimate section. The paper concludes with highlights of the paper's key points, including some possible future research.

Overview of Customs Reforms and Ocean Carriers

The importance of customs reforms in furthering the World Trade Organization's vision of a world in which there are no unnecessary barriers to legitimate international trade is well established. Promoting customs reforms that are consistent with that vision falls under the aegis of the acknowledged global center of customs expertise: the World Customs Organization (WCO). This effort is integral to its mission of continuously raising the effectiveness of customs operations across the world, and is articulated in a list of 60 guidelines (co-authored with the International Chamber of Commerce –ICC) as qualities of a modern, efficient, and effective customs administration[1]. The crux of the guidelines is to show how a customs administration can simultaneously facilitate legitimate international trade without compromising its sovereign duty of enforcing compliance with customs regulations.

Use of information and communication systems/technology (ICTS) is central to adoption of these guidelines. This includes, for example, electronic communication of a shipment's particulars (manifest, shipper, consignee, etc) to the destination country's Customs so it can decide whether to grant pre-arrival clearance. This advance information allows better planning by all parties involved with that shipment. Similarly, the use of risk assessment in determining which shipments are "fast-tracked" through border formalities and which are selected for more rigorous examination requires, among other things, a solid base of information on variables associated with each shipment.

Among the WCO's 156 members, Canada's customs administration (the CCRA) is reputed as one of the exemplars in applying these guidelines. Canada's pioneering efforts in IT-enabling customs

compliance processes can be traced back to the previously mentioned CADEX, and continues today with initiatives such as the pre-arrival review system (PARS) and Customs Self-Assessment (CSA- which is geared for US-Canada trade). In studying these reform initiatives, it quickly becomes clear that within global supply chains, importers and exporters are not the only beneficiaries, and, concomitantly, not the only ones with responsibility for assuring that the benefits are reaped.

Ocean carriers, for example, benefit by avoiding port delays caused by inspections based on suspected compliance violations. As has been noted by the Facilitation Committee of the International Maritime Organization (IMO), these are among the issues faced by shipmasters. Specifically, one of our hypotheses is that since the suspicion might be associated with the carriers' customer (e.g., the consignor), ocean carriers must be careful about their choice of customers. This is particularly true in the context of heightened border security since September 11th 2001. This example raises the specific question of how ocean carriers should accomplish careful customer selection, and underscores this study's central focus on how ocean carriers might effectively adapt in a global trading environment of radical customs reforms.

Figure 1 summarizes our hypotheses of how customs reforms might affect ocean carriers. This conceptual framework is based on concepts of how organizations might develop ICTS-based responses to changes in their operating environment. The framework depicts customs reforms as changing a carrier's operating environment (i.e., ocean-based global supply chains). From this, it shows the change as potentially affecting revenue (e.g., fast-track customs clearance increases a ship's availability for the revenue-generating activity of transporting merchandise) and costs (e.g., higher non-compliance penalties for carriers). The model then suggests that an ICTS-based response is a possibility, and identifies outsourcing and internal systems building as two broad options for obtaining the required ICTS capability. The answers to the stated research question provided a basis for examining the framework.

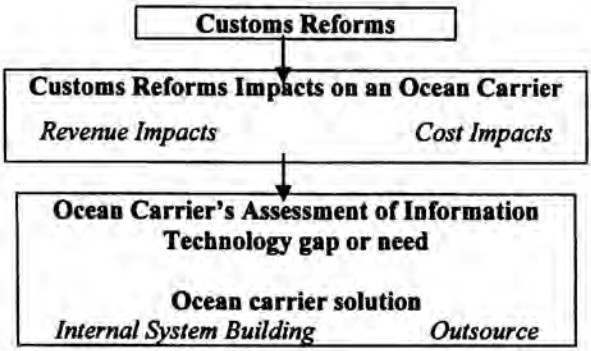


Figure 1
A Framework for Information/Communications Systems & Technology Responses to Customs Reforms by Ocean Carriers

Literature Overview

The portion of the global supply chain management literature that provide more than passing mention of customs issues consists of only a few studies. Among these is the work of Heaver[2], who used a four-country comparison of to identify how customs administrations can affect global logistics operations. In a more narrowly focused study, Helberg and Sannes[3] described how use of electronic data interchange (EDI) by three Norwegian International Freight Forwarders (IFFs) led to marked reductions in time and errors associated with customs processing.

The studies on the impacts in the context of contemporary customs reform include Carr and Crum[4], and, more recently, Haughton and Desmeules[5]. The former work focused on the United States Customs Modernization and Informed Compliance Act of 1993, and, in terms of issues of direct interest to carriers, predicted effects such as greater demand for carriers with automated manifest systems (AMS) and improved equipment utilization. The latter work was geographically broader and focused on the efforts required of traders (importers and

exporters) to garner the benefits of customs reforms. Thus, no study to date has dealt with the joint issue of the potential effects of customs reforms for international ocean carriers, and the efforts they may have to make to increase the positive effects (reduce the less welcome ones).

Methodology

The data collection element of the research methodology consisted of two components. One of these comes from the archival/document investigation sub-class of qualitative research methods. The other component was to contact a small sample of ocean carriers for further information. Concerning the former component, which occurred between August 2001 and January 2002, the approach was to make twice-weekly visits to the web sites that might have some information of relevance to the joint issue of customs reforms/compliance and ocean shipping. Using the search engine capabilities at these sites, as well as links such as "Press releases", the approach was to probe the downloaded documents/web-pages for answers to the previously stated research questions. The approach was not to draw any statistical/quantitative conclusion but to get a sense of the range of possible answers. Background on this type of qualitative data-analytic approach of deducing answers from archived documents can be found in, for example, Berg[6], Sarantakos[7], and Meredith, *et al*[8]. As shown in **Table 1**, the websites covered a wide range of organizations, including ocean shipping companies based in Canada, the CCRA, international bodies, and prominent vendors of solutions for global trade/customs compliance problems. Table 1 also conveys a particular feature of the research approach. That is, in attempting to draw potential implications for the Canadian situation, we sought to combine insights from a geographically larger picture of international ocean carrier issues with information specific to Canada.

In the other component of the methodology, the questions focused on information specific to Canada-based international ocean carriers, and were designed in light of questions and insights that came out of the

archival analysis. In particular, it sought to clarify the role of customs reforms in some of the IT-based solutions, especially solutions dealing with inter-organizational information flows that support the international flow of goods. The responses of four ocean carriers were quite insightful. These are discussed in the next section.

Table 1
Internet-Based Data Sources and Materials

International Organizations (Examples)
1. International Association of Ports and Harbors (IAPH)
2. International Chamber of Commerce (ICC)
3. International Federation of Customs Brokers Associations (IFCBA)
4. International Maritime Organization (IMO)
5. World Customs Organization (WCO)
6. World Trade Organization (WTO)
National Organizations in Canada (Examples)
1. Government (CCRA, Transport Canada, Industry Canada)
2. Industry Associations (Canadian Shipowners Association, Canadian Society of Customs Brokers, etc.)
Individual Companies (Examples)
1. Ocean Shipping Lines based in Canada
2. Providers of applications for trade/compliance processes (OpenHarbour, Vastera)
General Types of Materials Gathered from the Websites (Examples)
1. Official Newsletters/Journals/Bulletins/Reports/Papers
2. Policy/strategy/vision documents
3. Press releases
4. Client/customer testimonials
5. Miscellaneous/Other (e.g.. materials at the "what's new" link)

Findings and Discussion

The following is a summary of the answers to the questions posed to the four ocean carriers. Three of them described themselves as either dependent or heavily dependent on information and communication systems and technologies (ICST) with one non-response. Ocean carriers generally regard ICST linkages as high priority with all of its partners in the supply chain except banks and financial institutions. They also regard as their current priority levels as adequate with customs, the customs brokers, international freight forwarders and bank/financial institutions but need improvement with the importing and exporting companies. Finally, the contacted ocean carriers deem Customs reforms as having a high impact on their ICST plans in their relationship with customs authorities, customs brokers, importing companies, and international freight forwarders/exporting companies in that order.

Our use of this and the archival analysis to answer the central research question of how ocean carriers might respond to the new challenges and opportunities created by customs reforms follows. In general, the information indicated evidence of carrier initiatives that could be easily construed as being influenced by to customs reforms. However, there was very little by way of strong support for the hypotheses that these were *responses* to customs reforms from the four carriers contacted.

Before probing this surprising result, we indicate one source of the ostensibly small body of supporting evidence, and two representative examples of the observed initiatives, as well as how they could be construed as reform-driven. In terms of the evidence, information at the website of the International Maritime Organization (IMO)[8], and more specifically, at the link to the IMO's Facilitation Committee underscores the importance of customs reforms to marine carriage.

[8] The United Nation's agency concerned with maritime safety and the prevention of marine pollution from ships.

Further, this importance has received high profile emphasis[9]. Information such as this led us to still leave open the possibility that customs reforms might have played a role in the two initiatives we are about to describe.

The first of these is greater involvement by in origin-to-destination management of international trade logistics activities. The source opportunity for this is that some shippers view international trade processes as becoming increasingly complex as a result of customs reforms. So, to avoid diluting their focus on their core competencies, these shippers prefer to outsource those processes to organizations with the requisite knowledge and ICTS capability/infrastructure. Among the more prominent examples of this phenomenon are the decisions by Lucent Technology[10] and Ford Motor Company to outsource their global trade management operations to Vastera[11]. It is not inconceivable that this customer-side phenomenon prompted, for example, American President Line's transition from just an ocean transportation company to a provider of global logistics.

A second carrier-side initiative (which we encountered only as an externally available capability and not explicitly as done in-house by a carrier[12]) concerns determining a shipment's legitimacy on the basis of factors that customs might consider in assessing whether to grant pre-arrival clearance (e.g., consignor, consignee). In Canada, for example, a carrier's ability to make that determination (often referred to as "restricted party screening") is especially important in light of two elements of the CCRA's reforms: the use of risk assessment to select shipments for detailed examination and the higher non-compliance penalties, not only for shippers but also carriers. Thus, by being classified by customs as high risk (through association with, say, a non-compliant shipper), a carrier might lose the privilege of "fast track" customs clearance, not only on the current shipment but also on future shipments (since compliance history is among the risk assessment variables). This represents a competitive disadvantage when other carriers getting fast track clearance. So although the study unearthed no specific evidence of carriers implementing this

capability, there is little doubt that it is a needed capability, and needed more in the context of modern customs reforms.

There may be several reasons that, despite this logic, we did not find a preponderance of supporting empirical evidence for it. Four reasons are provided. One of these might be related to the growing presence of firms that are specialists in knowledge-based services for global supply chain management. Such firms provide powerful ICST capabilities that are under girded by rich knowledge/data bases of country-specific customs regulations. With these capabilities, those firms may get more attention than ocean carriers from shippers who seek to address customs complexity by outsourcing full origin-destination management of their global logistics processes. Moreover, some ocean carriers may choose to be direct customers of these firms instead of developing internal ICST capabilities for dealing the new customs compliance environment[13].

A second reason might lie in the fact that the outsourcing decision may take the form of alliances with the type of companies mentioned above[14]. While the cited example is prominent, it suggests the possibility that there are ocean carriers that engage in less visible alliances to accomplish the same objective.

A third explanation could be related to the matter of core competence. Specifically, the safe movement of vessels and their cargoes remains the essence of what ocean carriers strive for. Therefore, relative to safety issues, the potential gains to be made (losses to be avoided) by adjusting to new trade compliance requirements (though certainly not unrelated safety), might not comprise be a sufficiently strong call to action for some carriers.

A fourth possible explanation is that it is possible that the ICST that some ocean carriers already have in place are scalable enough to readily accommodate some of the requirements of customs reforms. For example, the creation of an ocean carrier's systems could have been prompted by requirements (of both shippers and the carrier) that were already very demanding. For a carrier such as that, customs

reforms might not create much anxiety. For example, according to the four ocean carriers interviewed, customs reforms were a high priority for the respondents in establishing computer-based linkages with customs, but that was not the case for linkages with other organizations in the international trade process. This observation seems well supported by a review of ICST usage in the Canadian marine sector (shipping lines, ports, service providers at the ports and connecting surface or air transportation service providers) by Chow[15]. In particular, nearly all of the leading container carriers are linked into Customs Automated Manifest System (CAMS) set up by U.S. customs.

As regards linkages not influenced by customs reforms, that review notes that shipping lines see E-Business as a means to improve productivity and reduce the cost of their operations. Major international carriers, domiciled offshore but serving Canadian ports, have highly-developed Internet portals (Web sites) to interact with customers. Maersk-Sealand for example, has developed a web site where a shipper can become a customer, receive Bill of Ladings, track cargo, book shipments, view schedules and see a variety of statistics online. Many of the international carriers are capable of rapidly taking advantage of new customs initiatives that will leverage the carrier's existing transaction data bases via the internet.

A final point of note concerning the findings is that wide variation in the results of the responses from the four ocean carriers. For example, while one respondent reported customs reforms as a very major factor in all of its linkage-oriented ICST initiatives, another deemed the reforms as being minor or very minor (except for linkages with customs itself). Yet, the latter carrier indicated that all these linkages were high priority. This appears to add credence to the argument that although a given initiative might be prompted by customs reforms for one carrier, it may, for another carrier, be influenced by factors such as those outlined in the aforementioned explanations for the findings.

Conclusions

The present sought to analyze the issue of how contemporary customs reforms might affect the operations of international ocean carriers. The main conclusion of the study is that while it is logical to view initiatives by ocean carriers in the present era as being influenced by customs, other factors may also be jointly or independently at work. Further, there may not be any real cross-sectional uniformity in how these factors affect carriers. The paper identifies some of the factors as the existence of options for their customers (shippers) and they themselves to outsource trade management and related documentary processes and the need to maintain focus on their mission-critical activity of vessel/cargo safety.

One possible extension of the research is to refine its theoretical foundation. This might involve examining the literature for theoretical models of that might explain how different firms within an industry/sector respond to changes in the external environment (e.g., reasons and outcomes associated with each response), and then examining how the insights from this paper fit the theory. This could provide a basis for clearer understanding of the ocean carrier sector and spawn further research that might include, say, other elements of the global supply chain process; e.g., ports.

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The Evolution of the Deep-sea Fleet that Supports Canada's International Trade

Introduction:

The oceans are truly global highways. Port states may control navigation in territorial waters, but not in the oceans beyond. In 1999, 46,002 cargo ships from 152 flag-states carried the world's trade[1]. There were 173 ship registers as some states had more than one.

Canada's trade depends on foreign-registered ships. In 1999, ships registered by 68 foreign states carried 80% of the international cargo handled by Canadian ports. This dependence may carry risk if those ships are substandard. The shipping industry's practice of 'flagging-out' or registering ships in countries other than the shipowner's nation of residence has been a cause for concern. Some high-profile shipping accidents[2] that have resulted in severe pollution have focussed international attention on "flags-of-convenience".

This paper identifies the flag-related trends of fleets used in Canada's international sea-borne trade relative to the world fleet over a 15-year time frame (1985 to 1999). The goal is to see if there is any indication that fleets that served Canada were any less safe in 1999 than 1985.

The idea a ship's flag may predict its condition is not new. Canada and other states use the flag as one variable for targeting port state control (PSC) inspections*. An interesting paradox is arising from these efforts. Canadian PSC inspection statistics show that the share of ships with deficiencies hovered around 50% with detentions of

* PSC is a ship inspection program. Foreign ships entering a state's waters are boarded and inspected to ensure compliance with major international maritime conventions.

11% for the past 6 years[3]. However, accident rates for foreign ships in Canadian waters declined 51% from 1991 to 2000[4].

Data Sources and Limitations

Statistics Canada's Marine International Origin-Destination (MIOD) Database (1985-1999) is the data source on the fleet used in Canada's international trade. This database is derived from a Canada Customs A6 General Declaration that all ships must file upon entering Canada. The A6 records the vessel name, registration number, flag, Gross Registered Tonnage (GRT) and last or next port of call.

The Lloyd's Register (LR) annual publications *World Fleet Statistics* (1992-1999) and *Statistical Tables* (1985-1991) are the sources for world fleet by registration. The data include self-propelled sea-going merchant ships of not less than 100 Gross Tons (GT), both cargo and non-cargo ships (e.g., ferries, fishing vessels). This differs from the MIOD data, which have non-self-propelled barges and no thresholds.

The Lloyd's Register annual publications *Casualty Statistics* (1994-2000) and *Casualty Returns* (1985-1993), are the sources for casualty data. The casualties are "total losses" which LR defines as ships "which as a result of a marine casualty, have ceased to exist, either by virtue of the fact that the ships are irrecoverable or have subsequently been broken up. Ships which have been declared constructive total losses but which are undergoing or have undergone repairs are not included"[5]. Accidents resulting in loss of life, environmental or economic losses are included only if there is a "total loss" of a self-propelled ship of at least 100 GT.

LR publications include tables of revised data for the previous five years that are significantly higher than those initially reported. For example, world fleet casualties for 1996 were reported as 179 ships and 891,351 GT in the 1996 Casualty Statistics and revised to 255 ships and 1,163,090 GT in the 2000 edition. The revised data are used in this study. These tables list the casualties for 37 flag states and a residual "other countries" that accounted for 28% of the ships and

16% of the GT for 1985 to 1999[6]. The tables cover 19 of the top 20 fleets by GT for 1999.

The Choice of Vessel Registers

The concept of vessel registration is simple but its application raises questions about the true nature of ship registers. In its simplest form, registration binds a ship to the flag-state and the merchant ship is an extension of the flag-state's territory and subjected to its laws[7].

Ship registers themselves have become a business as some flag-states compete for vessel registration with zero tax regimes, relaxed labor legislation, and even discounted registration fees. One state registers ships, sight unseen, over the internet. Some flag-states have contracted out their registers to private commercial enterprises.

These registers have developed in response to shipping industry demands. International shipping was among the first industries to engage in transnational production as shipowners sought the most attractive combinations of factors-of-production. For many years, ships have been built and financed in countries that offered subsidies, they have been crewed from low-income developing countries and managed from countries that offered expertise in effective ship management.

There are 2 fundamental types of registers: closed and open registers. Closed registers require the shipowner to be a national of the flag-state. Open registers are available to any shipowner regardless of nationality who meets the condition of the register. There are 2 types of open registers, Open National Registers and Open International Registers. Ships under Open National Registers are subjected to the economic regulations that apply to all businesses in the flag-state, including labour and tax regulations. Coastwise shipping is often reserved for National Registers (open or closed) under cabotage laws.

Open International Registers offer shipowners competitive terms for international shipping operations. These terms may include tax

exemptions on earnings, few restrictions on crewing ships with non-nationals, the easing of the legal requirements of corporate governance and liberal enforcement of safety standards[8]. Lax crewing regulations and safety standards appears to be the reason why some of these registers are described as "flags-of-convenience" or FOC.

The International Transportation Workers Federation (ITF) defines a FOC as a registry where there is no "genuine link" between the nationality of the shipowner and the flag of the ship. The ITF's Fair Practices Committee currently lists 30 FOCs based on six criteria[9]. The term FOC has negative connotations, however, it was once synonymous with 'flag-of-necessity'[10] at a time when such registers were needed to compete in an industry under constant price pressures.

To the shipowner, choosing a flag is akin to deciding where to incorporate. Entrepreneurs form companies to avail themselves of corporate tax laws and to limit personal liability. Shipowners select a flag for similar reasons. An 'economically-efficient' flag allows the shipowner to compete for cargo and earn profits. Shipowners must consider: costs; ownership restrictions; taxation; financing; insurance; Port State Control (PSC); law enforcement; safety standards; charterers' flag preferences; union and political actions (e.g., blockades, regional trade sanctions)[11]. While a FOC may have cost advantages, it may be constrained in terms of routes and markets.

Many charterers are increasingly selective in the flag of the ships they use. Vessel and cargo insurance may be prohibitively expensive for FOC ships. Some flags are targeted for frequent PSC inspections or for industrial actions by trade unions within the ports. Delays in port can add significantly to the shipowner's and charterer's costs.
In addition to these factors, characteristics of the ship itself affect the decision to use a national register or flag-out. An empirical study of U.K. tanker and general cargo shipowners by Bergantino and Marlow found a tendency to flag-out older and larger ships engaged in deep-sea trade routes[12]. Some registers (e.g., the Norwegian International Ship register (NIS)[13]) will not register ships over a certain age.

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This paper uses 4 standard categories of ship registers to analyze the world fleet, casualty returns and Canadian marine statistics:

1. **Traditional Maritime Nations (TMN)** - the national and international open registers (excluding FOCs) of 15 nations that account for 90% of the GT registered in OECD countries.
2. **Flags-of-convenience (FOC)** include 23 flags listed by the ITF. OECD shipowners were the primary users of these registers
3. **Flags of newly industrialized states (NIC).** The 1980's saw the rise of both shipowners and registries in developing countries as these countries played a larger role in a world economy[14].
4. The remaining registers or the **Rest of the World (ROW).** †

Evolution of the World Fleet 1985-1999

In 1999, the world fleet consisted of 86,817 ships with 543.6 million Gross Tons (mGT). From 1985 to 1999 the fleet expanded by 13.6% for ships and 30.6% for GT. However, the distribution of the fleet by registers changed dramatically over this period.

The TMN fleet declined by 19.5% in ships and 23.3% in GT over the 15 years. In contrast, the FOC fleet expanded with 90.7% more ships and 135.9% more GT. While the TMNs had more ships over the period than the FOCs, their dominance in terms of GT was lost to the FOCs by 1988. This seems to support Bergantino and Marlow's finding that shipowners are more likely to flag out their larger ships.

All TMN national fleets experienced declines in ships except Turkey. While the national fleets of Norway and Denmark declined, their overall fleets increased due to their international registers. In 1985, Japan had the largest TMN register in ships and GT. By 1999, Japan

† TMNs: Australia, Canada, Denmark, France, Germany, Greece, Italy, Japan, Netherlands, Norway, Spain, Sweden, Turkey, United Kingdom and the United States of America; FOC: Antigua and Barbuda, Bahamas, Barbados, Belize, Bermuda (UK), Bolivia, Myanmar, Cayman Islands (UK), Cyprus, Gibraltar (UK), Honduras, Lebanon, Liberia, Luxembourg, Malta, Marshall Islands (USA), Mauritius, Netherlands Antilles, Panama, Sri Lanka, St. Vincent, Tuvalu, Vanuatu. NICs: Brazil, Hong Kong, India, Indonesia, Malaysia, Mexico, Philippines, Peoples Republic of China, Poland, Russia, Singapore, South Korea, Taiwan.

had the most ships of the TMN registers but had fallen to 3rd place in GT after Greece and the combined Norwegian registers.

Table 1:	World Fleet by Flag Group			
	1985		1999	
	Ships	Million GT	Ships	Million GT
World Fleet	76,395	416.3	86,817	543.6
Share:				
TMN	49%	41%	35%	24%
FOC	13%	28%	22%	51%
NIC	14%	15%	24%	18%
ROW	24%	16%	20%	7%
Source: Lloyd's Register Statistical Tables(1985) and World Fleet Statistics (1999)				

Liberia was the largest FOC in 1985 but declined over the reference period, perhaps due to its civil unrest through most of the 1990s. In contrast the GT of the Panamanian-flagged fleet increased by 159% to become the world's largest fleet in GT by 1999. Nineteen of the 23 FOC registers saw increases in the GT of their registered fleets.

The NIC fleet also grew from 1985 to 1999 while the ROW fleet declined. These trends are partly explained by the breakup of the former Soviet Union resulting in a new Russian fleet in 1992. The fleets of Singapore and Malaysia experienced the most rapid growth with a threefold expansion in GT. The South Korean fleet's GT declined by 20%, possibly reflecting the impact that improvements in wages and working conditions in shore-based occupations has had on the supply of South Korean sailors[15].

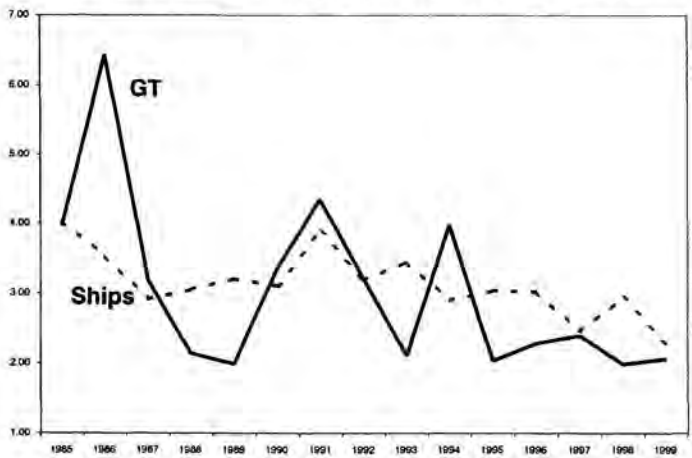
Casualty Rates

The casualty rate for the world fleet improved from 1985 to 1999, with declines in total losses of ships and their gross tonnage. In 1985, the world fleet lost 307 ships and 1.7 mGT for casualty rates of 4.0 ships per 1000 ships and 4.0 GT per 1000 GT. In 1999 the world fleet

lost 199 ships and 1.1 mGT or 2.3 ships per 1000 ships and 2.1 GT per 1000 GT. However, there was much volatility over the period.

Figure 1:

World Fleet Casualty Rates per 1000 GT and per 1000 Ships



(Source: *Lloyd's Register Casualty Statistics and Casualty Returns*)

The calculation of casualty rates by category is complicated by the suppression or lack of data for some flag states particularly in the FOC category where the casualties are reported for only 7 of the 23 flag states. Including the combined fleets of all 23 FOC in the denominator of the casualty rate results in an underestimate of the FOC casualty rates and an overestimate of the ROW rates. Fortunately the 7 FOC covered by the casualty statistics account for more than 80% of the FOC ships and 90% of the total FOC GT.

From 1985 to 1999, the TMN casualty rates have generally been the lowest and can therefore be used to benchmark the rates for the FOC, NIC and ROW fleets. The casualty rates for the NIC registers are

closest to the TMN rates over the 15-year term and show the least volatility relative to TMNs. The average FOC casualty rates over the same period have been double the TMN rates for ship casualty and triple the rate for GT casualties. The ROW registers have on average lost 1.5 times the number of ships and 3.6 times the GT of the TMN registers.

There are significant differences among the casualty rates for the fleets within the flag categories. Over the 15 year reference period, 3 TMN fleets have average casualty rates much higher than the TMN benchmarks: Turkey (2.2 times (x) the average TMN ship casualty rate; 5.9 times the average TMN GT rate), Spain (1.7x; 3.1x) and Greece (1.6x; 1.7x). Among the NICs, South Korea (1.9x; 3.5x), the Philippines (1.6x; 2.9x) and Taiwan (2.2x; 1.6x) have the worst rates.

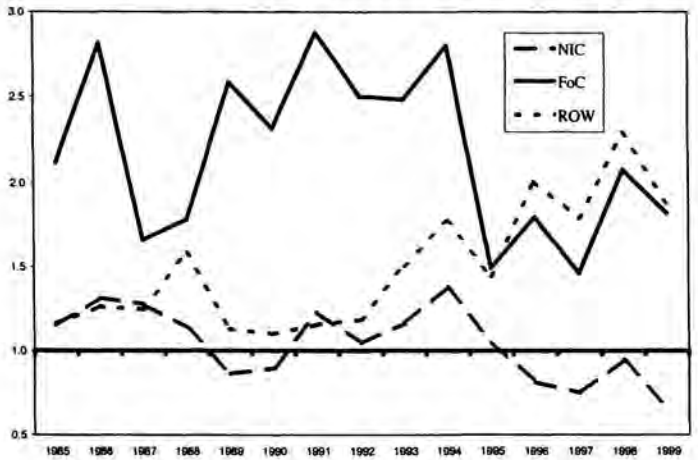
Among the FOC the worst casualty rates compared to the TMN rates are for Malta (4.9x; 7.1x), Honduras (4.8x; 14.3x), St. Vincent (4.8x; 9.4x), Cyprus (3.2x; 7.2x), Panama (2.3x; 2.7x), and Bahamas (1.4x; 1.7x)[‡]. Liberia, the world's second largest register, has the same casualty rate as the TMN registers for ships, but a GT casualty rate 2.7 times the TMN rate due to the larger average ship size in the Liberian-flagged fleet.

There are significant differences in the magnitude of the casualty rates among fleets. However, it is interesting to note there is a significant positive correlation in the annual casualty rates of the TMN, FOC, NIC and ROW fleets. This suggests that all fleets are affected by extreme conditions but not to the same degree.

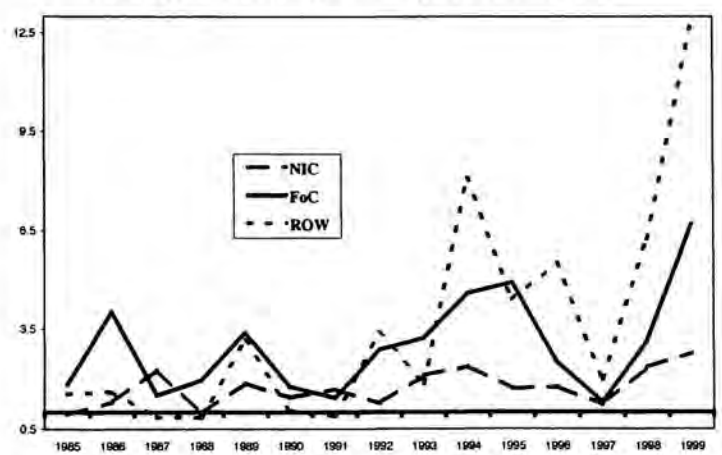
[‡] The rates for Bahamas, Honduras and Saint Vincent are based on 11 years of available casualty data.

Figures 2 and 3

FOC, NIC and ROW Ship Casualty Rates versus TMN



FOC, NIC and ROW GT Casualty Rates versus TMN



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The Fleets that Served Canada 1985 to 1999

While the world fleet's ships increased by 13.6% from 1985 to 1999, the number of ships arriving and departing Canadian ports with international origins and destinations declined by 1.9%. However, the gross registered tonnage (GRT) of those ships increased by 50.4% compared to the 30.6% growth in the GT of the world fleet[§].

Table 2. **Ships Arriving and Departing Canada by Flag Group**

	1985		1999	
	Ships	Million GRT	Ships	Million GRT
Total	52,993	515.1	51,982	774.8
Share:				
TMN	74%	49%	65%	39%
FOC	15%	29%	28%	48%
NIC	6%	19%	5%	9%
ROW	5%	8%	3%	4%

Note: a ship is counted when it arrives and when it departs and may be counted more than once if it makes repeat voyages.
Source: Statistics Canada Marine International Origin-Destination Database

The fleet serving Canada evolved similarly to the world fleet as the TMN share of Canadian international traffic declined while the FOC share increased. However, the TMN held a larger share of Canada's international traffic than their share of the world fleet from 1985 to 1999. Conversely, the NIC and ROW fleets' shares of Canada's traffic were considerably less than their shares of the world fleet.

TMN ship arrivals and departures declined by 13.8% from 1985 to 1999 while the GRT of those ships increased by 18.7%. The GRT increase was due to the fleets of the United States, Norway and Canada. However, over 98% of the activity for the Canadian and U.S. fleets was transborder traffic. Again this is consistent with

[§] The IMO's "International Convention on Tonnage Measurement of Ships" may have affected the GT and GRT reported during this period it entered into force in 1982, but not fully adopted until July 1994.

Begantino and Marlow's findings that it is the deep-sea fleet that is more likely to be flagged-out. Canadian and U.S. shipowners engaged in transborder trade may prefer their national register to avail of cabotage laws. The gains of the Norwegian fleet were entirely offset by decreased traffic by the Japanese fleet.

FOC ship arrivals and departures increased by 80.3% from 1985 to 1999 while the GRT of those ships increased by 148.6%. Almost all FOC fleet traffic increased particularly for ships registered in the Bahamas, Panama and Cyprus. Liberian ship traffic declined even though the GRT of those ships increased. The average GRT of the FOC ships increased 37.8% from 1985 to 1999 which was more than the 23.6% increase in the GT of FOC ships in the world fleet. In 1999, the FOC ships calling Canadian ports averaged 26,966 GRT while the FOC ships in the world fleet averaged 14,598 GT.

The NIC and ROW fleets declined in importance to Canada's seaborne trade in both numbers of ships and GRT. The one exception was the Singaporean flag, which increased in vessel traffic and GRT.

The increase in average vessel sizes appears to be supported by the international cargo statistics. International cargo loaded and unloaded at Canadian ports increased by 37.8% from 1985 to 1999 from 204.1 Million tonnes (Mt.) to 281.2 Mt.. TMN ships carried the largest share of this cargo over the 15-years, but their share has been declining relative to the share for FOC ships particularly since 1997. Cargo loaded and unloaded by TMN ships increased just 6.0% from 106.4 Mt. in 1985 to 112.8 Mt. in 1999, while cargo loaded and unloaded by FOC ships increased 104.6% from 62.1 Mt. to 127.0 Mt.

Two commodities, coal and crude petroleum, particularly illustrate the flag-related changes in the fleets serving Canada. Coal was the leading international commodity handled by the ports in 1999. Outbound coal rose by 24.2% from 26.0 Mt in 1985 to 32.2 Mt. in 1999. In 1985, 66.7% of the coal was destined for Japan and Japanese-flagged ships carried 51.7% of the total outbound coal, while Panamanian ships carried just 4.4%. By 1999, 46.2% of the

coal was bound for Japan and Japanese-flagged ships carried just 12.9% while Panamanian-flagged ships carried 44.6% of outbound coal. The flagging-out of some Japanese ships was evident from the detailed data. However it was not possible to follow all such changes over the reference period due to revisions in vessel registration numbers.**

Coal imports have centered mainly on the Great Lakes with the US being the source of 99.8% of the 15.2 Mt that were unloaded by Canadian ports in 1985 and 91.1% of the 20.4 Mt unloaded in 1999. Canadian-flagged ships carried 96.3% of the inbound coal in 1985 and 81.1% in 1999 as coal remained a staple of the Great Lakes fleet.

Crude petroleum has been one of the largest imports through much of the reference period as feedstock for petroleum products, particularly at East Coast refineries. The crude petroleum unloaded at the ports increased almost threefold from 9.7 Mt. in 1985 to 28.5 Mt in 1999. Europe, particularly the North Sea, was the major source of this crude throughout much of the reference period (43.1% in 1985, 52.9% in 1999) followed by the Middle East/Africa (28.1% in 1985, 35.7% in 1999) and South and Central America (26.9% in 1985, 11.3% in 1999). Several fleets were prominent in the carriage of this product, particularly the Liberian-flagged fleet, which carried 36.4% of the cargo over the 15-year term. However, the Liberian-flag fleet's share of the cargo has ranged from a high of 50.1% in 1996 to a low of 15.1% in 1999. These changes in share seem related to changes in Greek shipping policy over the years as the peaks in Liberian cargo appear related to valleys in Greek cargo and vice versa.

Outbound shipments of crude petroleum rose from 695 kilotonnes in 1985 to 9.3 Mt. in 1999. Two factors explain this increase: 1) double-hull regulations of the 1990 U.S. Oil Pollution Prevention Act that led

** In 1996, the International Maritime Organization (IMO) adopted the Lloyd's number as the official registration number for all vessels in international trade. The advantage of this number is that it can be used to track vessels over time even as the ships name and flag of registry changes.

to the 1994 start-up of a transshipment facility at Port Hawkebury, N.S. for North Sea crude bound for the U.S.; and 2) Newfoundland's offshore oil production started in 1989. In 1985, the fleets of Liberia, Greece, Panama and Norway handled 88.5% of outbound crude petroleum shipments. These fleets carried 2.6 times as much outbound crude in 1999, but their share of the total dropped to just 16.2%. By 1999, Singaporean and Canadian flagged ships dominated outbound crude shipments with 47.9% and 31.6% of the tonnage, respectively.

A Flag Related Risk Index

Risk is a composite measure of the probability and severity of an adverse occurrence.[16] The data presented above are not sufficient to calculate the risk of a marine casualty in Canada but can provide insight into the trends of the probability of casualties based on the flag-state criterion alone. An index (1985=100) was constructed based on the sum of the annual casualty rate for each flag group weighted by that group's proportion of the total ship arrivals and departures at Canadian ports in that year.

This index suggests that despite Canada's increasing dependence on FOC ships, the overall probability of a vessel casualty has declined. Indeed, the index remained under 100 for the entire reference period except for 1991 when it rose to 101. By 1999, the index had fallen to 56, due almost entirely to the decline in overall casualty rates.

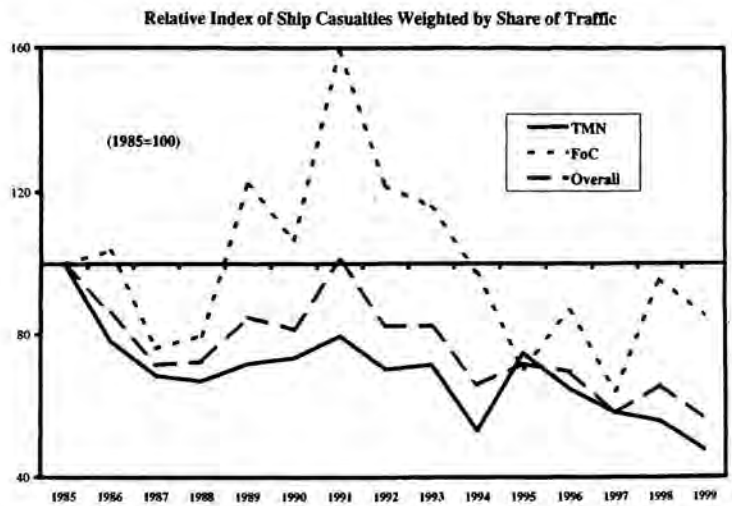
Some interesting observations arose in the calculation of this index:

1. The FOC posted the worst casualty rates over the reference period averaging 2.2 times the TMN rates, but TMN ships have averaged 3.5 times as many arrivals and departures as FOC ships suggesting that TMN ships could be more likely to have casualties in Canadian waters.
2. The weighted index for all flag groups except the FOC had fallen below 50 by 1999 due to the declines in both casualty rates and traffic for these fleets.

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3. While FOC casualty rates had declined by almost 54% over the reference period, the impact of this decline was limited by the 80.3% increase in FOC ship arrivals and departures resulting in a 15% improvement in the weighted index (i.e., 1999 = 85). For 6 of the 15-years the weighted index for FOC ships was above 100.
4. While the average ship size (GT) for casualties increased for the world fleet 5.0% from 1985 to 1999, the average ship size for the FOC fleet increased by 32.4%. The average FOC casualty over the reference period was 1.9 times the GT of the average world fleet casualty. This suggests that if a casualty had happened, the size of the ship involved would likely have been larger in 1999 than 1985, particularly if the casualty were an FOC ship.

Figure 4:



This weighted index was compared to the number of marine accidents to foreign ships in Canadian waters reported by the Transportation Safety Board (TSB) of Canada for 1989 to 1999. The 2 data series are significantly different as the TSB data do not include Canadian-

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flagged ships and include all accidents as opposed to just casualties. A positive correlation of $\rho=0.75$ was found suggesting that despite the differences the two data series are very similar. The TSB data and the index developed here appear to validate one another.

Conclusions and Recommendations

Canada has become significantly more dependent on 'flag-of-convenience' ships for its cargo international trade. Yet the fleet that called at the country's ports in 1999 seemed to be significantly safer than the one in 1985, as world shipping had in general become safer.

This improvement may appear to be in conflict with stable rate of deficiencies and detentions resulting from Port State Control inspections. Yet the improvement may be due in part to the effective targeting of PSC inspections that has resulted in these stable rates. It may also be due to the impact of regulations and legislation implemented by port states arising from accidents such as the Exxon Valdez and Erika.

Some cautions and concerns need to be stated with these findings. The first concern is with respect to the publicly released casualty data. There is a need for more complete accident data rather than just those that have resulted in casualties. There is also a need for more publicly available data on the causes and consequences of accidents and variables relating to the characteristics of the ships involved.

The suggestion that the overall fleet may be safer does not imply that there are no substandard ships calling at Canadian ports, nor does it imply that all coasts and ports share the same level of risk. The finding does not mitigate the need for effective PSC inspections but suggests that the vigilance of Port States acting in concert has positively impacted the overall safety of the seas.

Flag is one of a number of characteristics that could indicate the casualty potential of the fleets that support Canada's international trade. The average age of the fleet, nationality and certification

standards of officers and crew, classification society and frequency of changes in flag, ownership and class offer other avenues for further study.

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[1] Lloyd's Register (1999). *World Fleet Statistics*. Table 1A.

[2] For example – On December 12th, 1999, the 25-year old Maltese-flag tanker ERIKA, broke in two spilling 14,000 tonnes of fuel oil onto the beaches of northwestern France. The European Union responded by stepping up port state control inspections, more closely monitoring the performance of classification societies, speeding up the elimination of single-hulled tankers and improving the liability and compensation regimes for pollution damage. See *Erika Oil Spill Prompts Maritime Safety Action by EU*. Harbour and Shipping, January 2002, p.16-17.

[3] Transport Canada, Marine Safety Port State Control 2000 Annual Report, TP13595.

[4] Transportation Safety Board, *Annual Report to Parliament 2000-2001*. P.12

[5] Lloyd's Register. Casualty Returns, 2000. P 4.

[6] Lloyd's Register. Casualty Returns, 2000

[7] Cullinane, K and Robertshaw, M (1996) *The influence of qualitative factors in the Isle of Man ship registration decisions*. Maritime Policy and Management Vol 23, No 4.p. 321-326.

[8] Stopford, Martin (1988). *Maritime Economics* p. 161 Unwin Hyman Ltd. London, England.

[9] http://www.itf.org.uk/sections/mar/foceng.html . 1. Non citizens are allowed to own and control vessels; 2. Access to and from the register is easy; 3. Taxes upon shipping income are low or non-existent; 4. The country of registration does not need the shipping tonnage for its own purposes but is keen to earn the tonnage fees; 5. Manning by non-nationals is freely permitted; 6. The country lacks the power (or willingness) to impose national or international regulations on shipowners.

[10] Brodie, P (1994). *Dictionary of Shipping Terms, 2nd Edition*. Lloyd's of London Press Ltd. London

[11] Mathews, Steve (2001), *Choosing the Right Flag*. Lloyds Ship Manager (LSM), June 2001, p. 39-41.

[12] Bergantino, A and Marlow, P. (1998). *Factors influencing the choice of flag: empirical evidence*. Maritime Policy and Management. V25, No. 2, p.157-174.

[13] http://www.nis-nor.no/announce.htm

[14] Thanopoulou, H.A. (1995) *The growth of fleets registered in newly-emerging maritime countries and maritime crises*. Maritime Policy and Management Vol 22, No 1.p. 51-62.

[15] Lee, T.-W. (1996). *Flagging options for the future: A turning point in Korean shipping policy?* Maritime Policy and Management. V23, No. 2, p.177-186.

[16] Transport Canada (1994). *Guide to Benefit-Cost Analysis in Transport Canada*. TP 1187E.

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The Effect of Port State Control on Substandard Shipping

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Executive Summary

Port State Control (PSC) is the inspection of foreign ships in the harbours of coastal states to verify the condition of the ship and to ensure compliance with major international maritime conventions. This article evaluates the effect that PSC has had on substandard shipping and its contribution to the International Maritime Organisation's goal of "safer shipping and cleaner oceans." The article begins by examining the institutional character, jurisdictional scope and operating conditions of PSC, and then proceeds to evaluate the regime using the criteria of political feasibility, distributive implications, and social consequences. The author demonstrates how PSC serves to create a clear legal framework and some limited impetus for action by ship owners wishing to deploy their vessels where PSC agreements exist. The paper discusses how PSC is indeed an international success when placed in the historical context that gave rise to its creation. However, it concludes by suggesting that the regime of PSC is indeed somewhat less successful when the criteria of the distributive and social consequences of substandard shipping are considered. The benefits of inter-jurisdictional co-operation, while necessary to solve the problem of substandard shipping, are not sufficient. Solving the problem of substandard shipping requires political and business leadership.

1 Introduction

The growth in international trade and the service requirements of modern logistics systems have placed increasing pressure on ship owner profits. One strategy to increase profitability favoured by some ship owners is to neglect the maintenance and repair of the vessels under their command. Other ship owners have chosen to prolong the working life of their vessels past the age at which they would usually be sold for scrap. Still other ship operators choose to crew and man their vessels with personnel who are poorly trained or inadequately equipped to safely navigate a ship and transport its cargo. Recent research by the Transport Division of the Organisation for Economic Co-operation and Development (OECD 2002) suggests that the cost to ship owners of maintaining the world merchant fleet to the minimum required shipping standards is approximately $US 4 billion per year. The competitive advantage gained by individual ship owners who do not observe the international rules and standards could amount to 15% of the annual running cost of each vessel--an amount equivalent to $US 250,000 per annum. With such financial incentives as these, it is not surprising that the issue of substandard shipping arises. A substandard ship is considered to be any vessel that fails to meet basic standards of seaworthiness because of its physical condition, its operation, or the activities of its crew. A substandard ship poses threats to both human life and/or to marine environments (SSY Consultancy and Research 2001).

One policy response adopted by governments to deal with the problem of substandard ships (and substandard shipping) is the concept of *Port State Control* (PSC). Port state control refers to the inspection of foreign ships in the harbours of coastal states to verify the condition of the ship and to ensure its compliance with major international maritime conventions.

2 The International Regime of Port State Control

In response to difficulties or challenges such as substandard shipping, the international community often develops an international regime to help address or resolve problems that cannot be solved by the actions of any one nation alone. An international regime is a system of rules and norms, together with a set of formal and informal institutions, with the express intent that these arrangements be applied to a given social or political problem (Valencia 1996). In 1948, the international community adopted a convention formally establishing the International Maritime Consultative Organisation (IMCO) (renamed the International Maritime Organisation (IMO) in 1982). The Convention entered into force in 1958. This United Nations IMO expresses it raison d'être in the motto "safer shipping and cleaner seas."

The definition of substandard shipping suggests that for the regime of PSC to be considered effective, it must effectively address two problems, the first being the threat to human life, and the second problem the risk to the marine environment. According to Valencia (1996), we can consider the threat to human life to be a dilemma of common interest, and the problem of marine pollution to be a dilemma of common aversion. Regimes established to deal with a dilemma of common interests require collaboration, while those created to solve a dilemma of common aversion require co-ordination (Valencia 1996). Thus, the first factor to consider when evaluating the effectiveness of PSC is whether the regime does indeed promote collaboration and co-ordination.

2.1 Regime Dynamics

A second factor to consider when evaluating PSC effectiveness is whether the institutional arrangements underpinning it are responsive to emerging needs and issues.

Young (1980) suggests that the question of how and when the PSC regime came into existence becomes an important yardstick for judging the political feasibility of the policy instrument. Negotiations for the 1982 United Nations Conference on the Law of the Sea (UNCLOS) took place during the years 1973 to 1982. As negotiations progressed, the international community came to the realisation that the problem of non-compliance with IMO regulations could not be corrected by flag state enforcement alone.

The 'freedom of the seas' doctrine (*Mar Librium)*, articulated in 1609 by Dutch legal scholar Hugo Grotius, claimed that ocean resources should be available to all nations that wish to harvest them. The 'freedom-of-the-seas' principle meant that outside its territorial waters, a nation could not claim sovereignty over the seas, except with respect to its own vessels (Kibel 2000). Article 221(I) of UNCLOS codified this principle of customary international law.

During the UNCLOS negotiating process, compromises were needed if the international community was to develop a new legal framework for ocean governance. UNCLOS resulted in coastal nations having rather limited power in the control they could exercise over vessels navigating in their territorial seas; however, coastal nations were given express powers within the internal waters in which their harbours were located (Valenzuela 1999). Article 25(2) of UNCLOS formally expressed this principle. It is from this basis that PSC officials are able to exercise their authority. Examples of the conventions that can thus be enforced (using the regime of PSC) by coastal states include the: a) **SOLAS 74**: International Convention for the Safety of Life at Sea 1974; b) **LL 66**: Internal Convention on Load Lines 1966; c) **MARPOL 73/78**: International Convention for the Prevention of Pollution from Ships 1973, as modified by the Protocol of 1978; d) **STCW 78**: International Convention on Standards of Training, Certification and Watchkeeping for Seafarers; **TONNAGE 69**: International Convention on Tonnage Measurement of Ships, 1969; and e) **ILO 147**: International Labour Organisation Convention No. 147 Merchant Shipping (Minimum Standards).

2.2 Institutional Character

To evaluate the effectiveness of the PSC regime, it is essential to understand the central rights, rules, and choices that are available to those who operate commercial vessels or to those nations with international ports. The interaction of national maritime administrators with the individual actors in the international shipping community is based on Article 25 of UNCLOS. This clause specifically empowers nations to take necessary steps to prevent any breach of the shipping standard conventions by foreign vessels that call upon their harbours. In addition, Articles 216 and 218 enable a port state to enforce international antidumping and anti-pollution measures, while Article 219 permits nations to take administrative measures to prevent substandard vessels from sailing from their harbours. Legitimacy for PSC inspections is found in these articles. The only limitation is that any steps taken that invoke PSC must be reasonable, public, and not discriminatory.

2.3 Jurisdictional Scope

Understanding the jurisdictional scope of a regime is a necessary factor to consider when evaluating PSC's contribution to 'safer ships and cleaner seas.' While PSC clearly depends upon compliance with IMO conventions by individual states, over the past 20 years, nations that share common oceans have created 'regional' PSC agreements (or *Memorandums of Understanding*) to facilitate their work. Despite earlier IMO efforts to reduce substandard shipping, a number of high profile shipping accidents in the late 1980s and early 1990s led to an increased sense of urgency in finding solutions to the problems created by substandard shipping. Consequently, the IMO passed resolution A.682 (17) (Regional Co-operation in the Control of Ships and Discharges) in 1991. Canada's historical commitment to safer ships and cleaner sea has lagged behind that of the European Community. However, it predates the passage of the 1991 IMO resolution on regional co-operation.

Canada became an associate member of the 19-country Paris MOU in 1988, and was accepted as a full member in 1994. During the last decade, Canada has exercised some degree of leadership on the issues of substandard shipping by being instrumental in the creation of the 18-nation Tokyo MOU (Transport Canada 2001). The goals and objectives for PSC in each of the eight regions are based on the Paris MOU model, but with some regional variations. One of the most significant differences influencing the effectiveness of PSC agreements around the world is the rate of ship inspection.

Substandard vessels trading in the poor regions of the world have a significantly lower chance of being detained by PSC inspections. Table A, highlights the inspection target rate the members of the each MOU agreement have set as their performance standard.

Table A: Port State Control Agreements

MOU Region	Inception Date	Target Rate Ship Inspections
Tokyo	1993	50% regional
Paris	1982	25% per country
Acuderdo de Vina del Mar	1992	15% per country
Mediterranean	1997	15% per country
Abuja	1999	15% per country
Black Sea	2000	15% per country
Caribbean	1996	10% per country
Indian Ocean	1998	10% per country
Note: Persian Gulf agreement currently under development.		
Source: International Maritime Organisation		

Given the fact that the regime of PSC creates a new legal framework for enforcing existing IMO conventions, an important question for many observers is to what extent the jurisdictional arrangements of IMO conventions are (or are not) optional for member states. Since the 1970s, IMO technical conventions have adopted a new amendment system for the appendices.

Under the new procedures, amendments automatically enter into force on an agreed-upon date, unless the amendments are positively rejected by a specified number of state parties. This is in contrast to the previous method whereby a safety amendment to an annex entered force only after being positively accepted by a specified number of state parties to the convention (Valenzuela 1999). Consequently, nations exercising their rights and obligations under a PSC regime are automatically empowered to enforce the most recent internationally agreed upon safety standards.

2.4 Operating Conditions

As noted in previous sections, PSC control has evolved into a regional policy tool that supplements flag state control and responsibility in maritime matters. Thus, the effectiveness of PSC stems from the legal position of coastal nations vis-à-vis the flag state that has primary responsibility for enforcing IMO conventions. PSC operating procedures are governed by resolution A.787 (19) adopted by the IMO Assembly in 1995 (Sasamura 1998). Crucial to the successful operation of PSC is the sharing of information--gained about particular ships or their owners or operators--between jurisdictions in and out of which those ships trade. In recognition of this fact, the IMO has developed a global project to assist regional PSC agreements in the harmonisation of their operations, the development of their human resources capabilities, and in the co-operation and exchange of information amongst MOU signatories. As a United Nations organisation, however, the IMO can only encourage nations in these efforts, it can not obligate their compliance (Hoppe 2000). One obstacle to compliance is the need for technical and financial assistance to enforce regulations. This is particularly apparent within the newly established PSC agreements, the majority of whose members are from the developing countries and lack sufficient resources to enforce PSC. A second difficulty is ensuring the participation of all members within the regions, as active participation of all members is crucial in the successful implementation of the agreements.

3 Evaluation of Port State Control

3.1 Political Feasibility

According to Valencia (1996), the *political feasibility* of a policy regime refers to the political cost to achieve compliance with the principal behavioural prescriptions of the given regime: in other words, can the requirements of the regime be implemented and maintained to achieve the stated outcome. Valencia argues that in terms of political feasibility, regimes that are sector-specific have a greater chance of success than multipurpose systems that seek to perform a variety of functions within the framework of a single authority. He bases his conclusion on "inherent" political reality, despite the logic of, apparent need in some areas for, an integrated management system.

PSC regimes are regional in nature for a variety of reasons; however, the main reason is political feasibility. Proponents of a regional approach to PSC claim that unless such an approach is adopted, ship operators will simply divert their vessels to harbours in the region where no (or less stringent) PSC inspections are conducted. Consequently, a regional approach encourages co-operation and results in fewer places and economic opportunities for substandard ships to trade (Hoppe 2000). The regional PSC strategy implicitly acknowledges the fact that individual state action is insufficient to reduce the problem of substandard shipping, and that stronger international measures to deal with the problem (and/or greater political will and capacity to enforce IMO regulations) are not obtainable in the current political climate.

PSC is considered the last safety net when vessel owners, shipping classification societies, insurers, and flag state officials have in one way or another, failed to do their job (Plaza 1994). The regime of PSC state control is a right exercised by port states, and not an *obligation* (Plaza 1994).

Given the rather low political hurdle rate for judging PSC a success, one would expect to find a preponderance of evidence suggesting that indeed safer ships and cleaner seas have resulted from the PSC regime. Regretfully, this has not been the case, nor has substandard shipping been eliminated since the implementation of PSC. However, this is not to suggest that PSC has had no impact whatsoever. Data from Lloyd's Register of Shipping, based on all merchant vessel types, indicates a 35% reduction in the number of ships lost (absolute total loss and constructive total loss) since the 1970s. OECD (2000) research (Table B) reveals that the average merchant vessel losses per annum since the 1970's were as follows:

Table B: Average Annual Merchant Vessel Losses During the Decade

	1970s	1980s	1990s
Number of vessels	373	308	242

OECD research indicates that there was a decline of 17.4% between the 1970s and 1908s in the average the number of merchant vessels lost per annum. In the decade of the 1990s, the decline was 21.4%. Since PSC was introduced, the rate of decline in total merchant ship losses per annum has been 4% more than during the previous period, although the decline in vessel losses among different vessel types has not been consistent. For example, the decline of dry bulk carrier losses has been far more modest than the general average. During the period in which PSC was introduced (the 1990s), the average number of dry bulk vessels lost per annum was 21, while the average number of seafarer fatalities associated with these loses was 84 (OECD 2000). Clearly, PSC has demonstrated at least modest success in this regard. Because of these developments, some authors such as Hare (1997) suggest that PSC has now matured to the stage where it recognises the need to accept the stark reality that some ships pose more of a problem than do others.

3.2 Distributive Dimensions

The distributive dimension of a particular regime deals with the allocation of benefits among the various participants affected by that regime, and it is this aspect that so often lies at the centre of political discussion as to the effectiveness of the governing arrangements (Valencia 1996). The 1982 Paris MOU required that PSC be conducted 'without discrimination as to flag;' it also required that each state ensure that no more favourable treatment be given to ships flying the flag of a state party to the MOU than to one that was not party to it. A policy of without discrimination would seem to imply that the benefits of PSC should be evenly distributed among nations; however, this has not been the case because the problem of substandard ships is not evenly distributed amongst vessels.

Canadian PSC data reveals that during the past six years, ships from Cyprus, Liberia, Malta and Panama were detained by Canadian authorities more frequently than ships from any other country, and represented 53% of all detentions. Vessels (ships of 100 gt and over) from these countries accounted for approximately 50% of the world ore and dry bulk merchant fleet in 1999 (OECD 2000). Transport Canada (2001) data reveals that in the year 2000, bulk carriers had the highest inspection rate (47%) and the highest detention percentage at 57%. Deficiencies in fire fighting equipment (17%), life saving appliances (13%), and navigation equipment were the main items where Canadian PSC inspections revealed that foreign vessels did not comply with the necessary IMO conventions. Clearly, this indicates that ship owners find the economic cost of PSC inspection cheaper than the alternative of voluntarily complying with international standards.

While PSC may have matured, its distributive dimensions remain uneven. It is for this reason that Hindell (1996) points out that the European Union has encouraged a much more rigorous PSC regime for targeting substandard ships.

In the future, individual ships will be targeted by a new inspection formula of which the main elements will be the deficiency and detention rate of the flag state; the conventions ratified by that state; the age of the ship; the type of ship; and the classification society used.

Despite the various regional initiatives that have evolved in recent years, in some parts of the world, application of PSC controls remains very limited (SSY Consultancy and Research 2001). The IMO's Senior Deputy Director of the Maritime Safety Division has noted that many countries have experienced difficulty not only in complying with existing legislation, but also in coping with the changes that have been made in more recent years (Plaza 1994). In addition, A January 2001 report from the OECD entitled *The Cost to Users of Substandard Shipping* observers that even PSC can only partially compensate for the laxity of some flag states in enforcing compliance with maritime legislation. Again, PSC has clearly resulted in some unevenness in the "distribution" of efforts to ensure compliance with maritime legislation.

3.3 Social Consequences

The social consequences of a particular regime refer to the most economically efficient means of resolving a problem. As noted in Section 2.4, a crucial element of regional PSC initiatives is the sharing of information gained about particular ships or their owners or operators, between jurisdictions in and out of which those ships trade. This exchange of information is important for two reasons. First, it does not unduly inconvenience vessels by inspecting them at each and every port, and second, it provides forewarning to maritime administrators of the substandard ships in their region (Hare 1997).

In measuring the effectiveness of PSC, it is important to note that those countries that are taking their PSC obligations seriously and have sufficient technical and financial resources to do so, are narrowing the trading options of substandard ships (Hare 1997).

One of the unfortunate social consequences, however, has been to increase the exposure (to substandard shipping) of those nations and individuals less able to deal with the negative consequences substandard shipping engenders. This is hardly a ringing endorsement of the equity principle.

4 Conclusion

This paper reveals that the regime of PSC serves to meet three critical needs in relation to the threat to life and/or the environment from substandard ships. First, it establishes a clear legal framework with liability for actions. Second, it demonstrates that the eight regional PSC MOUs have improved the quality and quantity of information available to nations on substandard ships. Third, it reveals that by working together in regional groupings, nations have been able to reduce the transaction costs of enforcement, and reduce the impact of enforcement activities on commercial shipping (Valencia 1996). Evidence suggests that PSC has indeed had some success in contributing to "safer shipping and cleaner oceans." However, this paper's review of the different dimensions and institutional character of port state control suggests that all is not well. One is left wondering, for example, why substandard ships are still a problem in international shipping when substandard aircraft ceased to be an issue long ago. Canada's involvement in the PSC regime clearly indicates that the benefits of inter-jurisdictional co-operation, while necessary to solve the problem of substandard shipping, are not sufficient. One could almost conclude that PSC has inadvertently resulted in removing the pressure from flag states, and effectively absolved them from their international responsibilities. Thus, solving the problem of substandard shipping requires political and business leadership.

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The Use of Proxy Variables in Economic Gravity Models: A Cautionary Note

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Introduction

Economic gravity models are used to examine the role played by transportation costs in the volume of commodity flows and international trade. Although inspired by the laws of gravity, economic gravity models assume that the Law of One Price applies. Specifically, trade between two regions depends on the economic distance between them. Under the Law of One Price, markets are at equilibrium when all prices are separated by the cost of moving goods between them.

Geographic information data requirements are less burdensome for gravity models. This is a significant advantage for quantitative analysis. Traditional trade equilibrium models require commodity prices in different regions that represent the appropriate market level (wholesale or retail) and similar value-added quality. Economic gravity models require only an accurate measure of commodity flows and transportation costs between origins and destinations. Nevertheless, data on transport costs are often unavailable or difficult to obtain. Consequently, distance has been used as a proxy for transport costs in previous studies.

This study examines the validity of proxy variables in gravity model analysis. Models describing eight different trade scenarios are developed. Four different models are estimated for the land transport of refrigerated pork from the five major exporting provinces in Canada to the 48 contiguous states of the continental United States.

Four equivalent gravity models are estimated for intermodal ocean container shipments of lentils from Western Canada to destinations in 97 countries in Europe, Africa, South America and Asia. For half the scenarios, freight rates are specified as the impedance factor, while the balance of the scenarios use distance as a proxy for freight rates. In addition, this study analyzes the implications of using the dollar value of exports instead of the volume of exports as the dependant variable in half of the gravity model estimations.

Micro Foundations and Estimation Issues of the Gravity Model

Gravity Models were first applied to international trade by Tinbergen (1962), Poyhonen (1963) and Linneman (1966) who proposed that the volume of trade is an increasing function of the national incomes of the trading partners, and a decreasing function of the distance between them. The empirical success of gravity models was hard to deny but they were criticized by economists because they seemed to lack theoretical foundations. These foundations were subsequently developed by, among others, Anderson (1979) and Bergstrand (1985), who derived gravity models from models of monopolistic competition, and Deardorff (1998), who demonstrated that the gravity model could be derived within Ricardian and Heckscher-Ohlin frameworks.

Prentice *et al* (1998) and Urbina-Olana (1996) derive the gravity model for interregional trade using the Law of One Price as a theoretical base. In a world of one commodity and two regions where price differences exist in the absence of trade, this difference would give rise to potential trade flows from where price is low to where price is high. Assuming that exchange rates are fixed and that free trade is negotiated between the two regions, the Law of One Price dictates that trade flows would increase until the prices differed exactly by the transportation and logistics costs associated with transfer. The gravity model represents the derived demand for transportation from the low price market to the high price market.

Impedance Factor Specification

Linneman (1966) uses distance between trading countries as a proxy variable for the total natural trade impediments, in their widest sense. It embodies three elements; transport costs, transport time and psychic distance, constituting together the obstacles to trade due to the existence of space. Over the years, many other economists have adhered to this method.

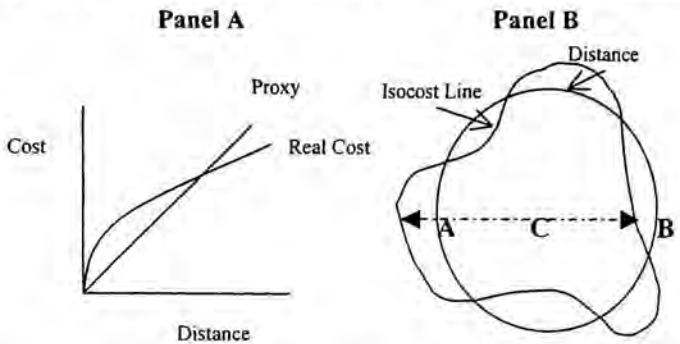
Several problems exist when using distance as a proxy for transport costs. First, no distance may be representative for countries that share long borders with goods moving across many entry points. Second, problems arise when allowing for variation in the cost of alternative means of transport. Land transport is more expensive than ocean transport and air transport is more expensive than land transport. Distance measures cannot account for these cost differences. Third, improvements in transportation technology affects the cost of producing these services and consumer demand for goods through the level of services provided (Bandyopadhay, 1999). A fall in transportation costs because of a more efficient distribution sector will lower the final prices of goods and increase their quantities demanded.

Geraci and Prewo (1977) and Ferguson (1972) observe other reasons that make distance measures a poor proxy for transport costs. First, freight rates are influenced by factors other than distance, such as the value, weight and bulk of the commodity being transported, as well as the mode of transportation used. Second, the use of distance assumes that freight rates are the same in either direction. In every trade lane there is a front haul and a back haul, with higher rates on front haul moves.

Figure 1 illustrates the relationship between transport cost and distance. In panel A, the proxy variable (distance) is assumed to exhibit a linear relationship. The real transport cost, on the other hand, does not lend itself to such simplicity. In this specific example, transportation costs are greater for shorter distances and begin to taper off as the distance increases. For shorter routes, the proxy

variable underestimates the effect of transfer costs on export flows and the opposite holds true for longer routes. Only on mid-range routes would the proxy variable accurately reflect the impact of transfer costs on export flows.

Figure 1 The Relationship Between Transport Cost and Distance.



Panel B outlines this same relationship, but includes other factors such as the level of infrastructure and the direction of travel. The smooth circle represents distance and every point on the circle is equidistant from the center, point C. The warped circle represents an isocost line where the transportation costs from point C to any point on the isocost line are equal. Let's assume that a shipper at point C has goods to deliver to points A and B, both of which are equidistant from point C. The route to point B is through a mountainous region where the road twists and turns and travel speed is slow. On the other hand, the route to point A is through a plain where the road is generally flat and straight and travel speed is fast. For a given level of costs (the isocost line) the distances traveled toward points A and B are different. In this example, the route toward point B is more costly than the route toward point A. Again, a proxy variable like distance would not distinguish between these cost differences.

Distance measures fail to account for currency exchange rates and do not reflect technological advances that impact the shippers' decisions

about mode choice. Mode choice, in turn, depends on the particular trade corridors used, the availability of equipment and infrastructure, freight rates, and the volumes and types of commodities being shipped. Finally, the estimated relationships between trade flows and static variables such as distance are not very helpful in predicting future trade levels or for policy analysis (Geraci and Prewo, 1977).

Alcaly (1967) estimated a gravity model using travel cost as the impedance factor instead of distance. The inclusion of cost tends to make the equations somewhat more specific to each mode of transport and more like traditional demand equations. Depending on the research objectives, different specifications of the model may be appropriate. Aggregate models with distance as the impedance factor help to explain aggregate trade flows as a function of distance, but do not provide useful results for marketers and policy analysts. Disaggregated models with a transport cost factor as an explanatory variable applies more to traditional demand analysis.

Prentice *et al* (1998) and Urbina-Olano (1996) both use actual freight rates paid by shippers as the impedance factor variable. Their analyses concentrated on estimating the derived demand for transport, or the freight rate elasticity, for the Canadian chilled pork export market. Because they used actual transport costs in a disaggregated model, their model performed more like a traditional demand model and their results are more meaningful to marketers, transportation service providers and policy analysts.

Alcaly (1967) points out that the relationship between distance and export volumes are likely to be different for different transportation modes. Air travel, for example is the most expensive form of transport, reserved mainly for time sensitive and/or high valued commodities. Aggregating these commodities with low valued, bulk commodities, which generally face much lower freight rates, would tend to make the characteristics of each commodity category less distinct, and thus less useful for understanding specific trade relationships. Furthermore, aggregate equations reflect the responsiveness of the dominant mode of travel, leading Alcaly to

suspect that what was being demonstrated may actually be the applicability of gravity models to the dominant mode of travel as opposed to travel by all modes and commodities.

Dependant Variable Specification

A gravity model requires some measure of the goods shipped as the dependant variable. The dependant variable in Bergstrand's (1985) gravity equation was specified as PX_{ij}, where PX_{ij} is the U.S. dollar value of the flow of goods from country i to country j. If prices have been relatively stagnant throughout the time series, PX_{ij} is merely the volume of exports multiplied by some constant. No doubt it is more difficult to get quantity data of trade flows, but price data is a questionable substitute in a gravity model if prices have great flexibility. For instance, the 1970's saw a tripling of grain prices within a couple of years. A model using the value of exports as the dependant variable would treat this as a tripling of trade volumes, but the impact of transport costs on this trade is unlikely to have changed as much. As a proportion of the delivered price, transport costs almost certainly fell during this period. The fluctuations in market prices and trade volumes could as easily move in opposite directions than move in tandem. By adding a volatile price variable into the equation, as in PX_{ij}, the results become less clear.

Both the value of goods traded or the volume of goods traded could be used as the dependant variable. Volume data are likely to be more independent of transport costs, to the extent that carriers are known to try to extract higher freight rates when commodity prices rise, and vice versa. At the same time, the burden of transport costs is greater for low value commodities, especially if they are heavy or bulky, which is most often the case.

Aggregate trade could include all goods, ranging from high valued manufactured items, such as computers, and low valued raw materials, like wheat. The valuation of goods provides a common unit of measure that is more easily analyzed and compared. The problem that arises is the relationship between some aggregate value and its sensitivity to transportation costs. A unit train of wheat has

about the same value as a truckload of computers, but the absolute costs of transport are about 30 times greater for the wheat.

Alcaly's (1967) gravity model was used to understand passenger travel between cities in the state of California. The dependant variable was specified as the volume of travel, in passenger miles. Prentice *et al* (1998) and Urbina-Olano (1996) use volume of pork exports measured in tonnes in their analyses. Using this specification helps the authors to answer the fundamental question; what volume of goods (passengers) are expected to move and where are they expected to move to, based on the cost of moving them?

Specification Testing

The purpose of this analysis is to focus on the impact of using value and distance as proxy variables. The experiments were designed to minimize other sources of variation. A land transport model and a marine transport model are estimated separately. Test commodities were chosen that move exclusively by one mode of transport, and are very uniform in quality. Finally, to test the sensitivity of location, the models are estimated with individual origins of supply and aggregate sources of supply. The land transport of pork model was first estimated aggregately and then disaggregated by Province. The marine transport of lentils model was first estimated aggregately and then disaggregated into Atlantic-based trade and Pacific-based trade.

Empirical Model

The model as derived in Prentice *et al* (1998) is used in this analysis. It is the simplest form of the gravity model.

Marine Transport Gravity Model

In the marine model, only intermodal container transport is considered. Lentils that are shipped exclusively in containers were used as a test commodity.

$$\ln Q_{ijt} = \alpha + \beta_1 \ln F_{ijt} + \beta_2 \ln Y_{jt} + \delta_1 B_{1jt} + \delta_2 B_{2jt} + \delta_3 B_{3jt} + \delta_4 B_{4jt} + e_{ijt} \quad (1)$$

$$\ln Q_{ijt} = \alpha + \beta_1 \ln D_{ijt} + \beta_2 \ln Y_{jt} + \delta_1 B_{1jt} + \delta_2 B_{2jt} + \delta_3 B_{3jt} + \delta_4 B_{4jt} + e_{ijt} \quad (2)$$

$$\ln V_{ijt} = \alpha + \beta_1 \ln F_{ijt} + \beta_2 \ln Y_{jt} + \delta_1 B_{1jt} + \delta_2 B_{2jt} + \delta_3 B_{3jt} + \delta_4 B_{4jt} + e_{ijt} \quad (3)$$

$$\ln V_{ijt} = \alpha + \beta_1 \ln D_{ijt} + \beta_2 \ln Y_{jt} + \delta_1 B_{1jt} + \delta_2 B_{2jt} + \delta_3 B_{3jt} + \delta_4 B_{4jt} + e_{ijt} \quad (4)$$

Q_{ijt} is the quantity of lentil exports, in terms of container loads, from Canada to 97 different countries worldwide. V_{ijt} is the value of lentil exports expressed in constant U.S. dollars. F_{ijt} are actual, confidential, ocean-leg container freight rates from the ports of Montreal or Vancouver to the destination markets. These data were obtained on a confidential basis from a large international freight forwarder that is active in this trade. D_{ijt} is the ocean distance (in nautical miles) from the ports of Montreal or Vancouver to the nearest port of entry, as found at www.distances.com.

A dummy variable, B_1, is used to identify competing lentil production in importing countries. The dummy variable was set to unity if the importing country produced lentils domestically, and zero otherwise. This model uses two dummy variables to distinguish high-volume, relational trade linkages, from low-volume spot market trade flows. Discussions with exporters revealed that they enjoy long-term relations with some markets, while other markets may only emerge at random when some local shortage appears. These markets are consistent importers and import disproportionately large volumes. The "spot market" regions have relatively small volumes and do not import every year. B_2 identifies those markets that consistently import Canadian lentils every year, irrespective of actual volumes, it is set to unity if countries import every year, and zero otherwise. B_3 distinguishes large importers from small importers, it was set to unity if imports exceed 500 container loads per year, and zero otherwise. B_4 distinguishes rich countries from poor countries. It was set to unity of the importing country is a member of the OECD, and zero otherwise. The above dummy variable approach best explains the diverse platform of the global lentil trade.

There are 97 cross-sections and 8 time periods (1991-1998). Two sub-models were estimated for Atlantic-based and Pacific-based trade, as well as the aggregate model.

Land Transport Gravity Model

In this model, only refrigerated, long haul tractor-trailer transport trucks were considered. The test commodity, fresh and frozen pork, moves exclusively in these vehicles between Canada and the U.S.

$$\ln Q_{ijt} = \alpha + \beta_1 \ln F_{ijt} + \beta_2 \ln Y_{jt} + \beta_3 \ln INX_{jt} + \delta B_{jt} + e_{ijt} \quad (5)$$

$$\ln Q_{ijt} = \alpha + \beta_1 \ln D_{ijt} + \beta_2 \ln Y_{jt} + \beta_3 \ln INX_{jt} + \delta B_{jt} + e_{ijt} \quad (6)$$

$$\ln V_{ijt} = \alpha + \beta_1 \ln F_{ijt} + \beta_2 \ln Y_{jt} + \beta_3 \ln INX_{jt} + \delta B_{jt} + e_{ijt} \quad (7)$$

$$\ln V_{ijt} = \alpha + \beta_1 lnD_{ijt} + \beta_2 \ln Y_{jt} + \beta_3 \ln INX_{jt} + \delta B_{jt} + e_{ijt} \quad (8)$$

Q_{ijt} is the quantity of pork exports, in terms of truckloads, from province i to state j in year t. V_{ijt} is the value of chilled/frozen pork exports expressed in constant U.S. dollars. F_{ijt} is the truckload freight rate of transporting pork from province i to state j in year t. These freight rates were obtained on a confidential basis from a large refrigerated truckload carrier that is an active participant in Canada-U.S. trade. D_{ijt} is the truck distance (in miles), obtained from the Rand McNally Road Atlas, from the five major pork-exporting provinces in Canada to the 48 states in the continental U.S., measured from the most populated city. There are 48x5 = 240 cross sections covering a five year period (1992-1996).

An additional variable was included to identify the effects of competing supply sources (B_1 in Marine Transport Gravity Model). This variable is called the production specialization index, INX_{jt}, which is calculated as the ratio of hog inventory to human population in importing regions. For an importing region, import quantity is expected to increase as income goes up or the specialization index declines.

The dummy variable is specified to distinguish high-volume, relational trade linkages, from low-volume spot market trade flows. The dummy variable is set to unity when a state's annual pork imports are more than 500 tonnes and zero otherwise.

Results and Discussion

The regression results for the land and marine transport gravity models are presented in Table I (lentils) and Table 2 (pork).

Table 1: Estimation results for the marine transport of lentils.

Model 1:volume=f(freightrates)				**Model 3:value=f(freightrate)**		
	Aggr.	**Atl.**	**Pac.**	**Aggr.**	**Atl.**	**Pac.**
α	0.3693	7.4544*	7.5732	0.5569	6.0153*	5.3546
β_1	-0.1572	-1.216*	-0.699	0.137	-1.06*	-0.637
β_2	0.0571	0.1156*	-0.097	0.148*	0.3347*	0.0973
δ_1	0.768*	0.296	1.678*	1.328*	0.78*	1.1112
δ_2	4.942*	3.4192*	6.25*	10.86*	9.151*	15.798*
δ_3	3.1328*	3.607*	2.906*	2.4*	1.819*	1.903*
δ_4	-0.0657	-0.65*	-0.896	1.127*	0.411	-0.3802
n	776	584	192	776	584	192
R^2	0.7629	0.7929	0.7842	0.5944	0.6909	0.6998
Model 2:volume=f(distance)				**Model 4: value=f(distance)**		
α	6.937*	-0.998	11.44*	17.317*	8.2712	20.878
β_1	-0.984*	-0.301	-1.06*	-1.986*	-1.238*	-2.022*
β_2	0.097*	0.1911*	-0.073	0.2317*	0.3556*	0.0177
δ_1	0.83*	0.489*	1.875*	1.3477*	1.246*	2.979*
δ_2	4.523*	3.738*	4.842*	9.778*	9.108*	12.061*
δ_3	2.98*	3.41*	2.54*	2.427*	2.051*	1.339*
δ_4	-0.30	-0.257	-1.194	-0.07	0.208	-1.641
n	776	584	192	776	584	192
R^2	0.7733	0.7823	0.8409	0.6384	0.6692	0.7195

* Denotes coefficient estimate is significant at the 5% level.

Table 2: Estimation results for the land transport of pork.

	All	Alberta	Sask.	Man.	Ont.	Quebec
Model 5: volume = f(freight rates)						
α	10.403*	47.098*	6.981*	6.3891*	-4.1663	13.285*
β_1	-3.371*	-9.313*	-1.1576*	-3.331*	-1.751*	-2.375*
β_2	1.9489*	3.1876*	0.25961*	2.2628*	2.409*	1.2723*
β_3	-0.0260	-0.038*	-0.00988	0.06521	0.070*	-0.0078
δ	8.3979*	0.89804	20.037*	8.2416*	2.855*	5.4536*
n	980	195	195	195	195	200
$\mathbf{R^2}$	0.9244	0.9676	0.9406	0.8592	0.6547	0.574
Model 6: volume = f(distance)						
α	5.2296*	33.337*	4.2895	3.5974	-7.746*	11.109*
β_1	-2.667*	-7.848*	-0.8688*	-2.94*	-1.118*	-2.126*
β_2	1.8825*	3.3289*	0.28202*	2.2107*	2.294*	1.2503*
β_3	-0.0239	-0.0236	-0.00988	0.06677	0.11101*	-0.0689
δ	8.7996*	0.34502	20.002*	8.5324*	3.2648*	5.3201*
n	980	195	195	195	195	200
$\mathbf{R^2}$	0.8932	0.9547	0.9242	0.8661	0.6069	0.568
Model 7: value = f(freight rates)						
α	9.8152*	46.52*	5.3158	4.9138	-6.8451*	14.306*
β_1	-3.462*	-9.263*	-1.1293*	-3.522*	-1.7713*	-2.451*
β_2	2.0834*	3.1942*	0.40067*	2.5231*	2.6965*	1.3001*
β_3	-0.145*	-0.1471	-0.03293	0.10593	0.073921	-0.058
δ	8.4204*	1.3084	20.414*	8.7178*	2.8025*	4.8309*
n	980	195	195	195	195	200
$\mathbf{R^2}$	0.789	0.8524	0.9251	0.6704	0.6679	0.5467
Model 8: value = f(distance)						
α	5.2962*	26.352*	2.7971	1.7817	-11.754*	11.675*
β_1	-2.772*	-6.955*	-0.882*	-3.115*	-0.8966*	-2.364*
β_2	1.9702*	3.2903*	0.43803*	2.493*	2.5417*	1.4279*
β_3	-0.142*	-0.1454	-0.03473	0.11582	0.1123*	-0.1285
δ	8.8703*	1.6913	20.369*	8.9383*	3.551*	4.8592*
n	980	195	195	195	195	200
$\mathbf{R^2}$	0.7723	0.7983	0.9279	0.6831	0.6263	0.5858

Standard criteria were used in evaluating the performance of the different gravity models such as agreement of the signs and the magnitude of the estimated coefficients, the statistical significance of the coefficients and the explanatory power (R-square) of the entire relationship. Given the consistency of the data, we would expect a similar level of performance from each of the different gravity models.

The coefficients of the impedance factor variables (freight rates versus distance) in the land transport (pork) gravity model all have the expected sign, their magnitude is reasonable and all are statistically significant. In this market, the specification of distance as the impedance factor consistently underestimates the impact of transfer costs on flows of chilled pork to the U.S.

The aggregate marine transport (lentil) gravity model did not perform as well as the aggregate land transport gravity model. This may be due to the more diverse platform of the global lentil trade, as compared to the relatively homogeneous North American chilled pork market. All of the impedance factor elasticities have the correct sign, except for the freight rate elasticity on the Aggregate Trade when value is specified as the dependant variable. However, the distance elasticities have a greater degree of stability and the freight rate elasticities in Models 5 and 7 in the Aggregate and Pacific Trades resulted in an insignificant estimate. It would appear that the problem stems from the Pacific trade that is 25 percent of the total. This highlights one of the problems in the aggregate trade.

In the marine gravity model, when volume of exports is used as the dependant variable, the distance elasticity underestimates the impact of transfer costs on lentils exports in the Atlantic sub-model, but overestimates the impact of transfer costs in the aggregate model. For the Atlantic model, which is the best overall, the results of the proxy variables are very similar to the land gravity models.

The transportation data used in these analyses could contribute to some variations. Ocean-leg container freight rates are different in

structure than truckload freight rates. Container rates are set by conferences, whilst truckload freight rates are highly competitive and generally quoted on a per mile basis. Additionally, container rates vary and change more than trucking rates do. Container rates are influenced by international equipment imbalances, and follow closely the balance of trade in the global economy. International terminal and transshipment charges vary considerably from port to port. Consequently, marine freight rates may not reflect the true costs of shipping to a particular region as closely as door-to-door, North American truck freight rates do.

The R-square value is an imperfect measure of performance, but is useful to compare alternative specifications. The model estimations perform according to the cautionary notes in the literature. The very best model is the volume and freight rate estimation. As proxies are used, the quality of the estimates falls for both the land and the marine gravity models.

Conclusion

Four variations of gravity models were examined for land and marine transport, giving a total of eight scenarios. For each mode of transport, one variation of the model used volumes and actual freight rates, another used volumes and distances, a third used values and distances and a fourth used market values and freight rates. Comparisons of the results of the four model specifications were discussed with regard to the performance of the proxy variables and quality of estimation.

Aggregation is the soft underbelly of the gravity model. These analyses show that even aggregating the shipping locations of an exporter can produce inferior results. The specification of a more defined gravity model to a single shipping point improves the accuracy and utility of the results

Commodity specific gravity models with a single transport mode (i.e. marine container, refrigerated truck) are likely to be more accurate,

regardless of data specification, because the market under analysis is more consistent. Freight rate data that applies to a specific mode is more representative of the actual transportation costs. When the model includes actual transport costs instead of distance as the impedance factor, it more closely resembles traditional demand equations, and is thus more useful for marketers, transportation service providers, and policy analysts. An elasticity with regard to distance is difficult, if not impossible to interpret.

Ultimately, for accurate, useful results, it is preferred to specify export volumes and transport costs in a gravity model. If only a single commodity and mode of transport are under analysis, it would appear that proxies (distance and value) would still yield acceptable results, but the margin of error is greater. This study does not suggest that proxy variables are acceptable for aggregate flows. In fact, the results cast doubt on the usefulness of aggregate product gravity models in general.

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MERGERS & ACQUISITIONS INVOLVING TRANSPORT COMPANIES IN THE 1990S

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Abstract

The number of mergers and acquisitions (M&As), as a path to corporate growth, has increased on a global scale over the past two decades. While the trade press would lead us to believe that international M&As are the trend of the day, the largest proportion of M&As has been domestic (as opposed to cross-border) in nature. *Thomson Financial Securities Data* has documented more than 121,000 M&As in the US since 1979 and more than 157,000 non-US M&As since 1985. Over the period 1 January 1990 to 31 December 2000, more than 9,600 mergers or acquisitions involving a transportation company as the ultimate parent of the target, the target, the acquiror, or the acquiror's ultimate parent were completed. While many more were not completed or involved acquirors of unknown industry sector or nationality, significant data are available for examination.

The paper provides a new perspective on the dynamic transportation industry over the last decade. It examines M&A cases involving transportation-related companies in Canada and elsewhere. Based on previous research by the author into M&A activity across all sectors internationally, it was expected that many of these cases would prove to be financial restructurings, acquisitions by property or leasing firms, or asset acquisitions. These expectations were confirmed. After excluding these purely financial deals, the balance

of the paper examines the remaining cases—bona fide legal agreements where the deal implies a consolidation of the industry or a deliberate corporate strategy of diversification. The data also permit the comparison of Canadian transportation-related M&As with others globally and concludes that Canadian transportation-related M&A patterns are very similar to those in the US and the UK.

Some Definitions

Before we begin, a few definitions are in order.
Acquisition: buying an existing firm or some of its assets.
Merger: two firms combine or pool their business activities, creating a new entity.
Diversification: entry into a new business through the acquisition of that activity from another firm or via a merger with a firm in that business.

Acquisition is often seen as an easy way to grow a business as it confers a full set of capabilities and potentially new markets in a short time. It also offers the quickest way to change a company's portfolio of businesses. Furthermore, it is a desirable path for entering a mature market where a new greenfield operation would increase competitive rivalry to a state of destructive competition. Mergers are also a relatively fast means of growth, offering the opportunity to gain economies of scale through streamlined post-transaction operations.

Diversification can take place at the business-level (the subsidiary business unit) or at the corporate level (a company-wide approach) (Hitt *et al.*, 2002). Many managers have a deliberate corporate-level strategy of diversification so that they can deploy excess resources, capabilities, or competencies in managing multi-faceted businesses. Large diversified firms may compete against other large diversified firms in multiple markets. Many of these conglomerates long ago began life as a transportation business, which may now warrant their primary classification as a transportation entity. For them, this paper will only note the incidence of their M&A activity but not explore it in greater detail unless the activity was accompanied by a transportation acquisition or divestiture at the subsidiary level.

Finally, acquisitions and mergers are generally classed as related or unrelated. The related acquisition is one that seeks to integrate businesses with strategic fit. The purpose of an unrelated acquisition is the spreading of systemic risk with a focus on helping management extract greater value from the business; financial gain should accrue through the internalization of benefits.

For the purposes of this paper, M&A activity is defined as consolidation/integration if the acquisition is of a transportation company by a transportation acquiror with the same 2-digit SIC code. Related diversification is acquisition of a transportation target by a transportation-related acquiror, but not one with the same 2-digit SIC code. Unrelated diversification occurs when the acquisition of a transportation company is by an acquiror with a non-transport primary business, or when a transportation company is the acquiror of a non-transport target.

Background

Across all industries, the pattern of M&A activity has changed over time. Morosini (1998:3-4) concluded that, in the 1960s and 1970s, multinationals tended to pursue conglomerate deals that provided the advantages associated with diversifying financial and operating risk. According to Shleifer and Vishnay (1991), takeovers in the 1960s were often **unrelated** diversifications, driven by companies (with large cash flows) as an alternative to paying dividends. They were also driven, in part, by the aggressive anti-trust policies of the day. During the 1970s many firms divested those acquisitions that failed. Gardner (1985) examined four shipping companies' efforts in this era and concluded that diversification had resulted from each company's financial state and vulnerability to takeover.

By the 1980s, takeovers were often the reverse, financed by cash for stock, often hostile but **related** as firms sought to specialize. The relaxation of US anti-trust policy under President Reagan made the acquisition of related firms more acceptable. According to Markides (1995), 50% of *Fortune 500* companies refocused on their core businesses between 1981 and 1987. While focus on core business was the watchword of the day, a wave of massive market diversification began as companies started the process of expanding their international reach. Morosini (1998) characterized businesses in

the 1990s as favouring strategic acquisitions. These incurred relatively little debt and were often friendly agreements combining complementary resources **across borders** as many conglomerates unwound the product diversifications of the 1970s (Brush, 1996).

In the transport industry, there is significant diversification at the corporate level—not all companies have business interests solely within the broad definition of their industry. In part, this diversity of businesses has resulted from firms seeking new growth opportunities beyond those possible merely from developing new services or expanding to new markets. In her study of the liner shipping industry, Brooks (2000) noted that such diversity may be considered a strength if the overall organization sees liner shipping as a critical core business and is prepared to bring the competencies of the whole business to support the core business. She also argued that this diversity may be a weakness if the organization is not structured so as to support the liner business or to benchmark its performance on other than short-term measures.

Literature Review

Internalization theory holds that multinationals grow through foreign direct investment, mergers, or acquisitions in preference to other methods of growth because ownership affords a reduction in transaction costs. This reduction enhances the ability of the firm to extract rents from both tangible and intangible assets (Buckley and Casson, 1976; Dunning, 1979; Rugman, 1981). Therefore, one would expect that mergers and acquisitions resulting in majority if not full ownership would be most prevalent.

A wide variety of motives have been ascribed to merger, acquisition, and diversification activity. Trautwein (1990) concluded that three (of eight) theories of why mergers occur have greater plausibility: (1) the valuation theory (bidding firm shareholders acquire gains through private information and managers claim efficiency goals); (2) the empire-building theory (the merger benefits managers); and (3) the process theory (the merger results from a not completely rational process on which managers embark without full information). Considerable support exists for the motives of risk

reduction and improved senior managers' compensation from diversification (Hitt *et al.*, 2002:264). Brouthers *et al.* (1998) explored the motives of 47 publicly-traded Dutch firms undertaking mergers in 1994 and found that the most important motivations were to pursue market power and increase profitability. Secondary motives were to exploit marketing economies of scale, create shareholder value, and to increase sales. The conventional wisdom of multiple motives for each of these corporate-level strategies was supported.

If acquisition is the route to growth, Bleeke *et al.* (1993) identified five factors to be the hallmarks of successful cross-border acquirors, the primary one being that targets are in their core business and are strong local performers. Given this and the other literature presented, it is expected that related acquisitions and consolidating or integrating mergers will be more common than unrelated diversification.

Research Questions

1. What has been the profile of deals involving transportation-related companies since the beginning of 1990? Are the majority of deals for full ownership?
2. How significant is M&A activity for financial restructuring in the transportation industry? What proportion reflects asset acquisition?
3. How much M&A activity involving transportation target companies is consolidation/integration, related or unrelated diversification? How much M&A activity involving transportation acquirors is related diversification and how much is unrelated diversification?
4. Is the pattern involving Canadian transport targets or acquirors different from that of non-Canadian transport companies?

Methodology

Thomson Financial Securities Data has documented more than 121,000 M&As in the US since 1979 and more than 157,000 non-

US M&As since 1985. Many of these M&As were not completed or involved acquirors of unknown industry sector or nationality, but significant data remain. From this database, more than 9,600 mergers or acquisitions involving a transportation company as the ultimate parent of the target, the target, the acquiror, or the acquiror's ultimate parent were completed between 1 January 1990 and 31 December 2000. This 11-year data set was downloaded for analysis. Cases with "undisclosed buyers" and hence no 1987 US Standard Industrial Classification (SIC) code or nationality were deleted. The numerous cases where the target and the acquiror were the same company (in other words, the transaction was an intracorporate financial restructuring) were also deleted. Also common were joint ventures, cases where one of the parents absorbs the shares owned by the other. These too were deleted.

The full data set provided a very diversified view of "transportation." Some of the conglomerates that initially grew out of rail, shipping, or air enterprises are now widely diversified with acquisitions in mining, environmental services, hotels, oil and gas exploration, and so on. At the other end of the scale, there has been significant M&A activity at the local level, where those providing ambulance and hearse services, and those providing taxi and school bus services have been acquired. As well, there are substantial numbers of M&As involving the acquisition of marina and recreational boating facilities and services. Postal companies have been active acquirors. It was decided that, in the interests of relevance to this forum and the business of commercial transport, companies providing ambulance (and hearse) services, postal services, or servicing the recreational boating industry would be removed from the definition of a "transportation" company. Likewise, *Thomson* also codes data storage companies as freight storage companies. This sector needed to be reviewed on a case by case basis to eliminate computer data storage companies from the database, as they should have been coded under business services. After this data cleaning, a data set of 9,079 M&As remained.

How were the large conglomerates handled? They were included for preliminary analysis, but only retained for the detailed analysis if a transport subsidiary was the target or acquiror. After this data

sanitization, 7,911 cases remained for examination. Of these, the tour operators and travel agencies, which were also in the process of consolidation, were removed if both target and acquiror were in this category. The 7,362 cases remaining were examined to answer the two remaining research questions.

Findings

1. What has been the profile of deals involving transportation-related companies since the beginning of 1990? Are the majority of deals for full ownership?

As was expected from prior M&A data analysis (Brooks and Rosson, 2001), domestic mergers (those where the nationality of the target company is the same as that of the acquiring company) exceeded cross-border mergers in numbers (Table 1 and Figure 1). Domestic M&As accounted for more than 70% of the total number of cases.

Table 1: Comparing Domestic and Cross-Border M&As

Transportation-Related Cases	Domestic	Cross-border
Of the 9079 total	6485	2594
Target is a transport company	4814	1875
Acquiror is a transport company	3563	1553
Both are transport companies	2708	1186
Neither is a transport company but at least one ultimate parent is a transport company	816	352
Canadian transport target	168	67
Canadian transport acquiror	122	60
Both were Canadian	98	NA

While there was little stability in the average value of the deals over the years (Figure 2), the pattern of those participating is similar

(Table 1). Transport companies are more often the target than the acquiror, and about 13% of both types of M&As are between non-transport subsidiaries of transport-related conglomerates.

Figure1: Number of Deals by Year

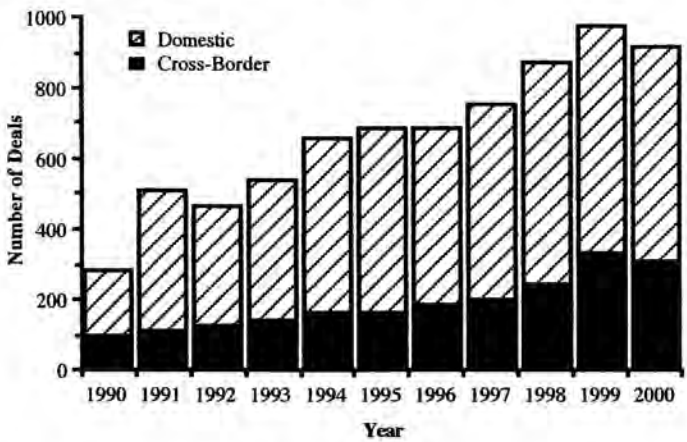
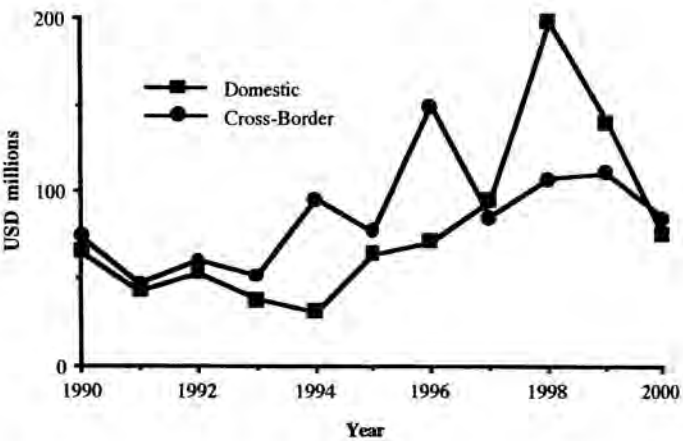


Table 2: Ownership After Transaction

Transportation-Related Cases	Domestic	Cross-border
100% shares owned after	4439	1495
Majority ownership (50-99.9%)	776	399
Minority ownership (<50%)	934	552
Unspecified	336	148

That relationship is replicated in the subset of Canadian companies. Interestingly, Canadian companies have also been active acquirors in cross-border deals. There has been significant consolidation in the transportation industry, with approximately 42% of domestic transportation-related M&As and about 46% of cross-border ones being between transportation companies.

Figure 2: Average Deal Size by Year



As shown in Table 2, the expectation driven by the literature that mergers and acquisitions resulting in majority if not full ownership would be most prevalent is confirmed. "Unspecified" cases are generally those in which the companies are privately held and not disclosed.

2. How significant is M&A activity for financial restructuring in the transportation industry? What share reflects asset acquisition?

Financial and asset management are significant drivers of M&A activity. It is common in this database to report the acquisition of shares by investor groups, management buyback of shares, or cases where the target is acquired by a pension fund, an employee stock ownership plan, a mutual fund (often a partial acquisition), or a bank. The cases noted in Table 1 include a significant number of firms acquired for such financial rather than operating purposes. As can be seen in Table 3, only a small number of acquisitions are by entities whose primary business is government, property management, or leasing. Many M&As are financial restructurings as

the acquisition of shares by investor groups, management, pension funds, employee stock ownership plan, mutual funds, and banks account for more than 20% of activity, particularly with respect to domestic M&As. Such activity accounts for more than 15% of cross-border M&As. The majority of M&As are clearly between companies that are operating entities as opposed to financing/owning entities.

Table 3: A Profile of Acquirors

Acquisition by	Domestic	Cross-border
Of the 9079 total cases	6485	2594
Investors or shareholders	696	134
Employees	9	0
Bank/insurance company, pension or mutual fund.	717	246
Property management or leasing company	116	22
Government or government agency	9	2
Other	4938	2190

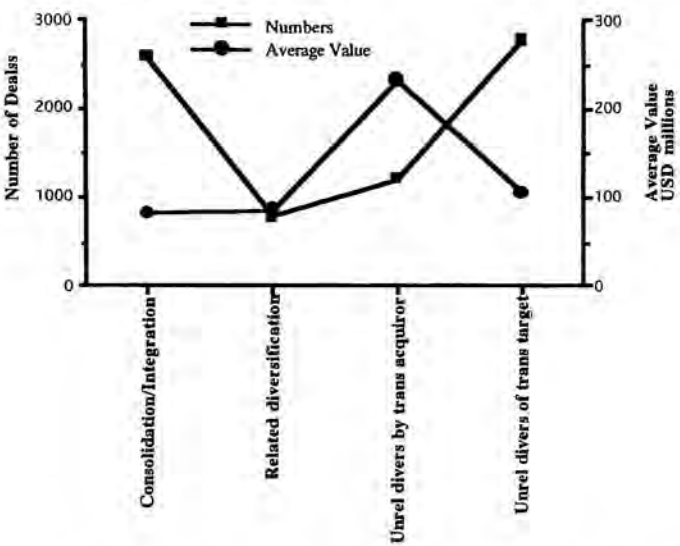
Based on experience with the same data source (Brooks and Rosson, 2001), it was also expected that many of the cases would be for the purpose of acquiring specific assets (such as planes, gates, slots, sales territories, brands, real estate, or equipment that are held as a separate subsidiary). These proved to be about 5% of the total transportation-related M&A cases, 72% domestic and 28% cross-border, a split similar to the overall data split. Of the 484 "unspecified" ownership cases in Table 2, only seven were acquisitions of this type.

3. How much M&A activity involving transportation target companies is consolidation/integration, related or unrelated diversification? How much M&A activity involving

transport acquirors is related diversification and how much is unrelated diversification?

Figure 3 illustrates that, in terms of the number of deals, transportation consolidation/integration is a significant share of the total number of deals examined. When transportation-related diversification is included, deals between transport companies account for about half of all the M&A activity.

Figure 3: Types of Transport-Related M&A Activity



What is surprising is the extent of unrelated diversification taking place. There were more than twice as many non-transport acquirors that acquired transport companies as there were transport companies that acquired unrelated businesses. This indicates that integration of transport activities into other businesses is a popular strategy. One can only speculate that it must be an outgrowth of the current interest in controlling more of the supply chain; if so, it raises the question: is outsourcing of transportation services less prevalent than

thought by the trade press? Obviously, these data require a closer look.

While deal numbers may be substantial for consolidation, the value is less so and not all that different from those for related transport diversification. The largest average deal value occurs in the unrelated diversification by a transport acquiror. Large transportation companies are clearly diversifying risk across business activities. This leads to speculation that financial returns in the transport sector are not as satisfactory as elsewhere and encourages a closer look at what type of businesses transportation companies are entering.

4. Is the pattern involving Canadian targets or acquirors different from that of non-Canadian companies?

Understanding how transport firms evolve is one reason for examining the pattern of M&As. Such examination does not provide evidence of motives or causality but merely sets the scene to ask questions from a position of knowledge about the situation at the time.

According to Brooks (2000), that pattern is set in part by the regulatory environment of the mode. For example, because of ownership restrictions applicable to the airline industry, crossborder M&As in the airline industry will likely only be partial minority acquisitions. She concluded that rail acquisitions, because of the managerial preference for ownership of track (rather than sharing), would more likely be deals for majority or full ownership. There has not been sufficient time or data depth to confirm these hypotheses. However, there is the potential to look at the pattern of M&As to see if the Canadian pattern mimics that of two other countries in the data set: the US and the UK. The results are shown in Table 4.

Of the 7,362 non-financial cases, 2,784 were transportation targets, 1,213 were transportation acquirors and 3,365 were between transportation companies. Slightly less than 60% of these came from the US, the UK, and Canada, and it is these three that are further examined in Table 4.

Table 4: Canada Compared with the US and UK

Transport-Related Cases	Domestic %	Consol %	Rel. Div. %	Unrel. Div. %
Canada				
Target Cdn transport co.	72.2%	42.6%	16.6%	40.8%
Acquiror Cdn transport co.	69.7%	55.2%	21.8%	23.0%
US				
Target US transport co.	89.8%	45.8%	9.9%	44.4%
Acquiror US transport co.	80.6%	58.6%	14.6%	26.8%
UK				
Target UK transport co.	78.3%	42.3%	10.5%	47.2%
Acquiror UK transport co.	68.2%	57.9%	13.1%	29.0%

As was seen in Table 1, domestic M&As far exceed international M&As as a share of the total. It is particularly interesting to note that this is most true of the US, less so of the UK, and even less where Canadian companies are involved. Whether this difference is significant is not tested.

What is very noticeable, however, is that the pattern of diversification activity is very similar in the three countries. Consolidation within a 2-digit SIC range is a dominant activity for transport-related acquirors, yet transport companies are often targets of unrelated companies seeking to diversify. Related diversification is not as common for either transport targets or acquirors. The in-depth evaluation as to why this similarity exists must be left for another paper and another day.

Conclusions

This paper provides a new perspective on the dynamic evolution of the transportation industry over the last decade. It explores M&A activity involving transportation-related companies in many countries in order to understand the nature of that activity both in

Canada and elsewhere. Based on previous research by the author into M&A activity across all sectors internationally, it was expected that many of these cases would prove to be financial restructurings, acquisitions by property or leasing firms, or asset acquisitions. These expectations were confirmed. In the cases where the agreement was a bona fide deal involving a transportation-related target and/or acquiror, the pattern of consolidation of the industry, related diversification, or a deliberate corporate strategy of unrelated diversification was examined. Canadian transportation-related M&A data were compared with those of the UK and the US. Given the literature review, it was expected that related acquisitions and consolidating or integrating mergers would be more common than unrelated diversification. However, there was more unrelated diversification activity than the literature would lead a reader to expect. Most interesting, Canadian transportation-related M&A patterns are very similar to those elsewhere. This descriptive paper has set the stage for further empirical study, particularly into the type of unrelated diversification being undertaken and the motives for this managerial decision path.

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Alternate Methodology for Conducting Economic Feasibility Studies of New Road Projects

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EXECUTIVE SUMMARY

This research established an alternate methodology to conduct economic feasibility studies of new road projects. New roads are those which had not provided all-year-round motor vehicle traffic services before construction to the present form. The existing methodology is laborious and involves extensive time and document production. Economic feasibility studies of six road projects were carried out using the existing and the proposed methodologies. The study roads were presumed to be feeder/collector roads that connect rural areas with existing primary roads. The alternate methodology focused on weighted averages of production factors rather than on each resource component. Resource production and value added were calculated using both methodologies. In addition, regression models were developed for different components of the produce. Statistical tests and analyses were conducted. The alternate methodology produced results that were very close to the conventional one. The proposed methodology is concise, efficient and effective. Based on this research, it is recommended that the proposed methodology be utilized in future economic feasibility studies of new feeder/collector road projects.

ALTERNATE METHODOLOGY FOR CONDUCTING ECONOMIC FEASIBILITY STUDIES OF NEW ROAD PROJECTS

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Abstract

This research established an alternate methodology to conduct economic feasibility studies of new road projects. New roads are those which had not provided all-year-round motor vehicle traffic services before construction to the present form. The existing methodology is laborious and involves extensive time and document production. Economic feasibility studies of six road projects were carried out using the existing and the proposed methodologies. The study roads were presumed to be feeder/collector roads that connect rural areas with existing primary roads. The alternate methodology focused on weighted averages of production factors rather than on each resource component. Resource production and value added were calculated using both methodologies. In addition, regression models were developed for different components of the produce. Statistical tests and analyses were conducted. The alternate methodology produced results that were very close to the conventional one. The proposed methodology is concise, efficient and effective. Based on this research, it is recommended that the proposed methodology be utilized in future economic feasibility studies of new feeder/collector road projects.

1 Background

Methodologies to conduct economic and engineering feasibility studies of development projects have been available for many years. Gittinger (1972) developed a methodology on economic analysis of agricultural projects. Similarly, Gittinger (1982) revised the previous methodology for use by the World Bank in their lending programs to member countries. Dickey and Miller (1984) devised an appraisal process of road projects with development of alternatives in respect of "do-nothing" or implementation.

Lending institutions strictly follow the utilization of this methodology during appraisal of new road projects. New road projects are those that are constructed on existing seasonal roads. The roads may currently provide services for a small number of seasonal motor vehicles, but not for year round service. Appraisal of rural road projects normally consider p roducer s urplus a pproach in e stimating r esource b enefits. Resource production 'with' and 'without' project roads are estimated and the resulting incremental production is accounted for as benefits and attributed to project roads. The estimation of resource benefits do not conflict with the basic theory of consumer or producer surplus since they generate similar results.

Economic feasibility studies of resource roads involve land use and resource patterns, influence area of roads, terrain classification, land use utilization factors, yields, consumption, loss, and re-utilization. Land use pattern includes land which is already cultivated within the influence area of the road, potentially cultivable land after construction of roads, forest areas, pasture and unusable land. Whereas, resource patterns deal with the existing rural resource activities, currently utilized resources and percentages of area coverage.

The conventional methodology of road project evaluation deals with resource by resource estimation i.e. area, yield, re-utilization, consumption and loss are all estimated by resource types. Similarly, future resource surpluses are estimated by considering 'with' and 'without' project roads in respect of each resource type. Consumption by

population in project areas, re-utilization and loss during harvesting are also estimated and projected by resource type. Consequently, net surplus are estimated by resource type and then aggregated in respect of 'with' and 'without' project roads. Lastly, surpluses attributed to project roads are estimated by subtracting the production 'without' the road from the production 'with' the road. This methodology involves a significant amount of time and document production.

This research focused on the development of an efficient technique to conduct economic feasibility studies of new road projects. Similar assumptions and values were used in both methodologies. The alternate methodology concentrated on weighted averages rather than on resource by resource bases. Six feeder/collector road projects that were envisaged to connect rural areas to primary highways were used from a developing country as a test case. Resource surpluses and value added were estimated using the conventional and alternate methodologies. The differences were examined to test the levels of statistical significance. Based on the research, conclusions and recommendations are presented.

2 Evaluation Methodologies

2.1 Conventional Methodology

The conventional methodology deals with resource by resource. Estimation of area, yield, seeding requirements, consumption and loss are all estimated by resource types. Similarly, future resource surpluses are estimated by considering 'with' and 'without' project roads in respect of each resource type. Consumption by population in project areas, seeding requirements and loss during harvesting are also estimated and projected by resource type. Production 'without' the road is subtracted from production 'with' road to estimate surplus attributed to the project road.

The conventional methodology is formulated as follows:

Resource Type = $R_1, R_2, \ldots\ldots, R_n$

Area Under Each Resource Type = $A_1, A_2, \ldots\ldots, A_n$

Thus: $A_1 \Rightarrow R_1, A_2 \Rightarrow R_2, \ldots\ldots, A_n \Rightarrow R_n$.

Yield Per Unit Area = $Y_1, Y_2, \ldots\ldots, Y_n$

Thus: $Y_1 \Rightarrow R_1$ and A_1, $Y_2 \Rightarrow R_2$ and A_2, ..., $Y_n \Rightarrow R_n$ and A_n.

Re-Utilization Per Unit Area = $U_{i,}$, where i goes from 1 to n corresponding as above.

Loss (%) = L_i , where i goes from 1 to n corresponding as above.

Consumption (Unit/person/year) = $M_{i,}$, where i goes from 1 to n corresponding as above.

Based on the above:

Initial Production (IP) = $A_1Y_1 + A_2Y_2 + \ldots\ldots + A_nY_n$

$$= \sum_{i=1}^{n} A_i Y_i \qquad (1)$$

Resource surplus is calculated as follows:

Overall Surplus (S_i) = $A_iY_i - (U_i + L_iA_iY_i + M_i)$ (2)

Current Surplus (CS_0) = $A_0Y_0 - (U_0 + L_0A_0Y_0 + M_0)$(3)

Future resource surplus is estimated with the consideration of "with" and "without" roads and the difference is attributed to project roads. Normally, estimates 'with' roads depend on future resource mix, additional areas falling under cultivation, yield improvements, reduction in resource loss, and changes in consumption patterns. The length of forecast depends on the economic lives of road projects. Net surpluses attributed to project roads are calculated by subtracting net surplus/deficit 'without' roads from net surplus 'with' roads. Prices of surpluses are collected by resource types in potential markets and subsequently, farm-gate prices (prices at the places of surplus production) are estimated by resource type. Finally, value added are estimated by resource type for the lives of project roads and aggregated as benefits.

2.2 Alternate Methodology

The alternate methodology mainly focuses on the percentages of area under each resource (R_i) at the initial stage. In the case of loss however, the methodology focuses on percentages of production rather than area. Based on the percentages, weighted averages of yield, re-utilization (seeding requirements), loss and consumption are estimated for all types of resources. Instead of dealing with resource by resource, the alternate methodology treats all items as a single resource and calculates current as well as projected surplus 'with' and 'without' project roads. Consequently, net surpluses attributed to project roads are calculated. Weighted averages are calculated as stated below. Notations of R, A, Y, U, M and L are the same as in section 2.1.

Proportion of area under each resource is calculated as follows:

$$P_i = \frac{A_i}{\sum_{i=1}^{n} A_i} \qquad (4)$$

Then,

(a) Area $= A_1P_1 + A_2P_2 + \ldots\ldots\ldots\ldots + A_nP_n = \sum_{i=1}^{n} A_i P_i$ (5)

(b) Yield $= Y_1P_1 + Y_2P_2 + \ldots\ldots\ldots\ldots + Y_iP_i = \sum_{i=1}^{n} Y_i P_i$ (6)

Consumption $= M_1P_1 + M_2P_2 + \ldots\ldots\ldots\ldots + M_iP_i = \sum_{i=1}^{n} M_i P_i$ (7)

Loss : Losses during harvesting and storage are estimated by calculating proportions based on production. Proportions of initial losses are estimated as follows:

$$PP_1 = \frac{A_1Y_1}{\sum_{i=1}^{n} A_iY_i}, \quad PP_2 = \frac{A_2Y_2}{\sum_{i=1}^{n} A_iY_i}, \ldots\ldots\ldots, \quad PP_n = \frac{A_nY_n}{\sum_{i=1}^{n} A_iY_i}$$

Thus, Loss $= L_1PP_1 + L_2PP_2 + \ldots\ldots\ldots\ldots + L_n PP_n$

$$= \sum_{i=1}^{n} L_i PP_i \qquad (8)$$

3 Data Acquisition

The appropriate way of comparing both methodologies is by using the same road projects and data in both cases. This was made possible in this research. The research dealt with six road projects that are common in developing countries. Pertinent data on the road projects were formulated accordingly. The base data were for roads in Ethiopia that were part of the World Bank and other multilateral banks funded projects. The resources considered in this research were agricultural crops. However, the methodologies can be applied to other resources including forest products. Table 1presents a summary of the base data. Adjustment factors comprise seeding requirements, consumption by population within the influence area of the roads, and loss during harvesting and storage activities.

Table 1: Summary of Base Data

Road	Length (km)	Area (ha)		Total Production (tons)	Sum of Adjustment Factors (tons)	Net Surplus (tons)
		Currently Under Crops	Potentially Cultivable			
R1	99	188,100	3,960	148,005	55,270	92,735
R2	140	13,825	110,590	10,445	6,290	4,155
R3	47	28,380	30,900	31,535	11,725	19,810
R4	74	39,340	66,685	47,370	15,725	31,645
R5	75	59,040	4,705	57,070	20,455	36,615
R6	85	39,225	8,965	36,000	25,675	10,325

4 Analyses and Results

4.1 Analyses

The data shown above is for the initial year. After construction of the roads, it was presumed that more land will be cultivated. In addition, improvements in yields are expected to materialize within influence areas. Envisaged cultivable land were projected during the lives of the project roads using presumed rates under both methodologies. S imilarly, im provements in f uture yie lds h ave b een considered and used in both approaches. Resource productions were projected for twenty years under both methodologies. Likewise, adjustment factors i.e. seeding requirements, consumption and loss were projected for twenty years. The adjustment factors were subtracted from the total production to estimate surplus/deficit.

Similarly, resource production is expected to grow even if the roads were not constructed since people in project areas will continue cultivation to sustain their needs. Thus, future production 'without' the roads was estimated taking base year surpluses and population growth rates. Finally, production 'without' the roads was subtracted from production 'with' the roads resulting in net surpluses that are attributed to the project roads. Normally, surpluses are marketed. Accordingly, market prices of subject crops were established. In the case of the conventional methodology, each price was multiplied by respective surpluses. In the case of the alternate methodology however, single weighted averages of prices were established and utilized. Value added was projected for twenty years under both methodologies. The projected value added was discounted to base year using ten percent as an opportunity cost of capital. The Mann-Whitney non-parametric tests were conducted using the results of the analyses and similarly, correlation coefficients were calculated. In addition, regression analyses were conducted to establish relationships between the two methodologies.

4.2 Results

Tables 2 and 3 present the results on resources and statistical analyses respectively. Regression equations were developed using the results of the resource data in both methodologies. Consumption, seeding requirement, loss, surplus 'with' and 'without' roads, net surplus and valued added were used as inputs in both methodologies.

As presented in Table 2, the new methodology produced almost identical results with the conventional methodology except in the cases of 'value added'. The 'value added' figures show disparity when there are significant differences between market prices of the resources. Weighted averages of prices that were estimated based on initial production instead of initial area produced better results. Prices are economic and shadow- priced as recommended by Weckstein (1969), Balassa (1971) and (1973), Squire and Van Der Tak (1975), and Ray (1984). Low standard deviations show the closeness of the value added under the two methodologies while high standard deviations show otherwise. Therefore, when standard deviations in the case of prices get significantly larger, more than 50, it is preferred to use weighted averages of prices based on initial production rather than initial areas.

Table 2: Results of the Resource Analysis By Both Conventional and Alternate Methodologies

Project	Total Agricultural Produce (million qts)			Consumption (million qts)			Seeding Requirements (million qts)			Agricultural Loss (million qts)		
	C	A	D	C	A	D	C	A	D	C	A	D
R1	38.6	38.6	--	7.7	7.7	--	2.1	2.1	--	3.9	3.9	--
R2	14.1	14.1	--	1.4	1.4	--	0.3	0.3	--	1.3	1.7	0.4
R3	13.8	13.7	0.1	1.3	1.3	--	0.3	0.3	--	2.6	2.6	--
R4	22.2	22.8	0.6	1.5	1.5	--	0.7	0.7	--	3.9	4.0	--
R5-1	20.5	20.5	--	3.1	3.1	--	0.5	0.5	--	2.6	2.6	--
R5-2	14.9	15.0	0.1	3.1	3.1	--	0.5	0.5	--	1.9	1.9	--

1 qt = 100 kg C =Conventional Methodology A =Alternate Methodology D=Difference

Table 2: Continued

Road	Crop Surplus (million quintals)						Value Added (Birr# million)			
	C			A			C	A		SD
	With Road	W/o Road	Net	With Road	W/o Road	Net		Based on Initial Year Crop Area	Initial Year Crop Production	
R1	25.0	24.3	0.7	25.0	24.4	0.6	27.2	28.5	28.1	4.3
R2	11.1	1.2	9.9	10.7	1.2	9.6	110.8	110.9	133.7	38.4
R3	9.8	5.6	4.3	9.6	5.2	4.4	98.6	289.0	71.9	118.2
R4	16.1	8.3	7.8	16.6	8.3	8.3	155.9	347.2	101.1	117.7
R5-1	14.4	9.8	4.6	14.4	9.8	4.5	142.6	165.8	144.9	143.0
R5-2	9.5	2.8	6.7	9.5	2.8	6.7	207.5	262.3	213.4	131.0

C = Conventional Methodology A=Alternate Methodology # 1 Birr = About USD 0.12

SD = Standard Deviation between prices of crops

Table 3: Results of the Regression Analysis

Source	Regression	Correlation Coefficient	T-test values	F-test values	P- test values
Total Production	C = -0.028+0.996A	1.00	73.5	5420	0.0
Consumption	C = -0.000+1.000A	1.00	#	#	#
Seeding Requirements	C = 0.000+1.000A	1.00	#	#	#
Loss	C = -0.233+1.05A	0.98	13.2	174	0.37
Agricultural Surplus With Roads	C = 0.325+0.979A	1.00	41.0	1677	0.0
Agricultural Surplus Without Roads	C = 0.105+0.995A	1.00	109	11824	0.0
Net Agricultural Surplus	C = -0.05+1.00A	0.99	23	539	0.0
Value Added	C = 54.7+0.344A	0.50	2.0	0.14	32.6

= Conventional and alternate methodologies produce identical results.

5 Conclusions and Recommendations

In this research, six road projects were analyzed to compare results generated using two road project evaluation methodologies. Measures of agricultural performances were calculated under both methodologies incorporating total produce, consumption, seeding requirements, resource loss, and surpluses 'with' and 'without' project roads. In addition, net surpluses attributed to project roads were calculated. Value added attributed to project roads were also calculated under both methodologies. Based on the analyses, the results produced under both methodologies were statistically close.

The alternate methodology can be used to carry out economic feasibility studies of road projects more efficiently than the conventional methodology both in respect of data analysis and production. Economic feasibility studies of road projects can be conducted in much less time under this methodology than using the conventional methodology. The analyses can be performed using ordinary data processing software such as Excel or Quattro Pro. Thus, it is recommended that the new methodology be adopted for future use in economic feasibility studies of feeder/collector road projects.

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Feasibility of Fuel Cell Railway Locomotives

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1. Introduction

Transportation in all its forms is a major contributor to Green House Gas (GHG) emissions, and in Canada is forecast to account for approximately 50 % of the increase in GHG output. In a recent survey on the future of fuel cells for transportation, respondents identified four market drivers responsible for fuel cell development, namely: 1) global warming, 2) criteria air pollutants, 3) global oil availability and 4) oil price increases. Criteria air pollutants and global warming are the main drivers for considering fuel cell locomotives.

Fuel cells have been in development since the early 1960's, primarily for spacecraft applications. Millions of dollars are being invested in the technological development of the fuel cell with the primary focus being on passenger vehicles and truck usage undoubtedly due to the size of the potential market for manufacturers. These market segments are also the primary contributors to GHG emissions, particularly in the highly populated urban areas where air quality management is of critical importance.

This study assesses the feasibility of fuel cell railway locomotives. The study methodology focused on a review of published work on fuel cell technological development and railway applications, interviews with officials from North American railways and associations, fuel cell developers and locomotive manufacturers and an assessment of railway fuel cell applications and research direction in a Canadian context.

2. Current Research in Fuel Cell Technology

Fuel cells in general have many advantages over existing power sources. Fuel cells are quieter and emit considerably less GHG's. They may also be more reliable, require less maintenance, and have excellent part-load performance (ref. 2). They also have some significant disadvantages, the major one being high cost. At present, fuel cell technology is not cost competitive with the present energy sources. Another current setback to fuel cells is size. Since fuel cell technology is in early development, systems tend to be bulky. In the transportation sector, this is an undesirable trait. Fuel production and storage is also a significant problem with fuel cell operation.

There are at least six fuel cell types under development, however, only four main types face wide spread application. Of the four main fuel cell types, PEMs (Proton Exchange Membrane) are the preferred choice for the transportation sector because they are compact, run at low temperatures, and can be started relatively quickly. SOFCs (Solid Oxide Fuel Cells) are also being considered for development as auxiliary power units for cars and trucks in the near term to replace the low efficiency alternator.

2.1.1 Transit Sector and Automotive Industry

The Northeast Advanced Vehicle Consortium (NAVC) (ref. 5) recently reported on a survey of experts on the future of fuel cells in the transportation sector. The consensus was that fuel cells could reach the transit market before the passenger vehicle market with a market penetration of 5% of production by 2005-2010. At present, Ballard fuel cell powered buses are being field tested in Vancouver and Chicago. Just recently, Ballard received an order to supply 205 kW fuel cells for 30 buses to Daimler Chrysler for 2002-2003. These buses will then be distributed to 10 European cities.

A 60-90 kW fuel cell is required to successfully operate a passenger vehicle (ref. 1). Many companies are presently involved in developing and testing fuel cell engines for passenger vehicles. The main companies involved are Daimler Chrysler, Energy Partners, Ford, General Motors, Honda, H Power, Hyundai, Mazda, Nissan,

Renault, Toyota, Volkswagen/Volvo, and Ballard Power Systems. All of the cars are either powered by hydrogen or methanol (with a fuel reformer).

Technical feasibility, appropriate fueling infrastructure, and customer acceptance are the three main factors that will determine whether fuel cell vehicles have commercial success. The technical feasibility exists, but costs need to be driven down. The fuel cell engine is around 7 times the price of a typical ICE (ref. 1). Fueling infrastructure is also a significant issue. Customer acceptance will only come with low cost, a need for the product, and high availability.

Today, the auto market is in the demonstration project phase with a limited number of units on the road. The California Fuel Cell Partnership, established in April 1999, plans to test fuel cell vehicles between 2001-2003. By late 2003, Ballard plans on making commercial units available for automotive applications, while Daimler Chrysler and Ford plan on marketing their fuel cell automobiles in 2004 (ref.1).

2.1.2 Railway Locomotive Applications

Two recent studies were conducted on the applicability of fuel cells to railway locomotives. The first entitled "*Fuel Cell Locomotive Development and Demonstration Program, Phase One: System Definition*" was prepared by the Jet Propulsion Laboratory (JPL) California Institute of Technology in 1995, and the second entitled "*Fuel Cell Technology for Railway Vehicles*", was completed by the International Union of Railroads, France 1999 (Ref. 3, 4).

The Fuel Cell Locomotive Development and Demonstration Program was driven by the emission standard requirements of the South Coast Air Quality Management District of California (SCAQMD). These standards established a target of 90 % reduction in NOx emissions from railway operations in the South Coast Air Basin (SCAB) by 2010. This target is in contrast to the USEPA standard set for 2005+ at the Tier 2 level of a 62 % NOx reduction. The special

circumstances of the SCAB geographic area drive their more stringent target.

Electrification of freight and commuter railroads in the SCAB using overhead catenaries would reduce NOx emissions significantly but would fall short of the 90 % goal and would be extremely expensive, costing over four billion dollars. Fuel cells are identified as an attractive alternative because they have extremely low emissions and the capability to operate with multiple fuels.

The specific objectives of the JPL study was to:

1) Recommend fuel cell system configurations to be used in the demonstration of first generation fuel cell powered locomotives;
2) Outline a development program that leads to a first generation fuel cell power system for locomotives; and
3) Identify significant improvements needed to achieve commercial viability for a second-generation fuel cell power system for locomotives.

This study undertook a comprehensive look at fundamental railway operating issues in assessing fuel cell locomotive requirements. The study defined the technical aspects of locomotive size, target operation, volume, weight, operating conditions and life cycle costs that a fuel cell locomotive must meet.

The most significant criteria set out for the demonstration project is the life cycle cost requirement of competing with diesel or LNG-fueled reciprocating engine-generator set with controlled emissions. The study developed life cycle cost goals for fuel cell power systems operating on LNG, LH2 and methanol. With a 40% system fuel efficient fuel cell system and no cost attributed for diesel-electric NOx abatement, the break-even fuel system capital cost is about $ 325/kw. At the existing costs, liquid hydrogen is not an economically feasible fuel for railroads. The capital cost of fuel cells of the capacity to power locomotives is not in the order of magnitude of competitive costs identified as a requirement in this study.

In a March 2000 report, the Energy Center of Wisconsin concluded that: "To be successful in this transportation sector, it is widely believed the PEM fuel cells will have to cost $ 150/kW or less. In fact, automakers believe that in light duty applications they will need to cost around $ 25-50/kW. This means that the current cost of $ 500/kW will have to be reduced by another order of magnitude. To accomplish this, production volumes on the order of **one million units** per year are necessary." (ref. 3)

This implies that if PEM fuel cells are not cost competitive in the light duty transportation sector, it will be some time before they are cost competitive in the heavy-duty sector, namely locomotives. The following conclusions were derived in the JPL report:

1) The delivered fuel cost must be cost competitive with the fuel delivered to diesel-electric systems.
2) The efficiency of a fuel cell power plant that will successfully compete with diesel electric must be significantly better than diesel; a goal of 45 to 50 % (LHV) is reasonable and 45 % should be the minimum.
3) The life of the fuel cell stack must be significantly better than that of the diesel-electric at one-million-miles equivalent.
4) The first generation demonstration of a locomotive fuel cell power plant must illustrate the following:
    - At least 1 MW size can be packaged and operated on a locomotive chassis with plate C dimensions.
    - Start-up/shutdown issues are identified to accommodate viable railroad operations.
    - A realistic basis exists for establishing required efficiency, operating and maintenance, life and capital cost goals for the next generation fuel cell locomotive.
    - Fuel cell power systems are compatible with the railroad-operating environment, e.g., vibration, shock, etc.
5) HPD-SO and PEM fuel cells appear to offer the most long-range promise, based upon potential size and weight reduction possibilities and performance improvements.

A development plan was created to pursue the development of fuel cell locomotive applications, however, the proposed PEM demonstration model was never built, as government funds were not forthcoming.

This study provided an excellent basis for evaluating the potential for fuel cell locomotive applications and more importantly, for identifying the significant hurdles that must be addressed before any commercial application of the technology could be considered. Based on the review of the current state-of-the-art in March 2001, advancements towards a fuel cell locomotive demonstration project are not any nearer now compared to 1995.

The conclusion that the fuel cell locomotive must be cost competitive with the fuel delivered to diesel-electric systems is consistent with the findings of the Railways and the Environment Workshop held in Winnipeg in June 1999. At this workshop many representatives of the railway industry and locomotive manufacturers strongly stated that initiatives addressing environmental considerations will have to take into account the cost effects that changes to fuel efficiency and locomotive power systems will have. The importance of fuel cost to a railway's operating budget was emphasized by several of the participants. The option of increasing rail expenses to achieve the emission targets is not a viable option. The railways, like any other business enterprise, must realize a return on investment.

In the International Union of Railroads (UIC) study (ref. 4), the purpose was to monitor the deployment of fuel cells in rail vehicles. The study makes reference to the Jet Propulsion Laboratory study in 1995 and various projects initiated or about to start in Europe. The significant step forward that this study made was its evaluation of the fuel supply system on a more dynamic basis than the JPL study.

The study reported that different fuel cell systems (fuel cells and fuels) are feasible for deployment in locomotives. It seems highly probable that the Proton Exchange Membrane Fuel Cell (PEMFC) will dominate the transportation market due to its cost-saving

potential resulting from mass-production for the car industry. However, the consequences of introducing fuel cell locomotives into the existing fleet of electric, diesel and gas locomotives could still present problems for interoperability as far as international traffic, maintenance and fuel supply is concerned.

Very often only the electrical efficiency of fuel cells is cited which can be very misleading as efficiency levels can be highly variable. It is vital not only to consider the engine efficiency but also the system efficiency and the energy chain efficiency ("well to wheel" approach). Several studies have shown, that depending on the fuel used, the "well to wheel" efficiencies of fuel cell powered cars can vary considerably (efficiency range between 17 and 28%). The driving force behind the commercialization of fuel cell powered cars is that the automobile industry is seeking more acceptance of their cars as an environmentally friendly mode of transport, as fuel cell powered cars can have zero impact locally (but must account for emissions from original energy sources). Therefore, from an environmental point of view, the benefits of new technologies such as fuel cell locomotives have to be examined carefully. This involves comparing the environmental and economic performance of fuel cell locomotives with that of diesel locomotives because fuel cell locomotives could easily replace diesel locomotives but not electric locomotives (e.g. high speed trains). DB AG calculated an efficiency of 31.7% for diesel and 6.1 to 31.1% for fuel cell rail vehicles.

Table 1 summarizes the efficiency performance of the different modes of traction.

Table 1: Efficiencies of fuel chains for different modes of traction

	Efficiency in %
Diesel traction	31.7
Fuel cell traction (H_2 compressed from CH_4)	31.1
Fuel cell traction (H_2 liquefied from water electrolysis)	6.1

The following conclusions can be drawn:

1.) Diesel traction is currently the most energy-efficient traction mode. However, the potential for a further increase in efficiency is very low.

2.) If hydrogen is generated by reforming natural gas, the global emissions are lower compared to diesel traction. However, environmentalists argue that natural gas could be used more efficiently in a combustion engine and that the energy demand for the generation of hydrogen is too high. (Fuel cell traction generates no local pollution; in heavily polluted cities, railway companies might therefore consider the use of fuel cell traction)

3.) The global pollution of fuel cell-powered locomotives is higher compared to diesel locomotives if the hydrogen is generated by water electrolysis using electricity from the public power grid (with a high percentage of fossil fuel power stations). Emission reductions are possible if renewable energies or nuclear power is used for electricity generation. Efficiency can be improved if high-pressure electrolysis is applied (η=0.76). However, the overall energy demand to generate hydrogen still remains very high.

Regarding the economic performance of different modes of traction, DB AG compared the different modes of traction based on a railcar equipped with two 485 kW engines and an operation time of 2500 hours per year (total lifetime 20 years). The investment, maintenance and fuel costs for 1999 and 2010 are shown in table 2. Because the fewer moving parts of fuel cells are less subject to wear and tear, the maintenance costs for fuel cell vehicles are lower than those for diesel vehicles.

For the 2010 time horizon, it was anticipated that in the year 2010, the price of fuel cells would fall to 100 EUR/kW and that the price of hydrogen would fall to 0.28 EUR/m^3 while diesel fuel would be heavily taxed.

Table 2: Investment and operation costs

	Engine price in EUR/kW	Maintenance EUR/annum	Fuel costs in EUR
Diesel (1999)	155	9,500	85,000
Diesel (2010)	155	9,500	170,000
Fuel cell (1999)	18,500	4,700	210,000
Fuel cell (2010)	100	4,700	147,000

Clearly, the scenarios from table 2 are oversimplified, but nonetheless the following conclusions regarding the economic performance can be drawn:

1.) For the time being the costs of fuel cells and hydrogen are too high to use fuel cell technology.

2.) Fuel cell rail vehicles will become only economically feasible, if engine and hydrogen prices go down, and diesel fuel costs go up.

3.) Fuel pricing is the determining factor for the economic viability of fuel cell vehicles. Political framework conditions therefore play a key role, and railways need to make sure that the development of fuel prices is taken into account in management decisions.

It is questionable whether there are any efficiency gains to be obtained from fuel cells when considering the full energy chain. However, the advantage of fuel cells is that hydrogen can be generated by electrolysis of water. If the electricity employed for the electrolysis originates, for example, from nuclear power or renewable energies, then the fossil fuel dependency would be reduced. (It is important to take also into account that oil reserves will suffice for about another 40 years and gas reserves will last for approximately another 200 years).

The issues raised in this report of system efficiency, interoperability between countries and the fact that fuel pricing is the determining factor for the economic viability of fuel cell vehicles suggests that the application of fuel cell technology to locomotives will not take place

until the world has significantly advanced fuel cell applications in other markets.

2.1.3 Other Sectors

The development of the fuel cell is more advanced in the portable fuel cell and the stationary power plant sectors. These sectors have either lower power requirements or no space constraints that are limiting factors in the transport market. In both these sectors the product is in the commercial market.

Marine may be the one transportation sector where Mega-Watt (MW) fuel cell power plants could enter service in the near future. Marine vessels, unlike locomotives, are not constrained by space requirements. Fuel cells, especially PEM's, for mining applications are under development. A consortia of commercial and government agencies are developing a fuel cell powered underground mining locomotive to replace diesel units by 2004-2005.

3. Industry Interviews

The next step in assessing the feasibility of fuel cell locomotives was to establish the position of the Canadian railway sector on fuel cell technology and applications. Interviews were conducted with mechanical and operating officers from Canadian National Railways, Canadian Pacific Railways and with representatives from the Railway Association of Canada.

In concise terms, no work is being undertaken in these organizations to assess the feasibility of fuel cell locomotives or to assess the operational application of the technology to the railway industry. It would also be relevant to state that fuel cell locomotives are not in their near or medium term planning horizon (the next decade).

Having stated that no direct work has been completed or is in progress to assess fuel cell applications, the subject has been discussed and considered within each organization at technical levels and the decision has been reached to not pursue the matter. The application of fuel cell technology is not an operational consideration

at this time and remains within the bounds of environmental concerns.

Both CN and CP are aware of the issue and are key representatives on the Railway Association of Canada's Environmental Committee. This committee has had several briefings on fuel cell developments by technology experts in recent years that have led to the conclusion that no direct applications will be feasible within the next decade and probably longer. Consequently, the committee has initiated no fuel cell specific work and has adopted a policy of staying abreast of developments.

All Class 1 railways in North America are members of and participate in the activities of the Association of American Railroads (AAR) headquartered in Washington, DC. The AAR also operates the Transportation Technology Center, Inc, located in Pueblo, Colorado that provides worldwide consulting and testing services in the railroad sectors. The AAR (including TTCI) has not addressed the subject of fuel cells in locomotives. The AAR Environmental Committee has established a subcommittee to look at future options to the diesel engine, however, this committee has only recently been established and work has not progressed to date. The Department of Energy and the Federal Railroad Administration in the United States have not reviewed fuel cell locomotive applications in recent years. From a North American operational perspective, fuel cell locomotives are not on the foreseeable horizon.

Interviews were conducted with Bombardier in Canada, and General Motors and General Electric in the United States. The CN and CP fleets of high horsepower locomotives are supplied by GM and GE. Bombardier is more specifically oriented to passenger rail service. In each case it was ascertained that no direct work on developing fuel cell locomotives is being carried out by these manufacturers. They have basically adopted a position of keeping on top of technology developments and waiting for the fuel cell developers to progress the technology development, manufacturing and application to other transportation modes before active interest will be taken. This

position is not without having considered the operational implications of alternate power systems in locomotives.

The fuel oil crisis of the 80's led the rail industry to look at electrification of rail systems in North America. In the final analysis, the industry concluded that it could not afford the infrastructure costs of implementing electrification. This nature of fundamental change to railroad infrastructure dynamics would have to be funded out of the public purse. One of the major US builders approached a US Class I road to look at the feasibility of fuel cell locomotives. Work was progressed to the point where a determination was made that with the current state of the technology, it was too costly to progress further. A fundamental problem identified is the enormous cost of the duplicative fuelling system required to support the fuel cell locomotives. This same conclusion was arrived at by one of the Canadian railways when it examined gas-powered locomotives. The cost of the fueling infrastructure drove the concept off of the drawing board.

Taking into consideration:

- The state of the art in fuel cell technology
- The operational considerations in implementing a radically new power system with the infrastructure requirements that it would demand
- The knowledge that the diesel engine will be a significant component of North American Railroad fleets for many decades

The locomotive manufacturing industry is waiting for the auto transportation mode to make the technological and operational breakthroughs that could make the fuel cell locomotive feasible and practical.

Ballard is Canada's leading fuel cell development corporation and a world leader of PEM fuel cell technology. Ballard was not willing to disclose technology development issues or to get into a discussion on fuel cell locomotives. They believe that the application of fuel cells to locomotives is feasible downstream but they are not looking at this application or the operational ramifications at the present time.

Ballard has a very clearly defined strategic plan to develop fuel cells and market the technology. The development and marketing horizon to 2006 is focused on:

- Portable generators – this product is the easiest to get to market
- Stationary power systems – applications for remote communities
- Automobiles – largest commercially viable market

The technology for application in boats and rail will be leveraged from the application of fuel cells to the automobile industry.

4. Fuel Cell Market Development

A recently released report (November 2000) by the Northeast Advanced Vehicle Consortium called Future Wheels (ref. 5) is based on interviews with 44 global experts on the future of fuel cells for transportation and infrastructure. A very critical segment of this work that is directly applicable to assessing the feasibility of fuel cell locomotive applications is the global expert's views of how the fuel cell market will develop in general

All respondents think that fuel cells will be commercially viable in the transit market before they are in the passenger vehicle market, although respondents vary on how optimistic they are about the speed of this market development. A majority predicts that fuel cell transit vehicles might reach 5% of the market by 2008 - 2010. This view was shared across many categories of fuel cell stakeholders.

Why did respondents think that fuel cells would reach a significant share of the transit market before they would in the passenger market? There are several reasons for this prediction. The first is the issue of sheer numbers, as noted above. Using the U.S. as the example, it will simply be quicker to get to annual production of 250 vehicles (for transit) than to reach production of 850,000 (for passenger vehicles). Respondents also think it will be easier to introduce fuel cells into the transit market for a variety of reasons

including infrastructure, cost, integration of the fuel cell onto the vehicle platform, government subsidy and regulatory drivers.

5. Conclusion

It is evident that a wide variety of opinions exist on the progress of fuel cell integration into the marketplace and the drivers that will make it happen. The preponderance of opinion suggests that the transit market will provide the test bed with the automotive market following. Of note to the NAVC report is the absence of any discussion on the applicability to the long haul truck and railway locomotive sector of the marketplace. Considering that no development work is being advanced in North America on the railway locomotive, this finding is not unexpected. The marketplace has already sorted out the rational introduction of the new fuel cell technology to the marketplace.

The industry generally believes that with time and money the engineering hurdles could be surmounted and a fuel cell locomotive could be built. However, the practical limitations of fuel cell locomotive implementation will preclude significant activity in the short and medium term planning horizon.

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Sustainable Transportation System: A System Dynamics Approach

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Introduction

From an economic standpoint, transportation is an important sector of an economy because it contributes substantially to the growth of real gross domestic product (GDP). Since the growth of real GDP over time reflects economic growth, transportation should be regarded as a substantial contributor to economic growth. However, over time as population has increased, cities have grown, and globalization and free trade have increased the regional and international movement of people and goods, our transportation infrastructure and systems have expanded

dramatically. The cars, trucks, buses, subways, trains, aeroplanes, ships and ferries that we use to move ourselves and our goods today have significant implications in terms of energy and material resource use, environmental pollution, noise and land use at local, regional and global level.

All the above led to the following conclusion made by the Organization for Economic Cooperation and Development (OECD, 2001): *"...Our current transportation system is not on a sustainable path. Our admirable achievements in terms of mobility have come at some considerable environmental as well as social and economic cost. The challenge now is to find ways of meeting our transportation needs that are environmentally sound, socially equitable and economically viable"*. Those are goals of sustainable transportation system.

Basic Features of a Sustainable Transportation System

In general the concept of comprehensive sustainability implies a balanced economic growth in terms of three dimensions: economic, social and environmental. In this regard, the following definition of the

sustainable transportation system, introduced by the Canadian Centre for Sustainable Transportation, reflects these dimensions the best:

"A sustainable transportation system is one that: (i) allows the basic needs of individuals and societies to be met safely and in a manner consistent with human and ecosystem health, and with equity within and between generations; (ii) is affordable, operates efficiently, offers choice of transport mode, and supports a vibrant economy; (iii) limits emissions and wastes within the planet's ability to absorb them, minimizes consumption of non-renewable resources, reuses and recycles its components, and minimizes the use of land and the production of noise" (Canadian Centre for Sustainable Transportation , 2001)

Design of such a system is a challenge. It is so because (i) sustainability is a long-run goal that involves more than one generation, and (ii) comprehensive sustainability is a system concept. With respect to the first one, since the time horizon associated with the sustainable transportation system goes beyond one generation, its evaluation should be viewed in terms of structural changes rather than marginal changes.

Unfortunately, all conventional methods such as cost-benefit analysis, cost-effectiveness analysis, multi-criteria analysis and some others that have been used to evaluate sustainability of transportation, were designed to evaluate specific projects. As such, they all suffer from the same drawback – assessment of marginal changes within the existing framework.

With respect to the second feature, comprehensive sustainability involves interactions of the economy, the society and the environment over time while all the conventional methods are based on the following principle: Expected developments in the transportation system are evaluated as the consequences of a once-and-for-all impact. Then a one-directional impact process is analysed which does not include feedbacks between the transportation system, the socio-economic system and the ecological system. Therefore, it is necessary to establish interactive linkages of transportation system with the economy, the society and the environment. In doing so, let us introduce vertical and horizontal linkages of the transportation system.

Since transportation is a substantial contributor to economic growth, it is a part of a macroeconomic system in the first place. According to the existing methodology, it is possible to define a macroeconomic system as a combination of markets (sectors) on the one hand, however, it is also possible to define a macroeconomic system as a combination of regional economic sub-systems. The latter appears to be more appropriate for studying implications of transportation since transportation services are produced and consumed in transportation networks that are parts of regional economies as well as national economy. Such a treatment of transportation is more appropriate because a transportation network is a spatial object, and regional economics analysis is mainly based on spatial considerations.

Therefore, methodologically transportation appears in "the economy" component of the comprehensive sustainable system. However, three levels have to be distinguished within this component with respect to transportation: (i) national economy as a whole – the highest

(macroeconomic) level; (ii) regional economy – the meso (intermediate) level; (iii) transportation – the lowest (microeconomic) level. These three levels describe vertical linkages of a sustainable transportation system within economic component. In addition, horizontal linkages that include social and ecological implications of the sustainable transportation system should be specified. Figure 1 illustrates the discussed structure:

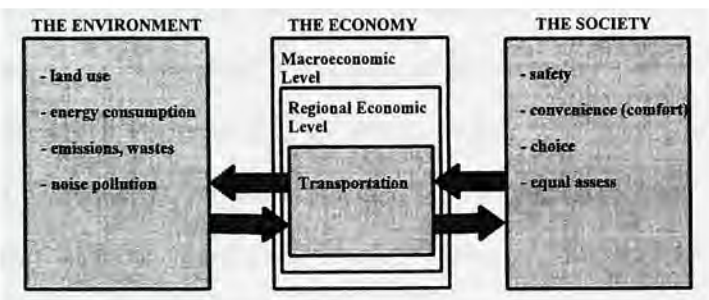


FIG. 1. VERTICAL AND HORIZONTAL LINKAGES OF A SUSTAINABLE TRANSPORTATION SYSTEM

Furthermore, at the microeconomic level transportation should be introduced as a network industry. Such a framework includes the following features:

- transportation network is a system of a durable good (infrastructure), associated goods (vehicles) and services (labour services of vehicle operators, maintenance of infrastructure, traffic operation, policing, etc.);
- transportation network is subject to the network effects such as network externalities, economies of density, size and scope.

Methodology

Recently, in order to overcome the deficiencies of the conventional methods, the system dynamics approach to study sustainability of the transportation system has been applied. The system dynamics approach is a methodology used to simulate the dynamic behaviour of complex biological, bio-physical and social systems. It has been applied in the bio-cybernetic experiments of Vester (1995) regarding the social impacts of industrial and transport development. There is growing international research activity for applying this methodology to problems of integrated assessments of policy strategies in transportation (see Kuchenbecker and Rothengatter, 1998).

The system dynamics approach is based on relationships between

state and flow variables organized in feedback loops. These loops can be positive (self-enforcing) or negative (dampening). For example, Vester (1995) concludes that man-made systems with only positive feedback are exponentially expanding and therefore, cannot be sustainable in the long term. In addition, the system dynamics approach recognizes that for long-run problems like sustainable transportation, methodologies based on data from the past such as econometric modelling and other statistical techniques are less reliable. Instead the approach investigates functional cause-and-effect relationships within an integrated system.

In this study, a sustainable transportation system is defined as the one that is integrated with the economy, the society and the environment through vertical and horizontal linkages. Application of the system dynamics approach therefore implies that such a system must evolve according to the state-flow relationships organized in feedback loops. This statement calls for the following framework:

1. *Development of intrinsic dynamics relationships*. Intrinsic dynamics

captures the relationship between state and flow variables. For example, energy consumption by transportation can be expressed in terms of a relationship between stock of energy resource (a state variable) and its current use (a flow variable). Since current resource utilization results in depletion of the resource stock, the requirement of a constant depletion rate, based on socially desired goals, would result in a sustainable pattern of energy use arising from intrinsic dynamics.

2. *Development of objective function.* Intrinsic dynamics relates state and flow variables over time. However, at any point in time the best choice must be made with respect to the economy, the society and the environment. It means that the choice variables must reflect the multi-dimensional nature of the problem. For example, a wider choice of different modes of transportation in a transportation network would result in an increase in convenience for the network users. The latter is a social effect, but at the same time it would increase the transportation network's economic value. Therefore, if this effect is directly incorporated into users' utility function, the requirement of utility

maximization would result in maximum of the network's socio-economic value associated with the optimal choice of the network's mode mix.

3. *Introduction of sustainability constraints*. Pearce, Barbier and Markandya (1988) defined sustainable development as follows: *"We take [sustainability] to be a vector of desirable social objectives... Sustainable development is then a situation in which the development vector increases monotonically over time"*. In this definition, a non-decreasing social utility is assumed. In a mathematical sense, it is a non-equality constraint. Since one of the goals of sustainable development is inter- and intra-generational equity, the requirement of a non-decreasing personal utility over time coupled with the utility maximization would reflect this goal.

In order to implement this framework, analytical methods coupled with computer modelling should be applied. In the described methodology, analytical methods refer to a mathematical description of relationships among economic variables. Such a description is based on economic theory which helps us to specify some functional forms. For

example, the notion of marginal utility and the understanding of the consumption of transportation services underlie specification of the utility function (see, for example, Domenich and McFadden, 1975). Some network effects can be captured by specific form of production function that describes production of transportation services in a transportation network (see, for example, Yevdokimov, 2001).

However, there are still some effects that cannot be directly described with the help from economic theory. This is especially true regarding horizontal linkages of the transportation system. For example, air pollution by transportation cannot be described by means of economic theory only. It involves understanding of physical, chemical, biological and some other aspects of the process. In order to avoid the complications arising from this multiple nature of the process, it is possible to use computer modelling. In such a case, horizontal linkages of the transportation system with the environment can be established by means of computer simulation. For example, once relevant stock and flow variables are identified, neural networks might be employed to

establish the relationship between the stocks and flows. Neural networks are an effective tool to meet this goal since they have the ability to sort patterns and learn from trial and error, discerning and extracting the relationships that underlie the existing data.

Conclusion

Since conventional methods have failed to correctly evaluate the performance of the transportation system from the viewpoint of sustainability, the system dynamics approach should be employed instead. The approach must be applied to describe vertical and horizontal linkages of the transportation system with the economy, the society and the environment. Only then the sustainable path of the transportation system can be derived on the basis of analytical methods and computer modelling.

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Secure, Efficient and Sustainable Trade Under NAFTA

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Introduction and Summary

Events of September 11, 2001, have reinforced the importance of enhancing seamless and secure movements across borders. Well before these cataclysmic events, there was a well-defined process to harmonize transport land standards. There was also an overall consensus of government and business opinion on how best to facilitate trade across the border while maintaining or improving security.

Unfortunately, progress to implement the solutions has been slow and in some cases regressing. Canada can no longer afford an ad-hoc approach to NAFTA harmonization. Almost one-half of Canada U.S. trade is taking place within transborder firms that have the option to consolidate production in one country or the other. Canadian ports are gateways to both Canada and the U.S. Government policies are now more than ever a factor in Canadian competitiveness internationally.

Expanded trade has fueled economic growth and employment, but it is focusing traffic and environmental problems in border areas, which have become the doormat for other people's traffic. Current trends are not sustainable environmentally, socially or economically.

This paper will provide a status report on harmonization under NAFTA, discuss emerging trends in NAFTA trade, and identify opportunities to improve transborder transportation and logistics.

The challenge is to find solutions that improve security, efficiency and sustainability of trade at the same time. An integrated policy approach would help meet this challenge by allowing each mode of transport to work to the natural economic advantage of its physical and organizational characteristics.

Regional Economic Integration

Regional economic integration can take the following different forms, or may evolve from one stage to another:

- Free Trade. Member countries eliminate all trade restrictions and reduce or eliminate tariffs (e.g. CUSTA, NAFTA)
- Customs Union. Member countries adopt uniform tariffs and other trade regulations concerning countries outside the union (e.g. European Economic Community)
- Common Market. Added to the customs union is free movement of the factors of production, goods, services, people and capital
- Economic Union. Added to the common market are fiscal and monetary harmonization
- Political Union. Supranational decision making beyond the economic area (e.g. European Union)

NAFTA is primarily a market driven process of integration, but the dynamic is now raising unanticipated issues of a fiscal or political nature. The events of September 11, 2001, have expanded the debate from a narrow focus on economic issues to other issues such as security and immigration.

Harmonization

The requirement to harmonize land transport regulations under NAFTA has proved to be a challenge. Although roadway and traffic control standards are essentially uniform, there is unfinished business with vehicle technical, operating and safety standards. In some cases, such as commercial driver hours of work, standards are diverging rather than converging. There may be a permanent rather than temporary harmonization process.

Regulation of motor carriers in NAFTA countries is to be accomplished by measuring safety compliance. Yet there is lack of reciprocity and uniformity in carrier safety ratings between the three countries. The U.S. has a safety rating system and rates Canadian carriers operating in the U.S. In Canada, there are different provincial systems that so far generate inconsistent ratings for similar carrier profiles. It may be five years before Canada has a consistent national system. Mexico is still at the conceptual stage.

Mexico successfully challenged the U.S. refusal to allow Mexican carriers to operate beyond the commercial zones near the border. The U.S. D.O.T. is preparing to open the border to Mexican carriers in 2002. The U.S. D.O.T. is proposing to screen new entrants and carry out periodic compliance reviews.

Meanwhile, the U.S. General Accounting Office reports to Congress that "The United States and most U.S. border States are not prepared to ensure that Mexican commercial carriers meet U.S. safety standards."[1] As of January, 2002, it is not clear exactly how this issue will be resolved among Congress, President and regulators. It does seem though that some Mexican carriers will be allowed to operate deeper into the U.S. under certain conditions.

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[1] U.S. General Accounting Office, *North American Free Trade Agreement, Coordinated Operational Plan Needed to Ensure Mexican Trucks' Compliance with U.S. Standards*, Dec. 2001, p.12

The LTSS process has not achieved continental harmonization of vehicle size and weight standards. Canada allows trucks at 138,000 pounds, while the U.S. federal limit on Interstates is 80,000 pounds. A major barrier to increasing weights in the U.S. to Canadian levels is the cost of upgrading bridges, estimated at $U.S. 65 billion.[2] Instead, the LTSS working group is proposing regional harmonization along certain trade corridors. However, Congress would have to change legislation to liberalize vehicle size and weight limits before some of the proposed trucks could operate beyond the border States.

Mexico and the U.S. have federal involvement in setting national trucking standards. Canada's federal government has delegated its powers to the provinces. Differences in regulations and standards create impediments and inefficiencies for transborder motor carriers. Before trade by truck can be fully automated, the basic principles and regulations by which trucks operate need to be standardized.

The trunk rail carriers are regulated at the federal level in all three NAFTA countries. Industry railway associations have already harmonized technical standards to allow cross-border movement of trains and the interchange of equipment. Class 1 railroads set car interchange standards through the Association of American Railroads which become the common denominator car standards for short lines.

However, since the LTSS process began in 1994, there has been little progress in harmonizing outstanding differences in government standards and regulations affecting rail operations. This has been less of a trade impediment for rail than trucking. Rail operates under federal jurisdiction in all three countries and has an industrial organization to set technical standards for vehicles on its own infrastructure. For railways, differences in economic regulations and taxes are a more serious problem than differences in technical and operating standards.

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[2] U.S. D.O.T., *Comprehensive Truck Size and Weight Study*, Chapter IV, 2000

Trade Trends

Canada has a small domestic population and market. It is more dependent on external trade than other countries. Canada depends on the U.S. for 85 per cent of its exports, but the U.S. depends on Canada for only 20 per cent of its exports. Almost one-half of Canada U.S. trade occurs within firms (intrafirm trade)[3] that can consolidate plants in either Canada or the U.S. International competitiveness is now much more important for Canada's economy.

Canadian goods exports to the U.S. grew from $265 billion in 1995 to $423 billion in 2000. Imports from the U.S. grew from $230 billion to $363 billion. However, growth in merchandise trade with the U.S. stalled in 2001. Energy exports masked declines in auto and forestry.

Canada earns a significant trade surplus with the U.S. ($92 billion in 2000) which offsets trade deficits with Europe and other countries. Canada is heavily dependent on imports to generate exports. For example, it has a deficit in auto parts to generate a surplus in vehicles.

Rail has about 28 per cent of the transborder rail/truck mode split by value and 44 per cent by weight southbound. Truck has 72 per cent and 56 per cent respectively. Rail has nine per cent by value and 22 per cent by weight northbound. Truck has 91 per cent and 78 per cent respectively.[4] However, there are gaps in trade data for intermodal transport and actual origin-destination. Rail probably has a majority of the transborder ton-miles.[5]

Between 1990 and 1999, Canada's share of foreign investment in NAFTA countries declined from 23 to 13 per cent. The U.S. share

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[3] Industry Canada, *Canada's Growing Economic Relations with the United States. Maximizing Our Opportunities*. Part 1-What are the key dimensions? Micro Economic Monitor, Second Quarter 1999.
[4] Transport Canada, *Transportation in Canada 2000*
[5] Parsons Brickerhoff Quade & Douglas, *Trade and Traffic Across the Eastern US Canada Border*, May, 1997, p.70

increased from 74 to 82 per cent. Security concerns as a result of September 11, 2001, could lead to a shift of production to U.S. plants to ensure ease of access to the U.S. market.

Canada has traditionally enjoyed a preferential bilateral relationship with the U.S. within the NAFTA partnership. The importance of Mexico is rising to challenge this situation. Whereas Canada is focused on its trade with the U.S., the attention of the U.S. is more evenly divided between Canada and Mexico. U.S. trade with Mexico is growing almost twice as fast as trade with Canada. NAFTA trade with Texas and California is growing three times as fast as NAFTA trade with Michigan. [6] During the 1990's, the population of Mexico grew twice as fast as the population of Canada, and its GDP grew three times as fast. Mexican GDP was one-half that of Canada's in 1990, but by 2000 had nearly caught up. [7] U.S. auto production is increasingly integrated with maquiladora factories in Mexico.

Security

Different modes of transport have different attributes that affect security and the application of security technology. Because of the dependence of Canada on the U.S. for its exports, U.S. security concerns are Canadian concerns. Security at the U.S. border could affect shipper and carrier competitiveness, just-in-time systems, investment, location of plants and employment. Integration of policies across borders and modes is now more important than ever.

Trade-offs are emerging between economic efficiency and security. Canadian exporters are particularly vulnerable to the way security measures are implemented in the U.S. For example, under a

[6] U.S. D.O.T., Bureau of Transportation Statistics, North American Trade and Travel Trends, 2001, figure 5

[7] U.S. D.O.T., Bureau of Transportation Statistics, North American Trade and Travel Trends, 2001, table 1

proposed Farm Security Act, there is a plan to segregate and label meat from different countries sold in the U.S. It could become very costly for slaughterhouses and stores in the U.S. to sell Canadian meat.

There is a general consensus of opinion among business leaders and government officials in Canada about what needs to be done to improve security in a way that allows the free trade:

- Move physical inspections away from the border to terminals either before or after crossing the border. Offshore traffic could be inspected at first point of entry to North America to satisfy U.S. and Canadian standards.

- Harmonize and coordinate management of the border. Share resources and information. Integrated policies, regulations and information systems.

- Use risk management to automate clearance of low-risk people and goods, and focus physical inspections on high-risk situations.

- Use information technology to expand pre-clearance programs for low-risk goods and people and to share and standardize information.

Efficiency

It is important to understand what is meant by the term efficiency. Webster's Dictionary defines efficient as *"productive of desired effects esp. without waste."* The desired effect is production and movement of goods and the physical access of people to economic and social activity. Waste to be avoided would be consumption of land and non-renewable energy, pollution of air or water, and loss of life or quality of life.

By what measure is the transportation system efficient? Price? Service? For whom is it efficient? Shippers? Travelers? Carriers? Taxpayers? Citizens? The U.S. D.O.T. reports that motor vehicle collisions are the leading cause of death for people under the age of 35. The transport system is not efficient for them. If we set regulations to optimize the internal efficiency of each mode individually, will we maximize system efficiency?

The least expensive logistics option is also the most efficient only when all costs are factored. Currently, the market confers monetary value on logistics benefits, but not public costs.

Transport Canada estimates the total transport related final demand to be $118 billion annually, including both commercial transport and personal transport, i.e. autos[8] This is the direct or internal aspect of transportation. Transport Canada also estimates the cost of road traffic collisions at $25 billion annually.[9] If one also factors the cost of pollution, noise and urban sprawl, the indirect costs of transportation are very significant in relation to direct costs.

Heavy vehicles cover 50-70 per cent of their share of road costs.[10] Road pricing to reflect axle load and time and place of road occupancy would allow a more efficient allocation of resources. Growth in demand would be more sustainable. There would be a more rational balance of traffic and investment between modes. Some private distribution costs would shift from public back to commercial ledgers. With information technology, it is now possible to track individual vehicle weights and roads used.

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[8] Transport Canada, *Transportation in Canada* 2000, p.7
[9] Transport Canada, *Road Safety Vision*, 1998, p.2
[10] U.S. D.O.T., Federal Highway Cost Allocation Study, 1997 and Royal Commission on National Passenger Transportation, 1992, Vol II

Sustainability

Globalization, increased trade and increased personal mobility have all put stress on the ability to sustain current levels of growth in consumption of resources for transborder transportation.

Global impacts include global warming, and the vagaries of oil supply/price shocks. Very small imbalances in oil supply and price create large price swings and economic adjustments. Currently, transportation consumes 66 per cent of all U.S. petroleum compared to 55 per cent in 1975. Imports already account for 61 per cent of U.S. oil supplies and this portion will grow. Reducing marginal oil intensity would increase competitiveness of Canada in the continental and global economies.

Increased NAFTA trade has focused air quality and land use environmental stress along key trade corridors, particularly in border areas. This is referred to as the doormat effect.

Four crossings in Ontario handle 55 per cent of all Canada/U.S. truck crossings, with Windsor alone handling 26 per cent.[11] Trucks at the Windsor/Detroit Ambassador bridge are 28 per cent of vehicles and 50 per cent of road traffic impact.[12] Windsor consistently exceeds the one-hour criterion for ozone, as well as parameters for PM.[13] Transborder freight accounts for 4.8 per cent of NOx and 7.4 per cent of PM-10 mobile source emissions in the Detroit corridor, which is significant given the local emissions generated by 5 million people.[14]

The amount of goods crossing the Ontario/Michigan border will nearly triple by 2020, as will emissions of greenhouse gas (GHG)

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[11] see footnote 4, Table 10-7

[12] using 1 truck = 2.5 passenger car equivalents

[13] Sierra Club and Shelia Holbrook-White, Texas Citizen Fund, *NAFTA Transportation Corridors: Approaches to Assessing Environmental Impacts and Alternatives*, 2000, p.15,27

[14] see footnote 15, p.17

emissions. Total nitrogen oxides (NOx) and particulate matter (PM) emissions in this corridor are projected to decline with new engine technology.[15] This is a good target, but optimistic given the experience with emissions technology falling behind demand growth in the past 15 years. Even if emissions are reduced, there remains the issue of handling three times as many goods vehicles.

Infrastructure and Information Technology

The Eastern Border Coalition has identified $U.S. 5.9 billion in highway border crossing and highway corridor expenditure needs along the Eastern Canada/U.S. border, particularly Ontario and Michigan.[16] Who should pay for this? If it becomes a commercial expense would the same amount of expansion be required, i.e. would it dampen transport demand or shift some of it to other modes?

The current public policy and budgetary focus appears to be on expansion of NAFTA trade highways and the growing use of road transport. Are there alternatives? Analysis of those forces which orient transport planning to one mode over another is crucial.[17]

A community-level report card[18] has identified the following task in dealing with infrastructure for NAFTA trade:

> *"Inventory the existing intermodal resources, capacity parameters, and overall transportation infrastructure of the three signatory nations; investigate the transportation decision-making process used in each of the three countries, identifying those forces or pressures that support or oppose intermodal transportation resources and networks."*

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[15] ICF Consulting, *North American Trade and Transportation Corridors: Environmental Impacts and Mitigation Strategies*, 2001, Tables 1,9,16

[16] see footnote 5, p.53 and Appendix

[17] see footnote 13, p.29,30

[18] see footnote 13, p.29

The scope of infrastructure is being expanded to include information communications technology (ICT). It can reduce delays for commercial vehicles at the border, improve cargo security and deal with traffic disruptions. It is also an economical and efficient way to price road use to recover costs and reduce congestion. The question of recovering the cost of publicly provided ICT from commercial users is also relevant to intermodal policy.

Modal Attributes

Different modes of surface land transport have different attributes that affect security, efficiency and sustainability. Railways have private corridors, vertical integration of roadway and vehicles, and a scale of industrial organization that creates a security advantage. Trucks have a smaller unit of production and access to a larger network that creates a service advantage.

Trains require less fuel, dollars and land to move goods, but many shipments do not start and stop at a siding or terminal. Trucks can pick up or take a load just about anywhere, but they require more space, fuel and resources to haul goods along main traffic routes. Attracting and retaining long-distance truck drivers is also reported to be a problem.

Today, the challenge is to improve security, environment and economic efficiency together. There is no good or bad mode of transport. Different modes have advantages or disadvantages in different circumstances. Governments cannot get involved in the thousands of daily shipper decisions by dictating how freight should move. But they can integrate policies across borders and modes to let each mode work to the natural economic advantage of its physical and organizational characteristics.

Following are some of the challenges and solutions in adapting to the continental transportation market:

Challenge	Solution
NAFTA integration	Harmonize fiscal, safety, technical and economic regulations across borders
Secure and Seamless movement	Identify and remove barriers to intermodal transport, and harmonize policies across modes Move inspections away from the border Integrate U.S./Canadian information systems Inspect containers at port Automate processing of low risk people/goods
Energy and Environment	Remove barriers to greater use of existing rail infrastructure and intermodal transport Road pricing for commercial traffic
Least cost logistics	Harmonize fiscal, safety, technical and economic regulations across borders
Balanced treatment of modes	Harmonize fiscal, safety, technical and economic regulations across modes Harmonize jurisdiction of transborder transport at the federal level for all modes
Market Forces vs Regulation	Under NAFTA, regulations can no longer be used to cross-subsidize specific commodities Recover costs of using public infrastructure
Sustainability	Decouple economic growth from growth in emissions More efficient use of transport and land Make greater use of existing infrastructure

Some Physical Characteristics of Land Transport

Characteristic	Trucking	Rail	Intermodal
Network kilometres[19] [20]	317,919 (Can paved) 3,830,000 (U.S. paved) 99,165 (Mex paved)	77,387 (Can) 284,818 (U.S.) 26,612 (Mex)	N/a
Guidance	Steered	Guided	Guided/Steered
Traffic Control (ITS)	Public	Private	Line-haul private
Corridor	Public	Private	Line-haul private
Cargo Volume/Vehicle (cubic metres)	140	15,000	17,000
Power/Payload (kWatt/tonne)	8.4 (bulk) 19.2 (intermodal)	0.7 (bulk)	3.3
Energy use (kJ/tonne-km) [21]	1224 composite inter-city	267 composite	354 composite[22]
Max Payload (tonnes)	44 (Can) 21 (U.S. Interstates) 40 (Mexico)	10,000	4,500
Truck Tractors/Locos	92,000 (Can) 1,500,000 (U.S.)	3,000 (Can) 20,000 (U.S.)	N/a

[19] Trucks are not allowed to use some of these paved roads, but can use some unpaved roads not listed

[20] Rail network includes yard tracks, sidings and parallel lines due to format of NA source data. Route kms are about 35% less, e.g. 48,000 Canada

[21] Delcan, KPMG, AK Socio-Technical, Assessment of Modal Integration & Modal Shift Opportunities, 1999, p.D4,D5

[22] Includes truck energy for 25 km pick up and 25 km delivery per 700 km rail line-haul

	n/a (Mexico)	n/a (Mexico)	

Some Organizational Characteristics of Land Transport

Characteristic	Trucking	Rail	Intermodal
Integration road/vehicle	Separate	Integrated	Line-haul integrated
Barriers to Entry	Low	High	High
Economies of Density	Low	High	Medium
Economies of Scale	Medium	High	Medium
Firms	10,000 (Can), 500,000 (U.S.) 83,000 (Mexico)	60 (Can) 450 (U.S.) n/a (Mexico)	N/a
Employees[23]	141,000 (Can) 1,484,000 (U.S.) 593,000 (Mexico)	41,000 (Can) 173,000 (U.S.) 20,000 (Mexico)	N/a
Unionization	Low	High	Line haul union
Employee turnover	High	Low	Line haul low

[23] There is some variation on employee data at different places within the same publication (North American Transportation in Figures)

Trends in U.S. International Trade, Trade with Canada, Mexico, Population, GDP, Trips

				Percentage	Annual
				change,	growth rate
	1990	1995	2000	1990–2000	(percent)
Population (millions)					
United States	249	263	281	13.2	1.2
Canada	28	30	31	10.6	1
Mexico	81	91	97	19.9	1.8
Gross domestic product (GDP)					
United States (billions of current $US)	5,744	7,270	9,963	73.5	5.7
United States (billions of chained 1996 $US)[1]	6708	7,544	9,319	38.9	3.3
Canada (billions of current $US)	540	546	699	29.5	2.6
Mexico (billions of current $US)	240	262	575	139	9.1
Value of total U.S.international					
merchandise trade					
Billions of current dollars	907	1,341	1,997	120.3	8.2
Billions of chained 1996 dollars1	891	1,308	2,163	142.7	9.3
Value of U.S.trade with NAFTA					
partners (billions of current $US)	233	380	653	179.9	10.8
Thousands of passenger trips					
between the United States and:					
Canada	105,167	89,484	86,827	–17.4	–2.1
Mexico	178,949	185,628	212,321	18.62	1.9

(copied from U.S. D.O.T. Bureau of Transportation Statistics, North American Trade and Travel Trends, 2001)

A Planning Model for the Optimization of Scheduled Freight Traffic

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Introduction

At the CTRF 2001 in Vancouver, the first author has presented a paper on the operation of Japanese express logistics services. By now, transport modelling experiences in Europe and insight into operations there and in Japan have been blended into a model for the planning and optimization of scheduled freight traffic, i.e. rail freight or regularly repeated road transports. The model builds onto an existing software, the "PTV Vision" transport modelling suite.

The new freight and logistics module is under development for use at DB Cargo, the largest German rail freight carrier, and others. Hence, some aspects reflect the European situation and operation practices and may have to be modified for the Canadian or North-American case. The critical planning task to offer efficient transport services is two-folded: On the one hand the qualities offered have to meet the real market conditions (in particular transport times and time windows). On the other hand the services have to be performed economically, in order to improve the economic result of the operator.

Motivation

The fulfillment of the two-folded planning task (given market conditions, economic viability and profitability) in the rail freight

transport business means a special challenge. The currently usual production structure – particularly in waggon-load traffic, which is still a mainstay of the freight divisions of many European railways - is closely linked to the available infrastructure (e.g. the marshalling yards). Generally, new arrangements can not be made at short notice. This characteristic differentiates the rail goods traffic from the long-distance haulage on the road, where in many cases large carriers use of operational tools for route planning flexibly in order to react to short-term demand variations, without making strategic network planning.

Yet, rail businesses have are means to increase flexibility in the context of the existing infrastructure, and to brake up their traditional, hierarchic production patterns. A more flexible handling of routes and a less rigid allocation of access points and yards can considerably improve the economy of the train formation process. In order to be able to quantify the advantage of such alternative production patterns, strategic planning models are necessary.

This methodology is common for public passenger traffic, where - on the basis of known average demand - a line network and a timetable are set up. Demand models forecast the traffic volume as well as the modal split for the offered travel times. An assignment model calculates, how the supply of timetabled services is accepted by the rail travelers. This allows to derive costs and revenues, and therefore the economic efficiency down to the level of individual lines.

The development of a similar model for the rail goods traffic enables a demand-oriented design of networks and timetables, using the same principles. On the basis of an infrastructure model with capacity limitations for tracks and train formation facilities, and given goods volumes (from a demand model) the procedure suggest an economical timetable for the transport of the goods volumes. Capacity restrictions and transport time requirements are taken into account. As for passenger traffic models, numerous characteristics can be derived from the results of the planning process, in order to

measure effectiveness, productivity and economy on different aggregation levels; ranging from the individual waggons to the performance of operators as a whole.

The remainder of the paper describes - on the basis a concrete implementation (Visum Cargo) - how a planning tool based of this concept can be used in practice. Subsequently, the most important constituents of the data model are described, and the computation methods specific to goods traffic are sketched. The paper closes with an outlook towards extensions for inter-modal traffic, the integration with passenger traffic planning, and a possible practical application.

Workflow

The diagram in figure 1 presents the fundamental mode of operation:

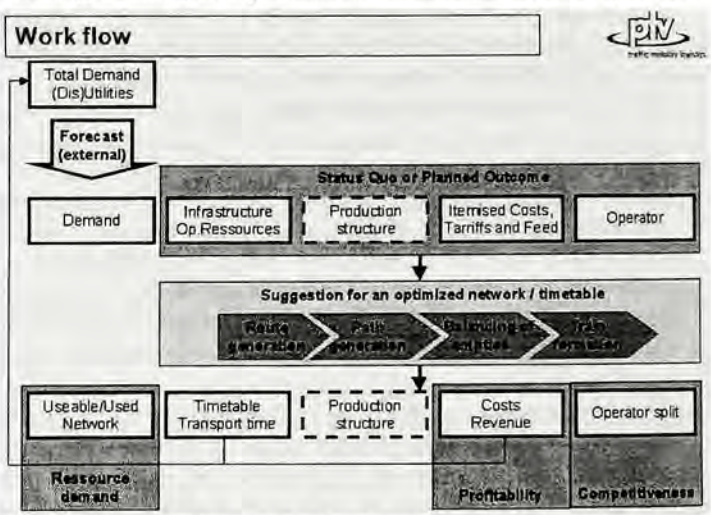


Fig 1: Information flow within the planning model Visum Cargo

The demand for rail goods traffic results from the total demand and the resistances (transport times and charges) of the different means of transport. Visum Cargo regards the result of this calculation as input,

and itself supplies resistances for an external forecast model. Likewise, capacities, travel time and unit cost prices for resources and infrastructure are input parameters. Some of them may vary between operators. The production structure represents a special case, as it can be either given (for status quo evaluations), or optimized in the course of the modelling procedure.

Each of the input parameters is suitable for the creation of planning scenarios. The most substantial ones are pointed out in the following:

- **Demand**: seasonal variation, shift of the demand of transportation to other goods classes.
- **Resources, infrastructure**: Number and capacity of train formation facilities, train formation criteria..
- **Production structure**: Formation of sub-networks with special hubs, partial specification of yard sequences.
- **Tariffs, unit cost prices**: Differentiation between standard and premium products with different tariff levels, unit cost changes through productivity improvements.
- **Operators**: Modelling of offers by competitors.

All input factors are used in the optimization procedure, which consists of four phases: 1) generation of route, 2) generation of yard sequence, 3) empty car balancing, and 4) train formation. Each individual phase can be customised using own processing parameters according to user's preferences. Between the individual steps, the user can intervene in the intermediate results, before the next process step is executed. Outputs of the procedure chain are the timetable and its characteristics from customer and operator view, optimized according to economic criteria. These characteristics enable the evaluation of a scenario according to transport quality, resources requirement, economy and competitive position.

Demand Description

According to the common European production structure in goods traffic, the user develops a timetable within Visum Cargo with a one-week-horizon. The forecast demand for one week has to be

transformed into matrices for each weekday. Thus the progression of volumes during the week (dependent e.g. on the production processes of large shippers) can be considered realistically during train formation and empty waggon balancing. Within a day, the goods supply is arranged into three dimensions:

- Geographically (origin/destination region, "traffic cells"),
- by content (goods class, leading to rolling stock requirements),
- according to transport volume or type of traffic.

Three basic operation modes are predefined:

- Single waggonload: Single cars are usually carried with several shunting operations at yards between origin and destination. Only if the shipping volume exceeds a minimum quantity determined by the user, a direct train is formed.
- Ordered full train (e.g. program traffic): Direct trains without rearrangement in transit.
- Combined transport, Intermodal: Goods are shipped in a container, swap body or on a lorry, which is carried on a rail waggon during part of the total haul. Accordingly the sample car is a container carrying waggon or a waggon for lorries or swap bodies. Access and egress to and from the terminals has to be considered; combined transport flows are relatively price-sensitive, due to the flexibility concerning the selection of the terminals.

Finally, Visum Cargo permits to distinguish transport volumes by lot sizes, and to define time windows specifying earliest departure and latest arrival. Hence, an individual item of the (daily-) volume matrix is specified by the 1) origin and 2) destination region; 3) goods class;4) mode of conveyance; 5) time window and 6) the lot size mix.

Infrastructure and Production Facilities

Within Visum Cargo, the underlying network is described in the usual manner, by a graph consisting of nodes and links. Links possess a capacity for goods traffic, which is defined as „number of line hauls per hour" for 24 hourly time slices. The nodes represent rail access points, sub yards marshalling yards as well as turnout points which

have a purely operational meaning. They are attributed with capacity limitations, costs and time requirement values for the different items of the train formation process. Additionally, a node carries information about modes of conveyance which can be handled (corresponds to the dispatching powers). Train services of the different types are characterized by so-called traffic systems. Each traffic system corresponds to a class of goods train with a system-specific standard speed rate as well as - if necessary - further, not explicitly modelled characteristics (e.g. max. axle load), which have influence on the trafficability of the route network. For example a train system for fast over night connections with a system speed of 120 kph can be defined by a dedicated traffic system. Besides, infrastructure use costs are traffic system dependent, so that e.g. differentiated track access charges can be integrated in this way.

The capacity modelling of a train formation facility is derived from the waggon flow through a conventional marshalling yard with collecting tracks, hump(s), sorting tracks and outbound tracks. In Visum Cargo, each of the areas carries attributes determining the time needed per waggon and per train. The total of the times determines whether a waggon transition from an incoming train to an outgoing train is possible. For the capacity calculation of the marshalling yard it is assumed here that the hump performance is the dominant factor. Therefore the load of a marshalling yard is defined by the time during which the hump is occupied. Accordingly, the capacity is the period of operation of the marshalling yard. The degree of utilization is described by a division of both. Turning relations (pairs of successive links) optionally are attributed with a time penalty, which represents travel time losses for direction of travel or traction changes, border delays or other technical stops in transit.

Modelling of the Production Structure

The transport of goods volumes takes place in two basically different ways, dependent on the quantity. Volumes transported by ordered full trains or operational direct trains (after achieving a given minimum quantity of waggonloads or for combined transport) take place in direct runs from the origin to the destination station. Single

waggons reach their destination through one or repeated shunting operations at sub yards and marshalling yards. Trains other than direct trains operate only between the following node types:

- Access point – neighbouring sub yard and v.v.
- Sub yard – marshalling yard and v.v.
- between marshalling yards.

Generally – at least in the case of the relatively dense European rail networks - several possible routings in the network exist for a journey between two nodes.

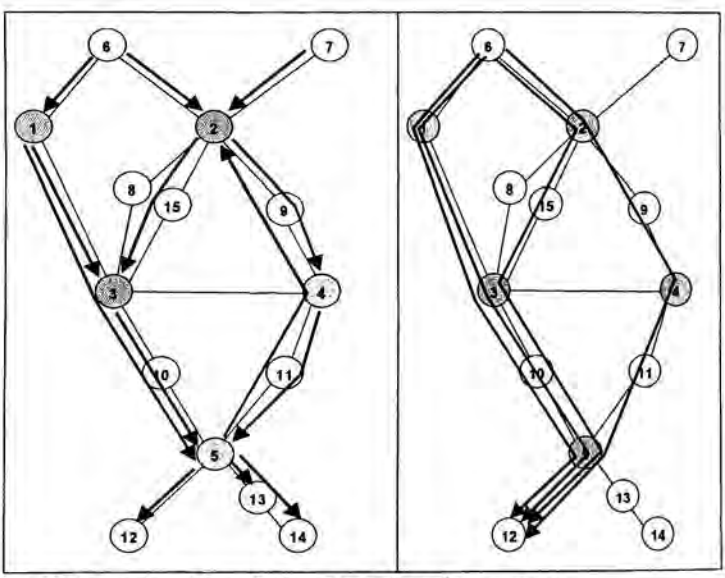


Fig 2: Example with partial routes and yard sequences

These are called partial routes, because they represent a sub-section in the routing of a car. Partial routes are defined by a concrete sequence of links, like lines in the scheduled passenger traffic. Goods trains operate on a partial route from start to destination station without scheduled stops on the way and do not change their composition on

the way. Visum Cargo can both use given partial routes (for status quo evaluations), or compute routes automatically according to different optimization criteria. Also, combinations of both are possible.

The entire run of a waggon from dispatch to the rail head at the destination is carried out (except for direct trains) as a sequence of partial routes, with shunting operations at yards in between. For a origin-destination relation, not all combinations are permitted, but only a pre-determined sequence. Several of such yard sequences may exist for a origin-destination relation. Visum Cargo can process pre-determined yard sequences, or perform an optimisation of yard sequences, or combine both possibilities. In fig. 2, apart from the partial route 2 → 3, which has of two route alternatives, all partial routes consist of exactly one route alternative. The right side shows yard sequences from node 6 to node 12.

In summary, two levels of choices exist for the transport of a waggon between origin and destination. At first, a yard sequence can be selected to connect origin and destination. Here, the yards with shunting marshalling operations are determined, however not the detailed routes. For each partial yard sequence between the marshalling yards several routing options may exist, one of which is chosen in the following. Now, the sequence of links to be used is completely determined, only the train timing has yet to follow.

Computation and Optimization

Partial route construction:

Partial routes are the potential paths of goods trains between two cargo stops. They determine the concrete traveled link sequence, similarly to line paths in scheduled passenger traffic. On the other hand the following yard sequence formation is performed without concrete link sequences. It produces only sequences of cargo stops, at which waggons are changed over.

For the selection of a partial route between two cargo stops several criteria are relevant and treated within Visum Cargo:

- Economy: A partial route should be "short" regarding a cost criterion, whereby route distance, travel time, costs or a combination of the above serve as yardstick. Partial routes result from a shortest-route search between two cargo stops, whereby the cost criterion can be selected by the user.

- Capacity: A partial route should provide sufficient capacity (= number of goods train paths). At the point in time of the partial route formation is not foreseeable, between which cargo stops large quantities will be carried. Therefore, always precautions are taken for the case that for capacity reasons part of the entire quantity cannot be carried along the most economical partial route. This may particularly occur on saturated main corridors. For all pairs of cargo stops between sub yards and marshalling yards, several alternative partial routes are computed. The user can determine that an alternative section partial route is taken into account only if its costs are not exeeding a certain factor compared to those of the most economical partial route.

- Trafficability: A partial route should be open to the use by goods trains.

The alternative route search takes place via several successively executed shortest path route searches, whereby the links already used in the preceding steps receive a penalty, in order to prefer partial routes using other links. The procedure rejects routes, which are substantially worse than the most economical route.

Yard sequence construction:
The yard sequences are determined - similarly as the partial routes - by shortest path search. In contrast to the partial routs, the shortest paths of yard sequences prime routes are looked up using the complete link network, but on the coarser network of partial yard sequences. Within the network of partial yard sequences, each pair of cargo stops is connected by a link if at least one partial route between them exists (computed in the preceeding partial route computation step, or taken from manual input).

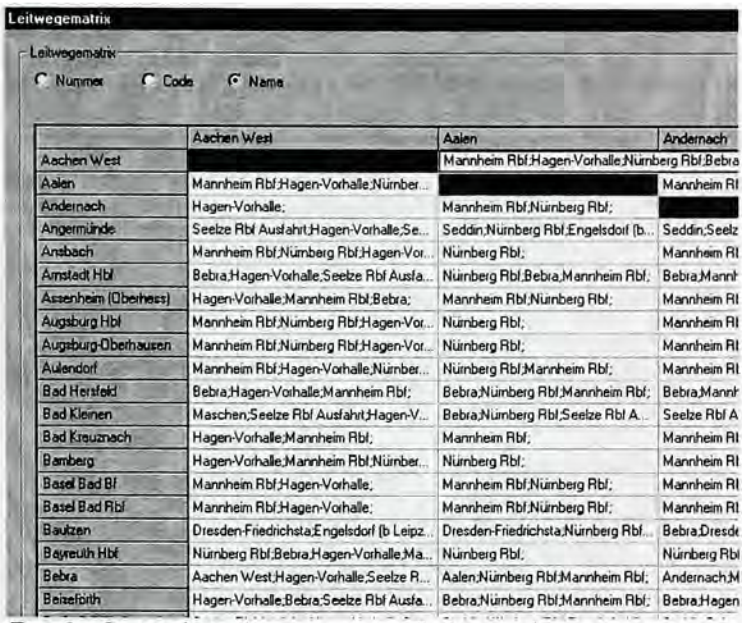


Fig 3: Screenshot showing part of the yard sequence matrix connecting sub yards and marshalling yards

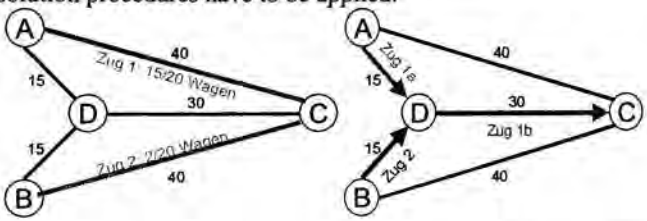
Balancing of empty waggons

The conversion of the demand into waggon loads, determines at the same time the number of incoming and outgoing waggons per waggon type and cargo stop. Imbalances between in- and outbound number of waggons occur. These have to be balanced by empty waggon runs at minimum cost. The question corresponds to a classical transportation problem per waggon type with sources, drains and costs. Visum Cargo plans with a temporal horizon of one week.

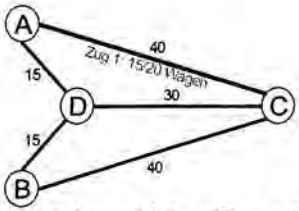
Train formation

During the train formation opposing objectives are to be brought into agreement: a) The capacity of nodes and links is limited. Staff costs and track access fees cause a jump in costs when inserting a further goods train. For these reasons timetables are favorable, which handle given transport volumes with few well charged trains. b) exploitation of bundling potentials leads to extended standing times at access points and cargo stops, and bundling potential often arises only as the result of selection of time-consuming indirect routes, such that flows can share a common partial yard sequence.

Target of an economic train formation is therefore maximal bundling of waggon loads to trains, without violating the acceptable transport time windows. To solve the task including all restrictions, extensive multi commodity flow approaches are necessary, for which heuristic solution procedures have to be applied.



a) Situation before optimisation b) Variant without bundling



c) Variant with bundling to D-C

Fig 4: Example for the bundling of waggon resources during train formation ("Zug" means train, "Wagen" means waggons)

A simplified example illustrates the effect of bundling: In figure 4 a small network is shown, in which the link inscriptions correspond to the distances. For the relation A-C, a train with capacity for 5 further waggons is scheduled. On the relation B-C 2 cars are to be carried. As yard sequences alternatively B-C or B-D-C are available. First it is checked whether on one of the two routes trains are already scheduled, to which the two waggons might be added. In the example this is not the case. Without bundling a new train has to be created, using the more economical, direct route B-C (figure 4b). However A-D-C is an admissible yard sequence from A to C, then an alternative consists by carrying both groups of waggons to D, and from there together to C (figure 4c). The advantage is the saving of the additional costs of running an extra train B-C. This is traded against the detours via D. If the savings exceed the costs of the detours, the train formation stage suggests the variant with bundling along D-C.

A substantial part of the method implemented in Visum Cargo serves the purpose estimating quickly whether a bundling attempt has at all chance for success. Out of all transport variants for a vehicle deployment, the algorithm finally selects that with minimum marginal costs. The procedure terminates, if either all vehicle deployments are processed, or if no more transport capacities exist for remaining vehicle deployments. In both cases, the resulting plan contains yard sequences with flow volumes and transport times. For each partial route, the trains operating are determined.

In the following analysis, vehicle deployments which could not be performed because of capacity limitations can be evaluated as lost demand. Likewise, transport volumes can be identified, which can be carried on a part of the yard sequence only with a train capacity usage underneath a given economic threshold.

Analysis and Assessment

The result of a planning run consists of a network with timetable and the train runs through which the goods volumes are distributed. Altogether it concerns a large, complex quantity of data. Special tools are offered for analysis, consisting of graphic visualization of loads

and similar characteristics on the network, and user-definable tabular reports.



Fig 5: Graphical analysis of the result of the planning process

Figure 5 shows a typical example of a graphic analysis, in which the link loads in tons of transport quantity per traffic system are represented. Simultaneously, the number of incoming waggons per cargo stop are shown in the columns.

Tabular analyses cover a wide span ranging from highly compressed characteristics (e.g. total train kilometers) to detail investigations of problematic individual cases (e.g. uneconomic train runs, relations with non-competitive transport times). In order to give to the user maximal liberty with the definition of its analyses, the entire calculation result is stored in a relational data base. A special assistant supports the user during the structuring of queries, whereby

the assistant uses the knowledge of the data base scheme, in order to avoid incorrectly formulated queries. In addition, experienced users can use from own evaluation programs over an ODBC interface to directly access the contents of the data base of results.

In the data base the results of planning are stored on the finest detailing level, related to individual waggon deployments and train runs. From these raw data, aggregations in spatial or temporal dimension, related to individual waggon types, traffic systems, goods classification or any combinations can be formed. The characteristics can be connected to obtain new derived measures. For example, lists of the vehicle trips with under-average cost coverage, or the relations (region to region) with particularly high detour factors (quotient driven km/crow flight km) can be produced, in order to seek out weak points in the network. Pivot analyses show the frequency distribution of such characteristics.

Conclusions and Outlook

Strategic planning models can make an important contribution towards the optimization of the production of the rail goods traffic: The quantitative evaluation of alternative becomes possible scenarios with manageable effort, despite the associated large quantities of data. The comparability necessary for investment and planning decisions is achieved. The practice-proven program packages for planning passenger traffic offer themselves as stable implementation base for such models, because they already bring along a large part of base functionality for comfortable processing of the extensive input data and for the analysis of the results. Even the new implementation of the goods traffic-specific computation methods benefits from the base algorithms and data structures which are optimized for efficiency in extensive networks.

The integration into a more open planning tool offers advantages, which go far beyond the pure technical implementation. A common network eases consistency and updating problems as well as recurring maintenance expenses. The data exchange between so far separated planning areas is simplified: the reduction of the link or line capacity

due to a base load originating from the passenger traffic is trivial, if the passenger traffic timetable is held in the same network.

Modern Transport planning tools offer beyond that the possibility of regarding road and rail traffic simultaneously within a common network model. This opens the possibility of examining complete logistics chains in combined traffic within only one planning model. Discussions with courier and express parcel companies show the potential for a fully integrated intermodal version of Visum Cargo.

Finally, the question arises whether and how the result of planning obtained in a strategic model can be used with the operational planning. The timetable suggested by Visum Cargo is not directly applicable to actual train operations, due to the inevitable simplification of link and node capacities. The solution is to transfer the planning result of ideal train paths to a timetable tool, in order to be refined there into a concrete timetable design.

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REGIONAL ELEVATOR SURVEY: GRAIN TRANSPORTATION AND CHARACTERISTICS OF GREAT PLAINS ELEVATORS

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ABSTRACT

The emergence of hub-and-spoke structures in transportation networks in recent years have impacted on most sectors of production. Local grain elevators, the subject of this paper, are a critical junction in the grain marketing system. The objective of here is to profile the transportation and industry characteristics of the elevators located in the Great Plains region of the US. The findings are based on a sample of over 2500 operators. Regional similarities and dissimilarities evidenced in this profile offer a basis for understanding the spatial impacts for agricultural and for developing future transport policy changes.

INTRODUCTION

The market for providing long distance bulk movements in North America has changed considerably over the past twenty years. In part this is due to longer term shifts in demand but it has also been influenced by new technologies, innovative management techniques, and the enhanced flexibility that regulatory reforms such as the Staggers Act in the US have initiated. Institutional changes such as the ability of railroads to more easily adjust rates to reflect costs and

to abandon non-viable short lines have been particularly important in shaping the operational changes that have occurred (Dennis, 2000; Park et al, 1999)

As with many of the network industries that have enjoyed the flexibility that more lightly regulated markets allow, the bulk grain transporters have moved towards more hub-and-spoke style of operations. This allows players to reap economies of scale, scope and density on the cost side (Rockey, 1998; MacDonald, 1989) and economies of market presence on the demand side. The result has not only been changes in the structure of the transportation linkages that are supported but there have also been impacts on the arrangement of collection and interchange points.

Local grain elevators are a critical junction in the grain logistics system. These facilities, estimated to number over 8,000, accumulate grain in quantities that make longer-distance markets economically feasible.[1] In this role, they provide various marketing, production, and crop conditioning services (Harling and Funk, 1978; Hanson et al., 1990; Wilson et al., 1984; Wright, 1965). The prices offered and investment decisions made by elevators signal trends or changes in producer-to-consumer marketing patterns.

The objective of this paper is to profile the transportation and industry characteristics of the elevators located in the Great Plains region of the US. This region is located in the main grain producing region of the US. Sub-regional similarities and dissimilarities evidenced in this profile offer a base for understanding spatial impacts of agricultural and transport policy changes.

[1]The population of 'licensed grain storage facilities' includes local grain elevators, terminal grain facilities, export facilities, and processing plants with adjacent storage. A more applicable definition of the 'local grain elevator' population may be the USDA Uniform Grain & Rice Storage Agreement participants (UGRSA). The UGRSA allows elevators to handle Commodity Credit Corporation (CCC) grain. Under the UGRSA elevators submit agreements to license individual facilities. Approximately 8,000 to 9,000 UGRSA agreements are completed each year (USDA).

ELEVATOR INDUSTRY CHARACTERISTICS

Understanding and predicting grain marketing patterns begins with a basic knowledge of industry characteristics. Some key characteristics considering in defining the elevator industry in the Great Plains are activity, size, and business structure. This information gathered in this study is aimed at providing a background for understanding variations in elevator marketing and investment decisions.

The numerical analysis is based upon a survey of grain elevator operators. Nine state elevator organizations in the US Plains region were invited to participate in the project. These organizations mailed 2,602 surveys to their members. Elevators returned a total of 518 usable responses.

The response rate from the survey of 20% offers results that are statistically valid at the 95th percentile. This level of response is satisfactory considering the length and scope of the survey. Response rates from individual states range from a high of 30% from Minnesota elevators, to a low of 13% from elevators in Texas. Responses were received from 25%, 24%, and 23% of the elevators in Colorado, North Dakota, and Montana, respectively. Response rates were slightly lower, between 21% and 18%, for Kansas, South Dakota, Nebraska, and Oklahoma.

Grain Storage and Handle

Factors such as size, non-grain merchandising activities, truck ownership, and rail access provide insight into potential impacts of local and national agricultural policy changes. Elevator 'size' is indicated by storage capacity and average annual grain handle. Average capacity for survey respondents is 2,217 thousand bushels and average handle is 4,577 thousand bushels (Figure 1).

As expected, there is a greater deviation from the mean is indicated for handle than for capacity, with the standard deviation for handle

being 12,114 thousand bushels and for storage 3,902 thousand bushels. Elevators in South Dakota report the highest annual grain handle, with an average 8,520 thousand bushels. Among states considered in the study, the lowest handle per facility is in Montana at 2,573 thousand bushels per year. Texas facilities report the highest average storage capacity, with 3,264 thousand bushels per facility. The lowest storage capacity, as with handle, is in Montana with 503,815 bushels.

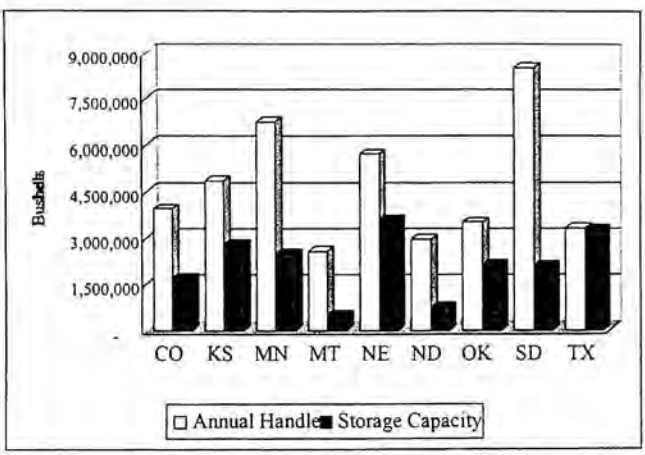


Figure 1. Elevator Handle and Capacity, Average by State

The efficiency of individual facilities within states and concentration of volume in these facilities varies. A measure of average turnover ratios (weighted by handle) among elevators in each state is provided to account for these variations. Elevators in Montana have the highest turnover among the averages, with an average of 7.8 (Table 1). The turnovers range from this high to a low of 2.2 for Nebraska elevators. Elevators in Oklahoma and Texas are second and third, turning volumes over six times each year.

Rail Access and Truck Ownership

Rail access is important in understanding grain merchandising decisions and network functions. The level of rail access infers investment in and commitment to marketing via this mode. Given its qualities of relatively high homogeneity and low product value, grain is typically most efficiently handled in bulk quantities. One-quarter of the elevators responding to the survey reported having no direct access to rail. For those facilities with access to rail, a key factor in understanding the economics in marketing decisions is the level of access.

Table 1. Individual Elevators Average Turnover Ratio, by State

State	Responses	Weighted Average for Elevators in State[1]
Colorado	28	4.8
Kansas	87	2.9
Minnesota	57	3.5
Montana	25	7.8
Nebraska	65	2.2
North Dakota	95	5.6
Oklahoma	48	6.5
South Dakota	30	4.1
Texas	55	6.2
Average		4.1

[1] Average of Individual Elevator Turnover Ratios, Weighted by Handle

The level of access is termed 'shipper size' for the purposes of this

report. The definition of shipper size is based on the track space an elevator has for spotting a delivery of rail cars. Five levels of shipper size are defined, based in the rate differentials railroads offer in public rail rate tariffs. The shipper size definitions are:
No Rail – No Rail Access
Single Car – 1 to 24 Cars
Multicar – 25 to 49 Cars
Unit Train – 50 to 99 Cars
Shuttle – 100 Cars or More.

Single car shippers form the largest component of the elevator industry, based on number of facilities, with 35% of elevators reporting ability to spot 1 to 24 rail cars. No rail facilities were second, in number, among levels of shipper size with 25%. The prevalence of multicar and unit train facilities were similar, as 14% and 15% of the facilities could spot the larger trains, respectively. Shuttle train, a relatively new level of shipper size, is available at 8% of the elevator locations.

Single car facilities are the most prominent shipper size for seven of the nine states. In the two states, Nebraska and South Dakota, no rail elevators are most common among elevators. Both these states, in contrast, have the largest percentage of facilities attributed to the shuttle type shipper, as 14% of Nebraska respondents and 15% South Dakota respondents have track space to spot delivery of 100 rail cars or more. Montana and North Dakota elevator industries have the largest investment in unit train facilities. Factors such as distance to market, rail competition, and truck capacity influence the elevator decisions to invest in rail capacity.

Non-Grain Sales and Services

Grain merchandising is not the only activity of elevators. Providing other products and services may allow an elevator to spread risk by diversifying business interests, attract and retain customers, and better manage human resources. Involvement in other activities may influence the marketing decisions of elevators. For instance, if an

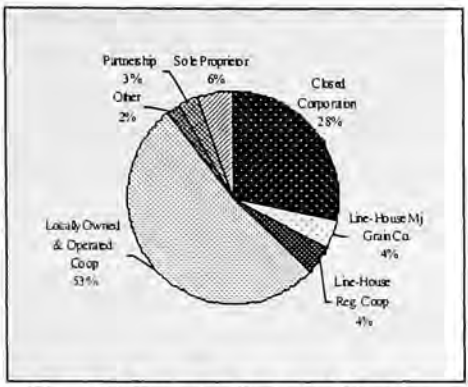


Figure 2. Elevator Business Structure

As these bushels move from field to consumer, the elevator plays a key role in the linking supply and demand. They effectively act as a buffer to smooth over short term any short term divergence between the two side of the market.

The shipment characteristics of the elevator industry are considered in two segments. The first segment is the farm-to-elevator or procurement move. The second segment is the elevator-to-user distribution. The user may be associated with processing, feeding, or exporting the raw grain product. These two segments are distinct, surrounded by unique equipment and infrastructure demands and market phenomena, yet are interrelated in their goal to move product to market in an efficient and economical manner.

Grain Procurement

With regard to the farm-to-elevator movement, elevators were asked to define the distribution of the origins for the grain they accumulate. They were also asked to describe the truck equipment farmers used for deliveries from the farm origin to the elevator. Distance and equipment are factored into producer grain delivery decisions/costs.

Elevators over half the bushels handled from within 15 miles of their

elevator (Figure 3). On average, elevator purchase a third of the grain they handle from a draw within an 8-mile radius around the elevator. Twenty-three percent is delivered from an area between 8 and 14 miles from the elevator. Approximately 16% and 12% are drawn from radii of 15 to 29 miles and 30 to 44 miles, respectively. Elevators drew 16% of the bushels they handle from a region beyond 45 miles of their facility.

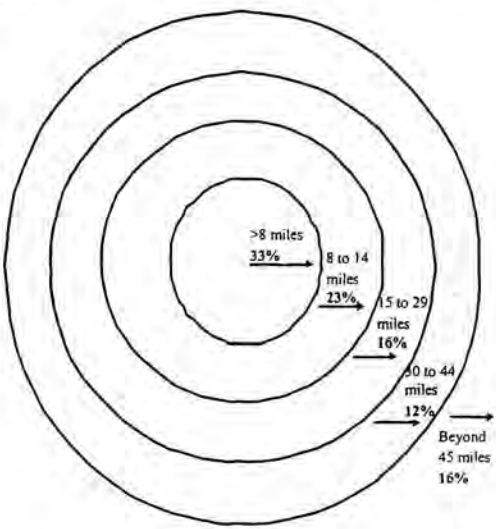


Figure 3. Distribution of Elevator Handle by Delivery

Proximity to grain handled is an important component in determining infrastructure needs and investments. To further assess this, grain drawn from within a 14-mile radius of the elevator is considered as a 'local market draw' and grain draw from beyond as a 'peripheral market.' Looking at differences in proximity to draw area across elevators, based on state, draw areas are found to be significantly different among elevator groups as the 99th percentile (Chi=35.4, α=.00) (Bowen, 1960).

More elevators in Kansas draw a majority of their bushels from the local market (within 14 miles) than elevators than other states in the survey (Table 2). For Kansas, 93% of the elevators report that they draw a majority of their grain from a 14-mile radius. Minnesota elevators also reported relatively close proximity to bushels handled, with 91% of the respondents drawing a majority from their local market area.

Table 2. Share of Elevators Drawing Majority of Grain Handle from Local Market (within a 14-Mile Radius of Elevator), by State

	Responses	50% to 100% of Grain Handle Purchased from Local Origins
Colorado	21	76%
Kansas	80	92%
Minnesota	55	91%
Montana	21	43%
Nebraska	64	83%
North Dakota	84	75%
Oklahoma	43	81%
South Dakota	34	68%
Texas	51	76%
All	453	80%

Deliveries to Montana elevators are least likely to be of distances under 15 miles, 43% of these elevators reported that they accumulated a majority of the grain they handled from origins within 14 miles. Elevators in South Dakota, North Dakota, Colorado, and Texas are more dependant on their peripheral market, drawing 68% to 76% of

the grain they handle from an area within 14-miles of their facility. Elevators in Oklahoma and Nebraska are more dependent than average, on the local draw area, with 81% and 83% of elevators drawing a majority of grain from origins within 14-miles of the elevator.

The equipment employed in inbound grain deliveries has important implications for infrastructure needs and local market patterns. The majority (54%) of the grain arrived via semi-truck and trailer (Figure 4). Tandem axle equipment accounted for 25%, of inbound grain deliveries, considering equipment. Single axle trucks are attributed 12% of the inbound bushels. Tri-axle and other equipment, such as grain carts, are used for the remainder.

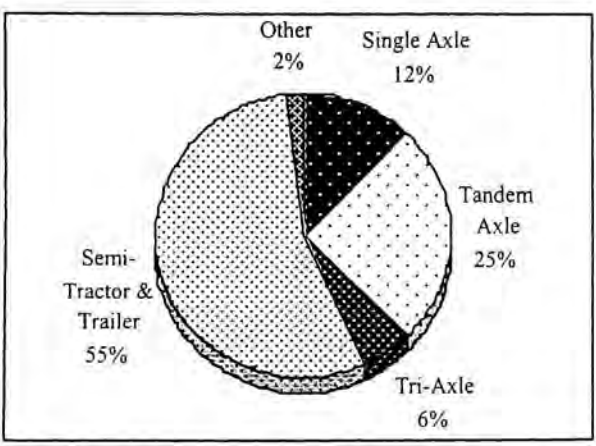


Figure 4. Composition of Equipment Employed for Grain Deliveries Made to Great Plains Elevators

Because the inbound component is important for local planning, it is useful to recognize differences within the large Great Plains region. For additional assessment of inbound grain deliveries, those respondents reporting that they receive a majority of their deliveries

via semi-truck and trailer were compared to responses reporting less than 50% of their inbound grain deliveries made via semi-truck and trailer. Variance in inbound semi-truck trailers among deliveries is statistically significantly at the 99th percentile considering state (Chi=65.56, $\propto$=.00) of recipient elevator.

Over 80% of the respondents in Colorado, Montana, and Texas reported that a majority of the grain they handled was delivered via semi-truck and trailer. In contrast, only 32%, 36%, and 41% of the elevators in Minnesota, North Dakota, and South Dakota report a majority delivered by semi-truck and trailer. The use of semi-trucks and trailer for inbound grain deliveries has important implications for the elevator industry and local infrastructure planners. Higher capacity trucks allow producers to increase the spans of the market they consider in grain delivery because of the nature of economies of bulk movement.

ELEVATOR INDUSTRY EXPECTATIONS

The elevator industry continues its metamorphosis, adjusting to changes in the agricultural production and consumer sectors. As local and national policies are assessed and investment are considered, insight into the future of the industry may allow decision makers to be proactive in addressing the needs of the industry and those affected by it. Elevator opinions toward the grain industry logistics issues were assessed using a Liquert Scale (Figure 5).

Elevators rate the merger of grain companies as the most important industry issue with 4.4 on a five point scale. Approximately 77% of the respondents felt this issue was more important (rated 4 or 5). Second in importance to elevators is future government policy, with an average rating of 4.2, received the greatest proportion ratings of 4 and 5. Next in importance is the access to market information. This issue, too may be attributed to some degree to government as government has an important role in collecting and disseminating

much of the publicly available grain market information.

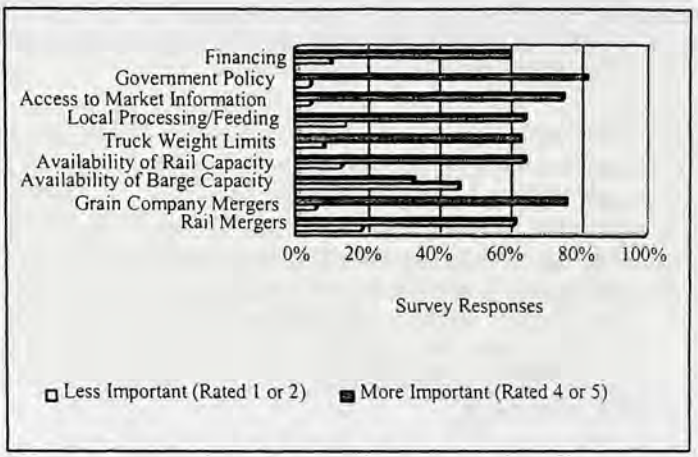


Figure 5. Distribution of Elevator Rating by Industry Issues

Several issues are rated between of average importance. Truck weight limits and financing are among the issues, both rated 3.8. Local processing/feeding, rail capacity, and rail mergers received similar average ratings of 3.7, 3.7 and 3.6, respectively. The mid-range ratings of these issues may be attributed to the variation in individual elevator characteristics and market environments that are more or less impacted. The least important issue was seen to be barge capacity. A majority of respondents rated this issue as less important by indicating an importance of 1 or 2 on the 5 point scale.

CONCLUSIONS

Whilst much emphasis in traditional transportation analysis was put on analyzing the links in the transportation system, modern logistical thinking attaches as much importance to interchange and terminal points. Local grain elevators are a critical junction in the bulk grain

marketing system. The objective of this study has been to profile the transportation and industry characteristics of the elevators in the Great Plains region of the US. An efficient and effective transportation system is crucial in the competitive position of elevators seeking to succeed in a global market. Knowledge of this industry and how it fits into the larger supply chain is important for public policy making.

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Improving Container Availability for Pulse Growers in Saskatchewan: A Pilot Study

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1) Introduction

Overseas marketing for specialized agriculture in Saskatchewan has been hampered in recent years by inconsistent supply of transportation capacity. This has been especially true with respect to containers. The Saskatchewan Container Pilot project was conceived as a plan to move a greater number of inter-modal containers through the province to address this problem. The stakeholders agreed that a coordinated plan is necessary in order to meet what is perceived by many interests as a fast-growing demand for container services within several Saskatchewan industries.

In this study, we examine the following question: Is there enough demand for containers among specialized crop producers, livestock processors and short-line manufacturers such that a coordinated, inter-modal transportation solution within the province would make it profitable for a railway to divert empty containers into Saskatchewan for source loading?

Essentially, the feasibility of such a project hinges on matching container demand with container supply. Due to logistics concerns and certain transportation restrictions, the supply chain for containers is complex. The first sections of the study provide a breakdown and analysis of the container supply chain. We focus on assessing the current structure of container markets, future container line trends and current line routings. In addition, a marketing survey was conducted among major ocean shipping lines, yielding detailed information on ports-of-call, comparisons of transit days to various overseas markets from both Montreal and Vancouver, and operational characteristics with respect to container movement. The information indicated that several major ocean shippers are interested in moving containers

filled with goods produced in Saskatchewan destined for overseas markets.

Using the best available information combined with more survey information, in the next portions of the study we compute an estimate of the total demand for containers in Saskatchewan. The demand forecast included the various industries in the province interested in obtaining increased and more reliable container supply, including agriculture (pulses, meats, organic) and machinery.

Total new container demand from Saskatchewan averaged around 1000 (TEU's) per month, with considerably higher demand (roughly double) in the peak periods of October, November and December. Data from the railway showed that at present, there are sufficient numbers of containers passing near the province that could be diverted to meet this demand.

By providing pertinent information about a steady supply of compatible containers for export shipments, the pilot project will greatly benefit the many smaller Saskatchewan shippers in a variety of industries who because of their size have previously been unable to obtain containers when and where they needed them.

To reiterate, the Saskatchewan Container Pilot project was conceived as a plan to move more inter-modal containers through the province to meet what was perceived by stakeholders as a growing demand for container services in several industries, including specialized agriculture. The pilot project was developed as a result of dialogue between Saskatchewan Agrivision Corporation Inc. (SAC Inc.), a major Canadian railway, the Yanke Group of Companies and the Container Port of Saskatchewan.

For a variety of reasons, the marketing of specialized crops has been hampered in recent years by inconsistent transportation capacity, especially for containers. In response to this problem, the logistics division of the railway offered that it was possible for them to increase the number of empty containers moved into Saskatchewan

by diverting them from their present route south of the province. From a cost perspective, the railway needed assurances that enough cargo could be marshalled together on a consistent basis to at least cover the cost of this container diversion. Could enough interest among specialized crop producers, livestock processors and short-line manufacturers be harnessed and coordinated to make it profitable for the railway to divert these empty containers so that they could be source-loaded in the province before being moved on to port? The following study presents a series of facts and interpretation in order to help answer this question.

1.1) Background and Potential Goals

The difficulty in obtaining timely access and availability for container placements in Saskatchewan is an emerging roadblock to agri-value processors shipping to offshore markets. As the agri-value sector rapidly expands across Saskatchewan, and as the quality requirements for identity preservation (IP) grow, the demand for inter-modal and rail containers will continue to increase.

One advantage of this pilot project is that the infrastructure for the expanded use of inter-modal and marine containers within Saskatchewan is already in place. There are established transportation protocols with several major shipping lines out of the Port of Vancouver and the Port of Montreal dealing with the movement of loaded marine and domestic containers to the Toronto, Montreal and Chicago markets.

Opportunity lies in the fact that many of the containers moving back to the Ports of Vancouver and Montreal are passing through this province empty, a movement referred to in the industry as an empty backhaul. Steamship lines have been reluctant to divert empty containers passing near or through Saskatchewan for the movement of relatively low value commodities, if diversion means the containers are out of circulation for a period of time.

Currently, Saskatchewan accounts for four times the volume of special crop (pulse, organic, herb & spice) shipments of either

Alberta or Manitoba. At present, there are other shipping options by boxcar or bulk to the port for re-stuffing containers or bagging and stuffing at the ports. However, this practice does not extract the highest value to producers in this province, or create jobs in the province or provide the "Identity Preserved" (IP) quality assurance from source loading.

Pulse crop industry output is expected to double in the next five years from 4.5 million acres to 8 to 9 million acres of production. The majority of this will be shipped into the food export markets. Saskatchewan is home to 70% of Western Canada's certified organic foods industry, which accounted for approximately 750,000 acres in 2000. This sector is growing at a rate of 20% per year. Almost all of the food grade organic produce will move by container (including so-called "reefer" containers) in the near future. Source loading with an "identity preserved" quality assurance guarantee will be increasingly critical for the organic and red meat sectors as well as the pulse industry.

This feasibility study creates a demand forecast for containers and will help design the pilot project. Further, the pilot project reported on the following issues;

- Costs of expanded use of containers compared to the current system
- Transportation logistics and communications system requirements for Saskatchewan
- Viability of container rail loading points in key locations across the province
- Peak shipping periods of each of the main sectors, pulse, red meat, organic and short-line manufacturers
- Recommendations for further modifications to enhance the availability and coordination of containers by better understanding customer demands and requirements. These requirements will be moved back down the transportation and logistics system to the agri-value processor.

2) The Structure of Container Markets

This section provides an overview of the container line markets that service the important lanes between the Port of Vancouver and Asia and from Port of Montreal to Europe, the Middle East and South America. Container lines were also surveyed and results obtained concerning attitudes towards the pilot project concept. In addition, the study evaluated present communications/booking protocols with these lines. We also established those areas of communication that could be improved between container lines and container users in the province.

2.1) An Overview of the Container Liner Market

The container line shipping industry is undergoing a period of increased concentration as world-trading patterns emerge. The top 20 liner companies control 76% of the world's containerships (Journal of Commerce). Shipping companies are building larger vessels capable of carrying greater than 6,000 total equivalent containers (TEU's). Due to the integration of vessel trade corridors with terminals and the port's capability to load/offload containers, there has been increased emphasis placed on reducing the number of ports of call for each ship.

A recent study by Drewry Shipping Consultants (1998) found huge trade imbalances worldwide with respect to the movement of 38 million TEU's of empty containers. Some of the major trade imbalances were found in the movement of goods within the following corridors:

1. Eastbound -from Asia to North America.
2. Westbound -Asia to North EEC
3. Westbound- North EEC to North America.

Due to these imbalances and tight competitive conditions, the industry is especially subject to cyclical price shifts. Higher rates are prevalent when the total cargo to be moved exceeds vessel capacity in the trade corridor. Current plans for increasing capacity with the use of larger ships will increase pressure to reduce the number of ports of call between servicing of market trade areas.

In 1999, North America received over 3 million more TEU's from overseas than it originated as export shipments. It is estimated that 28% of the containers bound for South-Central America and Mideast-Africa are empty. Other sources indicate that empty shipments represent 42% of all shipments from North America back to Asia. (Journal of Commerce)

The vertical integration of shipping lines in multi-modal freight markets is a trend to watch as liner companies expand to achieve operational efficiencies. Some lines, in association with terminals, rail lines, freight forwarders, trucks and e-commerce providers are offering more value added services in order to reduce supply chain costs and increase the velocity of shipments. Heaver (2001) also found those markets serviced by smaller shippers are used by freight forwarders to arrange their shipping services. In his report, he concludes that these trends will increase in selected regions where proper economic circumstances prevail.

Like most other transportation industries, shipping lines are improving their information technology (IT) to enhance operational capabilities. This in turn improves the quality and reliability of their logistics services. In the context of this study, Saskatchewan producers using container lines in the future may be limited in their choice of carriers and ports to export goods to particular markets as carriers rationalize the ports of call between trade routes. At present, most shipments of containers from Saskatchewan to Asia and South America use Vancouver and shipments to the EEC Mideast-Africa market use Montreal.

3) Estimating Future Container Demand within Saskatchewan

This portion of the study targeted essential trade corridors for Agri-value (AG) products. We focused predominantly on trade with countries in Asia (North, South and Southeast Asia) and those South American regions that can be serviced by container lines operating from the Port of Vancouver. In addition, we considered those

movements served traditionally by the Port of Montreal, the affiliated markets in Europe and the Middle East.

We collected data on current agricultural shipments from Canada to countries in this region over a two-year period. We then estimated the proportion of shipments originating within Saskatchewan. We relied on information provided by the Saskatchewan Pulse Growers Association, the organic sector, special crops, the red meat industry and short-line manufacturers.

Finally, we estimated the number of potential current and future container loads from Canada to these markets by the AG sector for a two-year period. This included estimated future container growth from regions within Saskatchewan to help identify the likely container flows.

At present, there are three inter-modal transportation yards in Saskatchewan, contained in the cities of Saskatoon and Regina. With increased demand for containers and a need to minimize drayage costs, we analyzed the feasability of locating other inter-modal terminals in places like Unity, Swift Current or Moose Jaw. In particular, we postulated that yards at these locations would reduce the distance required to place agricultural containers on rail cars and could also help minimize existing congestion at yards.

In assessing the demand for containers by sector, many producers in the pulse, pork, machinery and organic sectors were surveyed and some of the considerations from both surveyed material and discussions with industry were taken into account to determine future forecasts.

3.1) Final Estimated Container Demand

By determining the current demand and trade routes for Saskatchewan based shipments, we evaluated and allocated future shipments based upon:

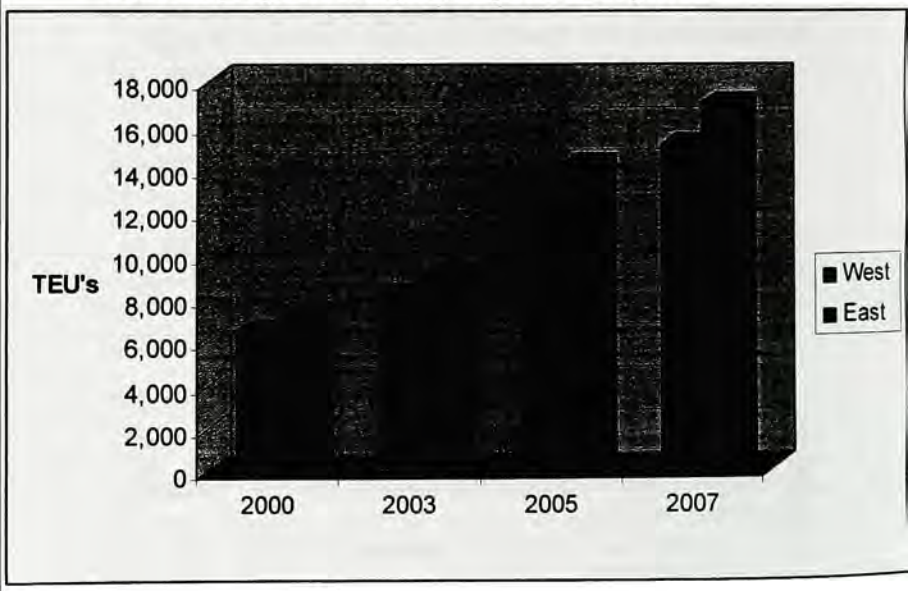
- Phone interviews with the pulse, machinery and pork associations

- Percentages of current markets that are currently serviced.

There are regulatory policies and trade barriers which will ultimately determine the future trade flows of agriculture products. As such, this forecast is to be used as a basis for a "What If?" scenario. In fact, Saskatchewan has attained many of the market changes that we have assumed for livestock, pulse and other sectors.

We found that the greatest growth for source loading is for the pulse sector. In turn, this will increase the demand for source loading of containers. The market growth we estimate would be roughly double the current demand, possibly achieved by 2005. With increased demand, the need to work on communications, forecasting and logistics systems to improve the timely availability of containers will become increasingly important.

Chart 1. Forecasted Source Loadings, Saskatchewan Container Pulse Crops by Port of Export, Projected to the year 2007.



4) Rail Data Regarding Availability of Empty Containers
In order to assess the impact of available empty containers on the pilot project, the railway provided information to us about the potential supply of empty containers that presently leave western Canada and Saskatchewan back to the ports. In sum, the total empties available positioned and loaded, in a one-year period were 6,300 units, comprising 4,300 - 20 foot and 2,000 - 40-foot units.

Table 1. Current empty rail-based containers in Saskatchewan (for the major railway)

Current Empties Through Saskatchewan			
	20'	40'	TOTAL
EMPTIES FROM EASTERN TO WEST	2,626	7,390	10,016
EMPTIES FROM USA TO WEST	1,783	4,538	6,321
Total	4,409	11,928	16,337
Total by Month	367	994	1,361

5) Potential Barriers for the Pilot Project: Rail and Road Access
Pulse producers located on secondary roads can only ship 21 metric tonnes in a container and cannot use domestic intermodal equipment, which would allow a higher loading of 27 metric tonnes per container to the port. Our study of locations indicated that most pulse processors are not located on mainline rail. The majority of these processors are located on grain dependent branchlines. At the present time, it is unclear how many of these lines will remain over the time horizon discussed for the pilot.

5.1) Locational Assessment of Processors
We evaluated pulse processor locations by assessing their proximity to Saskatoon, Regina, Unity and Swift Current. In turn, we computed the number of processor sites within 0 to 300 kilometres of each city. The following table shows the breakdown of locations within 0-100, 101-200 and 201 to 300 km.

Table 2. Number of Pulse Plants Within X km of towns

	0-100 km	101-200 km	201-300 km
SASKATOON	57	54	19
REGINA	28	24	61
UNITY	12	35	21
SWIFT CURRENT	15	33	45

There are more locations clustered around Saskatoon and Regina. Using 130 sites as a basis, a three-hour drive from Saskatoon provides the most coverage at 100%, compared to Regina at 87%, Unity at 37% and Swift Current at 72%. Saskatoon minimizes the time traveled to inter-modal sites and therefore reduces drayage costs.

We also estimated the total trucking tonne miles generated by pulse industry deliveries across the province. The following list shows these results.

Site Location	Total tonne-Miles(millions)
Saskatoon	547
Regina	519
Moose Jaw	506
Swift Current	582
Unity	723

Assuming that there is only one inter-modal delivery location within the province, our analysis showed that Moose Jaw yields the least trucking tonne-miles generated. The question of building additional container yards within the province was beyond the scope of this project. Clearly, there are too many other issues that cannot be addressed here that would influence the decision to build alternative sites.

6) Current Logistics Practices and Communication Systems between Container Lines and Saskatchewan Companies

The study also evaluated current logistics practices of value added AG producers who supply markets from the Ports of Vancouver and Montreal. We sent out surveys to various industry representatives. We sought to evaluate their present trade practices, mode of transport, location and arrangements in booking freight with container lines. We also surveyed their current practices in using e-commerce with carriers to book containers, trace or produce bill of lading systems with carriers.

For instance, pulse processors may have more than one option to supply other than direct containers. Organic processors may be restricted to containers due to customer preferences about identity preservation (IP). Beef, pork and poultry producers may ship by truck rather than by container. The survey results continually emphasized the importance of timing in supply; from contacting suppliers to fulfilling orders with container companies through to tracing the product through the supply chain. A summary of these results are available upon request.

7) Evaluating the Overall Feasibility of the Pilot Project

Consider these important facts concerning feasibility, uncovered by this research. First, present demand for source loading of all containers today is at 500 to 1,500 per month, whereas a conservative demand estimate for future containers is projected to be double or triple this amount. Second, container demand to the East Coast has traditionally been greater than to the West Coast. However the West Coast has seen rapid increases in recent years. Finally, the major railway was able to identify 4,400 empty containers (20') that traversed the province last year. This equates to 367 per month on average. There are also 11,000 (40') that also travel through the province empty.

Therefore, we find that there will be more than adequate demand within the province to meet the projected supply of empty containers to load. Finance and the willingness of all participants to improve

dialogue and follow structured protocols to communicate their needs and coordinate their business processes with e-commerce and contract agreements will determine the final outcome of the project.

8) Conclusion

The information system required to run a pilot project of this scope, with many diverse participants, will be a major undertaking in terms of time and human resources. What needs to be created is an information system that shares all the necessary facts, such as booking details, container availability, drayage requirements, etc. Under the auspices of the pilot project, this would represent a vast improvement from current practices. We found that the current system of ensuring empty container availability is characterized by mismanagement, mistrust and a general lack of information sharing. The pilot project as described here will attempt to address many of these issues in a proactive and open manner.

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Establishing a Kyoto Benchmark for Heavy Truck Fuel Consumption in Manitoba

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1. Introduction

This paper develops and applies a methodology to extrapolate emission levels from transportation systems where there are no direct measurements. Concentration of the study is on trucks on the Manitoban Trans-Canada highway in the Kyoto benchmark year. The particular scope has been limited to heavy weight, diesel trucks operating on the Manitoba portion of the Trans-Canada highway.

Analysis considers two major trend variations related to truck characteristics. These include technological changes with time, as well as how fleet composition and gross vehicle weight vary and thus affect fuel consumption.

Background

In 1997, over 170 countries gathered in Kyoto, Japan to discuss the human contribution to climate change as well as future ramifications. The proceedings produced a protocol with responsibilities issued in two forms. Developing countries were given "differential responsibilities" such that they consider and reduce actions detrimental to the environment in order to minimise climate changes. Industrialised countries, however, are to be bound legally to reduce greenhouse emissions to a certain benchmark value (1). This second grouping includes Canada.

Approach and Data in Estimating Greenhouse Gas Emissions

The approach in estimating emissions caused by heavy trucks is to define the relevant parameters. The five variables of particular interest are: the total travel made during the 1990 period, truck classes, trucks weights, the fuel consumption rates of the trucks studied, as well as a factor relating the combustion of diesel fuel to its mass of emitted gas. Other parameters to consider are generally associated with truck travel characteristics. The conditions defined for analysis in this paper normalises the data in terms of these latter attributes. Once the five major parameters have been isolated, they can be directly applied to determine the total number of tonnes of pollution produced by this particular scenario.

The data sources in this paper are either Canadian or from the United States. These sources include relationships and values from the DOT (Department of Transportation), NRCan (Natural Resources Canada), the Protrucker Competition, DriveSave/TruckSave Competition, StatsCan, and the University of Manitoba.

A simple schematic, Figure 1, shows the progression and variables essential to estimate emissions from the transportation sector.

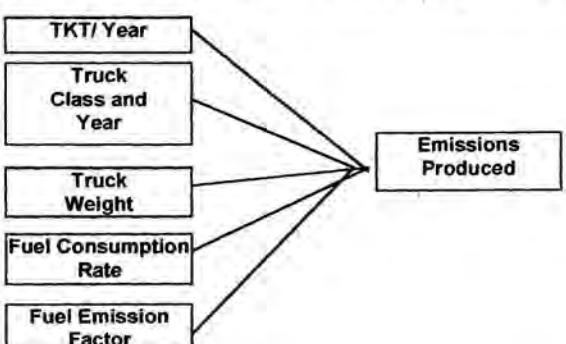


FIGURE 1: STEPS TO DETERMINE EMISSIONS FROM THE TRANSPORTATION SECTOR

2. Outline of a Methodology for Estimating Benchmark Emissions

Detailing the Benchmark of Interest to the Research

The specific case analysed focuses on truck travel in Manitoba, on the Trans-Canada highway. This choice was made so that idling, and start-stop driving would not need be considered. The vehicles chosen are heavy, diesel trucks; more specifically: 3-S2s, 3-S3s, 8-axle B-trains and 7-axle A-trains. In Manitoba, the market for this travel is high; in fact roughly 25 per cent of heavy truck traffic in Manitoba is on the Trans-Canada highway (14). Thus, this paper represents real emissions, and a real situation to target for improvement.

Developing the Methodology

To develop a quantitative representation of emissions produced by the transportation sector, the link between the activity of the sector and the actual emissions produced must be illustrated. There generally is not only a correlation between activity and emissions, but also, between the type of vehicle as well as the terrain and manoeuvring employed. The methodology has been constructed using the parameters set in the previous section: namely, a fuel consumption rate, vehicle type and weight, the TKT/year and a fuel-emission factor.

Travel Conditions

Travel has been considered solely on the Trans-Canada highway, which has enabled the identification of travel attributes. These characteristics include travel speed, distance travelled, number of stops, as well as accelerations/decelerations induced by grade variations. As the length of travel across Manitoba is so substantial, it can be assumed that stops (i.e. weigh-in, gas stops, overnight stops, etc.) are negligible with respect to the magnitude of the entire trip. Speed can thus be estimated to be constant, and is approximated to 100 km/hour.

Truck Characteristics

The truck types considered are heavy trucks, using diesel fuel. Having certain classes of vehicles helps to find reasonable values,

representative of actual consumption. Also, narrowing the field of consideration assists in creating true-to-life values, as opposed to averages, which may or may not be representative of the entire data set. Based on these truck categories, estimates on fuel consumption were approximated. Values of these estimates were in terms of kilometres of travel per litre of fuel consumed (km/L). Data accrued was generally found in two forms: a direct value, or as a polynomial equation using gross vehicle weight (GVW) as the prime variable. When comparing the various data using the polynomial form, GVW was approximated to be 70 000 lbs, or 31.8 metric tonnes. This GVW for some of the value representations was the number to which fuel consumption was calibrated, allowing more of the data to be compared.

TKT/Year

As important in approximating the fuel consumption of the vehicles under examination, is finding the distance travelled in relation to this consumption. Finding the TKT/Year, or the total kilometres of travel on the Trans-Canada highway can be accomplished. Not only is the total traffic monitored, but the breakdown by vehicle type as well. The UMTIG database has values representative of heavy truck traffic on the Trans-Canada highway between the years 1995 and 1999. Extrapolating the data to 1990 values requires the development of a certain correlation or growth rate. This method of finding the benchmark TKT/Year is more accurate, as the technology and information systems are much more developed today than in past years.

Fuel Consumption Rate

The findings from studying fuel consumption rates were expected to outline a range of reasonable values. Many factors make it difficult to estimate a fuel consumption rate that is representative of an entire fleet. This is due, mostly, to the variability of a particular trip as well as the variability in the reporting data. A large trucking company, with a highly developed logistics system and trained drivers may exceed the fuel efficiency of similar trucks owned and run by a different company. There will always be problems associated with

reporting fuel consumption rates for large trucks. This is simply due to the inherent problems encountered when dealing with such a large number of variables. However, since the case scenario of this paper is specific, choosing a fuel consumption rate relationship developed under a similar scope is expected to provide reasonable results. The chosen relationship can then be modelled to the case scenario as needed. The principal parameters to model a fuel consumption rate for the purpose of this paper are the effects over time and the effects due to weight. The trends associated with fuel consumption include the following:

- Fuel efficiency decreases with increasing truck weight
- Fuel efficiency improves over time with truck improvements; and
- Truck fleets, with time, have a proportionally higher percentage of larger trucks

Fuel-Emission Factor

A final requirement in finding a value for emission production is a method to relate heavy truck use in Manitoba to greenhouse gas emissions. The chosen approach for this is to determine a factor describing the number of grams of pollution produced per litre of diesel utilised. Diesel fuel is burned by combustion, and no matter the rate, so long as no fuel leaves the engine without being transformed into energy it will release the gases in question. So, employing a same factor to all studied trucks is indicative of the commonality of the fuel and not the trucks themselves.

3. Populating the Methodology and Estimating the 1990 Benchmark

TKT/Year

The TKT/Year or the truck-kilometres of travel, estimates the total travel of trucks in a given year. This value is a major parameter in estimating the mass of greenhouse gases produced by the transportation sector. The UMTIG database at the University of Manitoba has data on truck traffic reported by control segment between the years 1995 and 1999. This data is available across the

province, as well as on PTH 1 or the Manitoba portion of the Trans-Canada Highway.

To calculate the TKT/Year, a variable known as the AADTT is also required. This variable, the average annual daily traffic for trucks, indicates the volume of traffic on a particular section of highway on a given day. The UMTIG database is thus responsible for supplying the AADTT for each control-segment along the Trans-Canada highway. There are 85 control sections along PTH 1 in Manitoba, accounting for 524 km of highway. Each of these sections has a related AADTT value. To determine the TKT/Year, each AADTT value is multiplied by its section length and then by the number of days in a year. These sections can then be added to generate the average daily truck travel in Manitoba in a given year.
More explicitly this process appears as follows:

$$TKT/year = \sum 365 \times AADTT \times Section\ Length$$

The data used for actual calculations was along the entire Trans-Canada highway, including highway 100, or the south perimeter around the city of Winnipeg. Omitted from consideration are highways 1A near Brandon and Portage La Prairie. A summary is presented below in Figure 2 showing the total TKT/year values for the years aforementioned.

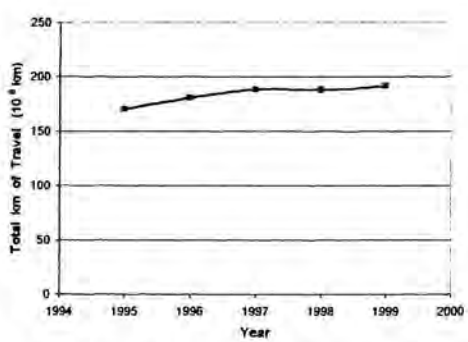


FIGURE 2: CALCULATED TKT/YEAR ON PTH 1 (14)

Data to calculate the TKT/year for the benchmark year is not present. A means for estimating the value for the year in question requires data from a source experiencing similar conditions to extrapolate from the 1995 to 1999 data. Plotting the UMTIG data alongside its corresponding United States, Department of Transportation data shows similar variations. The emphasis again is to reflect appropriate variation in the data, not comparable actual values. This plot can be seen in Figure 3.

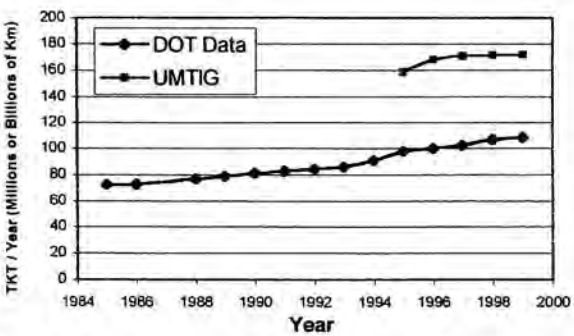


FIGURE 3: TKT/YEAR COMPARISON OF CANADA (MILLIONS OF KM) AND THE UNITED STATES (BILLIONS OF KM) (14 & 15)

In Figure 3, (above) Canadian TKT/year values are presented in millions of kilometres and the American data is in billions of kilometres. Though the values are quite different, quick inspection indicates that the fashion by which they differ is in fact quite similar. It can therefore be construed reasonable to apply the measured variation of the American data to its Canadian counterpart. This variation is 3.3 per cent per year. When this growth factor is applied to the UMTIG data, the final TKT/year for the benchmark year is: 135.6 million kilometres.

Estimating the 1990 Fleet Mix

The data gathered to develop the 1990 fleet mix was acquired from the Headingly control section. Using this data characterises the vehicles

passing through the Manitoba portion of the Trans-Canada highway. Considering that gross vehicle weight, or GVW is a principal characteristic in fuel consumption rates, vehicle classification interprets the efficiency of the truck traffic through the province. From above, it is seen that in the year 1990, the vast majority of trucks travelling across the Trans-Canada were smaller, 5 axle trucks. Though, these trucks have greater fuel economies than the larger trucks, a certain quantity of goods, provided good logistics are in place, would be transported the most efficiently using larger trucks. It will be consideration of these combinations, which will permit Canada to comply with the Kyoto protocol.

Apart from simply designating the types of vehicles travelling across the Trans-Canada highway, it is also important to describe the loadings of these trucks. Depending on the freight being transported or the quantity of freight being transported, the actual weight of a truck can be substantially different than its load capacity. Table 1, below, presents average a fleet description and respective GVW values for the trucks in consideration.

TABLE 1: BREAKDOWN OF THE 1990 MANITOBA FLEET AS ESTIMATED AT THE HEADINGLY CONTROL SEGMENT

Truck Type	Percentage Recorded at Headingley	Average Recorded Weight
3-S2	80	31
3-S3	10	40
7-axle	7	50
8-axle	3	55

Upon consideration of the fleet mix and the GVW makeup along the Trans-Canada highway in Manitoba, an average truck size was estimated. This estimate is in metric tonnes and is equal to 34.3.

Estimating Average Fuel Consumption Rates and Total Consumption

A fuel consumption rate aids in determining the quantity of greenhouse gas production by relating the distance travelled by a

vehicle on a single unit of fuel. The units considered for the application discussed in this paper are km/L. The final resultant value is, for illustration purposes, also expressed in miles per American gallon.

To develop a fuel consumption rate relevant to this paper, various external approximations were considered. These include values taken from the American Department of Transportation, the MT Handbook, DriveSave/TruckSave, Protrucker, NRCan, Canadian Averages (taken from Stats Can), and from a study conducted at the University of Manitoba. A short description of each of the above data sources will follow, demonstrating why they are, or in most cases are not relevant to the case scenario of this paper. These relationships have been plotted below in Figure 4. In most cases the range of data plotted is greater than the actual data available. Descriptions regarding this latter statement will also be further discussed.

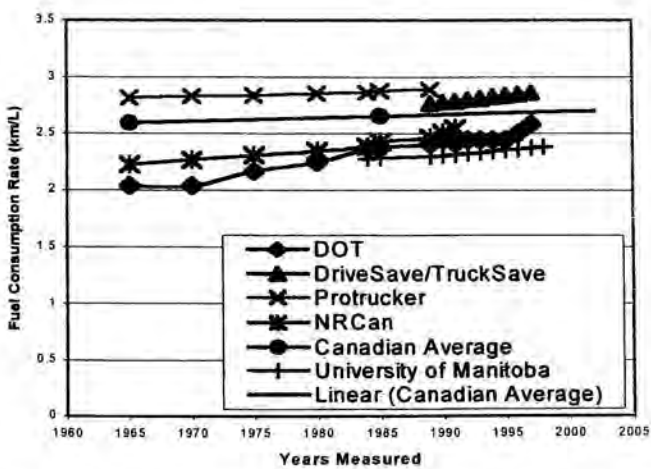


FIGURE 4: FUEL CONSUMPTION APPROXIMATIONS FROM VARIOUS AVAILABLE DATA SOURCES

Protrucker

The highest data range in terms of greatest fuel consumption rates is the Protrucker relationships. The relationship was established by means of a competition held annually between 1989 and 1995. This event required truck participants to drive between Headingly and Brandon a total of four times. The best fuel performance was then recorded for each driver. This latter statement partly explains the fuel economy achieved. Other contributors include the type of terrain, the type of highway, and the age of the participating fleet. All of these characteristics require relatively small effort on behalf of the vehicles or simply that the represented vehicles are of higher calibre. Based on the nature of the raw data, therefore, it is not considered representative of the general fleet travelling through Manitoba. Rather, this could be conceived to be an indication of a best-case scenario.

DriveSave/TruckSave

The next relationship, DriveSave/TruckSave, was developed in a similar manner as the Protrucker relationship. The competition in this case, however, was held in Ontario. Considering Ontario has a more rigorous terrain for vehicles to negotiate, its lower values were anticipated. This drop in performance is still generally minor, and therefore the relationship not a good representation of Manitoba conditions. The actual data available was for the year 1989 only. Years plotted beyond this value were approximated using a fuel efficiency improvement factor developed by Canada's transportation table. This factor is 0.42 per cent per year (12).

NRCan and Transportation Table

Following these two relationships are two separate averages for Canadian heavy truck travel. These two were obtained from NRCan and, the national average, from data presented for the Transportation table. The issues presented with these two approximations are their categorisation of heavy trucks. These two sources label trucks as being heavy trucks at roughly 10, 000 lb. This paper, however, considers heavy trucks to be upwards of 60, 000 lb. As argued previously, larger truck sizes imply smaller fuel consumption rates. Thus, these values are also not indicative of the scope of this paper.

Available data for the NRCan relationship is for the years 1995, 1996 and 1997. The average change between these three years is 0.4 per cent per year. This value is comparable to that estimated by the Transportation Table, and thus it was applied to the years plotted before and after the available points. There were two fuel consumption values presented by the Transportation table, in 1990 and 1995. These two points were connected linearly to demonstrate a possible pathway for the increase in fuel consumption performance.

DOT

Data from the DOT, or Department of Transportation, records properties related to travel and fuel consumption for registered trucks in the United States. Considering the range of years for which values are available is so extensive, this data provides a good indication of the trends related to fuel consumption, as shown in Figure 5. Measured change from this data is an improvement of 0.5 per cent per year.

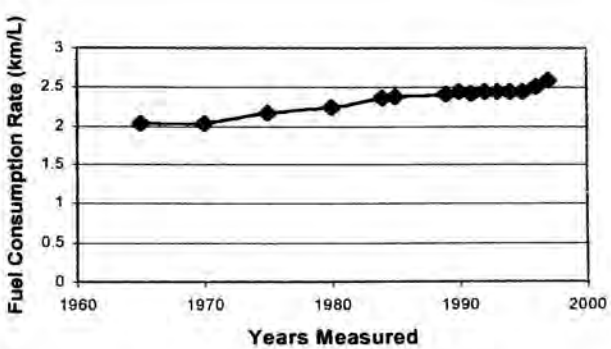


FIGURE 5: FUEL CONSUMPTION RATES AS ESTIMATED BY THE DOT (15)

University of Manitoba

The relationship developed at the University of Manitoba is in fact a spring/fall reflection of fuel consumption rates recorded in Manitoba in the year 1984. Considering that data collected in the United States

is generally more extensive and more inclusive, modifying the 1984 approximation is accomplished with American growth rates. Furthermore, as was shown in the TKT/year calculations, American fluctuations are quite comparable to those experienced in Canada.

The Manitoba developed fuel consumption relationship from 1984 is as follows:

$$Km/L = 2.65 - 0.0207GVW \quad (16)$$

Applying the 0.5 per cent per year growth rate for the six year interval between 1984 and 1996 to each coefficient in the equation results in the following form:

$$Km/L = 2.73 - 0.0213GVW$$

To now find an approximated value for heavy trucks in Manitoba, the only remaining variable is gross vehicle weight, GVW. This however was previously illustrated, the approximated value being 34.3 tonnes. Applying this value results in a representative fuel consumption rate of 2.0 kilometres per litre or 4.84 miles per American gallon.

Estimating a Fuel-Emission Factor

To find the direct emissions from the transportation sector, it is essential to relate the quantity of fuel utilised to the mass of emissions omitted. If the assumption is made that fuel in North America is fairly standardised, its combustion should be comparable throughout the continent. Thus, for each litre the number of direct grams produced should be the same. A value for this reaction is 2.764 g/L (10). This value reflects an amalgamation of all three greenhouse gases produced. Application of the factor would represent the sum of emissions as CO_2 equivalents.

Estimating Related Emissions

To determine the total direct emissions from heavy truck travel in Manitoba requires multiplication of the three major parameters. These three are again, the TKT/Year, the fuel consumption rate and a fuel-emission factor.

To illustrate this application, the parameters by their units are multiplied below:

Tonnes of GHG = (km) × (L/ km) × (g/L)

Applying the developed parameters results in a total emission toll for the year 1990 of:

Tonnes of GHG = (135.6) × (0.5) × (2.764)

Tonnes of GHG = 143.6 tonnes.

In summary, emissions produced solely by heavy trucks in 1990, on PTH 1 in Manitoba was 143.6 tonnes of CO_2 and CO_2 equivalents.

4. Discussion, Observations and Concluding Remarks

Discussion and Progress towards Related Kyoto Commitment

Applying the parameters as established by the methodology of this paper to the 1997 case indicates that total emissions were 191.7 metric tonnes. A direct comparison of greenhouse gas emissions between the years 1990 and 1997 indicates that emissions increased by 33 per cent. Such an increase poses great concern in regards to meeting the Kyoto Protocol. The extent of the increase may in fact prohibit its ratification by Canada.

Analysis of the change in certain parameters themselves also reflects changes in the sector. The fuel consumption rate between the two study years is essentially unchanged. This demonstrates that the technological advancements in the vehicles are being matched by increasing truck and freight sizes. The increasing in TKT/Year can be either explained by economic growth or by a modal shift from the rail system.

Overall, the trends reflected in this analysis demonstrate the magnitude of the difficulties to be overcome for the transportation industry to be sustainable. A 33 per cent increase in seven years would raise Canada's Kyoto Protocol goal to a 39 per cent required reduction.

Limitations of the Method and the Estimates

The methodology developed in this paper has modelled a more basic case of transportation related emissions. The scope undertaken in

analysis has allowed parameters such as acceleration and deceleration events, terrain, and seasonal variations to be ignored. The study of other routes in Canada might require the incorporation of these attributes in approximating greenhouse gas emissions.

Opportunities for Expanding and Enhancing Application of the Method

Considering the layout of the methodology is simply the application of five parameters, refinement of the parameters to include more complicated driving conditions is very possible. Since data collecting systems are being integrated into transportation systems, data is generally readily available in North America. Some of this information would include detailed geometry of highway and road sections, precipitation and air quality information, as well as weigh stations and information transportation systems. Each of these systems transmits information regarding the conditions under which vehicles negotiate roadways. The variability of these conditions has direct correlations with how a particular route is manoeuvred. Another method of reducing greenhouse gas emissions is through driver training. Consulting various carriers in varying regions can help determine the human component to fuel consumption. Learning to model this data will allow emission estimations of additional regions in Canada.

Conclusions

The sensitivity of transportation related emissions indicates that there is indeed potential for reductions. Alterations to systems affecting travel logistics as well as technological efficiencies can limit emission production. The Kyoto Protocol is an important step to attempt to reverse the climate change effects felt today. Understanding the severity of environmental impacts caused by transportation may help illustrate the steps required for lowering emissions to acceptable levels. The methodology and results achieved in this paper demonstrate it is possible to track greenhouse gas emissions produced from the transportation field and also relate some initial estimates. Required now, is response to reduce these emissions.

Acknowledgements:
Thanks to Terry Zdan, Kai Han and Alan Clayton.

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Developing a LOS Evaluation Model for Baggage Handling Systems at Canadian Airports

1 INTRODUCTION

Air travel is constantly experiencing an increase in the demand volume. Between 1964 and 1984, the number of Canadian passengers increased by 473% (Statistics Canada 1999). The total number of passengers carried on worldwide scheduled air services exceeded 1.25 billion in 1995 (International Civil 1995) and exceeded 1.5 billion in 1999 (International Civil 1999).

The Canadian air transportation system must be able to accommodate the ever-increasing number of passengers and their personal needs. Additionally, surveys have indicated that passengers consider baggage handling to be a very significant air travel priority (Ashford et al. 1984). A delay in the baggage handling system (BHS) can adversely affect the whole operation of the airport facility with a resultant increase in cost.

Differences have been observed between airlines, airports and baggage handlers in terms of their physical baggage handling systems, their standards for measuring lost baggage, and their levels of service. The BHS can be improved by reducing the amount of mishandled baggage, increasing the level of service (LOS) provided to the passengers, increasing the operating capacity, and by improving security. However, established methods for evaluating these improvements are not available. This paper reviews the methods used to transport baggage safely and efficiently through the airport system, discusses the factors that affect the LOS provided by the BHS, and proposes

a LOS model to evaluate the BHS's nationwide. Following this, the passenger and BHS characteristics of six Canadian airports where research was conducted are discussed.

2 BAGGAGE HANDLING SYSTEMS

The main goal of the BHS is to transport the baggage to and from the aircraft via the most economical and efficient method possible, while minimizing mishandled baggage and passenger delay. Certain tasks are involved in transferring baggage from the passenger to the aircraft and, upon arrival, return it to the passenger in a safe & efficient manner. Although the sequence of activities required to transport the baggage is similar for all airport, the methods and equipment used to accomplish this task can vary significantly from airport to airport.

Commencing with the check-in area, possible baggage check-in counter configurations include the linear, island and flowthrough orientations. Then, baggage is transported to the baggage room from the check-in area along a system of conveyor belts where it is subsequently sorted and placed on bag carts or containers. Baggage in carts must be transferred to and from the plane individually, whereas baggage within a container remains in the container during the flight. Three possible types of sorting areas include centralized, decentralized and remote areas. Additionally, the methods used to sort baggage at airports can be manual, semi-automated, fully automated or a combination of these. Arrival baggage is transported to a baggage reclaim area where four possible types of reclaim devices are used to transfer baggage from the airside of the terminal to the passengers. These include linear counters, linear conveyors, carousels and racetracks. Additional information pertaining to check-in counters configurations, baggage sort room areas, sortation methods, and types of reclaim devices can be found in Horonjeff (1994).

3 NATIONAL STRATEGY FOR BAGGAGE HANDLING

Both the airport and airline operating characteristics influence the LOS provided by the BHS. The main factors affecting the operation of the BHS include the number of aircraft movements, the total number of passengers, the airport layout, the peak traffic, the capacity of the handling equipment and the operating procedures of the baggage handling personnel. Airlines and airport authorities can optimize these variables to achieve a high level of operating performance, but should also consider the LOS felt by the passenger. The performance provided by an airline and the passenger's perceived performance can vary greatly. Furthermore, while the actual service depends mainly on the handling equipment and the skill displayed by the baggage handling personnel, the LOS felt by the passenger varies from airport to airport depending on such variables as the distance and time required for the passenger to reach the reclaim area. Both the passenger's walking distance and the speed of delivering baggage must be balanced to optimize the LOS provided by the BHS. However, since each airport varies immensely, all factors must be jointly analyzed to determine how each factor influences the operation of the BHS and affects the LOS.

From background research, it is evident that a national strategy for defining the LOS of BHS's and the means to improve this LOS are lacking. Moreover, as the demand for air transportation is growing all airports will face the same situation of having limited and/or insufficient capacity to handle the ever-increasing amount of baggage.

Without improving the capacity of the airport terminal facilities to match this increase in the amount of baggage, the overall quality of service offered by Canadian airports will deteriorate. Clearly, a LOS model that can ascertain the LOS being achieved by each BHS would be beneficial to airlines,

passengers and airport designers. The development of such a model would enable airport authorities and airlines to determine when improvements are required and to develop a strategy for implementing the needed changes.

3.1 Common Level of Service Evaluation Methods

A level of service measurement allows designers and operators to evaluate the system of interest (highway, walkway, queuing area, BHS, etc.) at the different load conditions that may be encountered during the life of the system. The LOS provides a basis for determining when improvements are necessary in the system's lifetime.

Highway capacity analysis was the earliest use of the concept of LOS. The Highway Capacity Manual first introduced the concept in 1965 (Highway Research Board) to provide a means of evaluating the LOS for a variety of facilities (freeways, local streets, etc.). Six levels of service, with levels from A through F, were defined to indicate the LOS (Table 1).

Table 1: IATA level of service standards (IATA 1990)

LOS	*Level*	*Description*
A	Excellent	Free flow, no delays, excellent comfort level
B	High	Stable flow, very few delays, high comfort level
C	Good	Stable flow, acceptable delays, good comfort level
D	Adequate	Unstable flow, passable delays, adequate comfort level
E	Inadequate	Unstable flow, unacceptable delays, inadequate comfort level
F	Unacceptable	Cross-flow, system breakdown, unacceptable delays & comfort level

However, the state of LOS evaluation in airport terminals is much less advanced than that of highway analysis. Methods used for terminal evaluation have evolved in the past, but one single, generally used method has not been developed (Ashford 1988). The approach used by many agencies, including the British Airport Authority (BAA), the International Air Transport Association (IATA), Schiphol Airport Authority, and Aeroports de Paris is to set time and space standards separately (Ashford 1988). However, the standards for each facility do not reflect varying levels of service that include the passenger's perception.

Transport Canada (1979) proposed a method that sets different levels of space provisions for the six different levels of service (A to F), similar to the evaluation of highway LOS. The space provisions proposed by Transport Canada (TC) are shown in Table 2. This table also provides the more stringent standards suggested by IATA in a 1990 update (IATA 1990). The linearity of the relationship between space provisions and LOS suggests a lack of a relationship between these space provisions and the LOS perceived by users (Ashford 1988).

Table 2: Air Terminal Building Space Standards (Revised from Transport Canada 1979, IATA 1990)

	Level of Service Ranges (Minimum M^2 per Occupant)					
Facility	***A***	***B***	***C***	***D***	***E***	***F***
TC - Bag Claim Area (without device)	> 1.6	1.4	1.2	1.0	0.8	< 0.8
IATA – Bag Claim Area (without device)	> 2.0	1.8	1.6	1.4	1.2	< 1.2

3.2 Proposed Level of Service Model

An LOS model would allow airports and airlines to analyze their BHS's and determine the LOS being provided to the passengers. This analysis would consider the safety, security, convenience, cost and delay to the passengers, the airlines, the baggage handling companies, and the airport authorities. The proposed LOS model would also consider the commonly used variables of space requirements and service times, but would put emphasis on user preference and perception.

This paper previously outlined the factors affecting the capacity of the BHS and that influence the LOS felt by passengers. Following an evaluation of these factors, regression analysis will identify the effect of each variable on the LOS perceived by the airport user. The model will be evaluated and calibrated using a comprehensive survey of Canadian airports. The multiple regression relationship will be of the form:

$$[1] \quad UPLOS = a + \sum_{i=1}^{k} b_i \, f_i(X_i)$$

where: $UPLOS$ = user perceived level of service,
$f_i(X_i)$ = function of independent variable X_i, and
a and b_i = constants.

This model will determine the user perceived LOS, based on the previously mentioned variables. By knowing the causal effect between each variable and the UPLOS, a guideline for improvements to the BHS can be created, thus allowing the airlines and airport authorities to instigate effective modifications to the BHS. This would provide a new strategy to airport operators for BHS modifications that take into account the preferences of the main users, the passengers.

4 DATA COLLECTION AND ANALYSIS

The information required concerning baggage handling systems was collected from six Canadian airports. Three methods were used to collect this information: communication with the airport authority and the baggage handlers for general information, a tour of the terminal building and the distribution of numerous passenger questionnaires during the site visit. The data collected from the questionnaires was in regards to the level of service perceived by the passengers.

4.1 Descriptions of Case Studies

The six Canadian airports ranged in size from small to large. In terms of annual passenger traffic levels, one of these airports was a small airport (<1 million annual passengers), four were medium (1-10 million annual passengers) and one was large (>10 million annual passengers). In order to keep the airport names confidential, the airports are referred to by size, as SMALL, MEDIUM1, MEDIUM2, MEDIUM3, MEDIUM4, and LARGE. The data that was collected from each airport was analyzed and is discussed herein.

The airports evaluated varied between locale, size and BHS characteristics. This data, along with information collected from the passengers is being used to develop the LOS model.

4.2 Respondent Characteristics

Information required for the LOS model development was collected, in part, through a passenger questionnaire. A minimum of 100 completed questionnaires were collected at each of six airports across Canada. The randomly selected respondents were from domestic, transborder and international flights during both peak and off-peak time periods.

The first two sections of the questionnaire were designed to categorize the respondents by flight information and personal

passenger information. The flight information included type of flight (domestic, transborder, or international) and class of ticket. The personal information collected included the respondent's gender, age range, trip purpose, the number of checked items of baggage, and the number of flights taken per year. The third section of the questionnaire solicited their opinion of various aspects of the baggage handling system. The results obtained are summarized in the following sections.

- Response rates varied between 97% (123 responses from 127 passengers asked) at MEDIUM1 to 90% at MEDIUM2 (140 responses from 156 passengers asked).
- With the exception of the small airport, the percent of male passengers ranged from 62 to 72%. The smallest airport resulted in only 47% of respondents being male. Overall, it was found that due to the female gender of the interviewer, male respondents were more likely to complete the questionnaire than female passengers. However, at the small airport, it is believed that the female passengers were more at ease in the smaller, less crowded airport environment.
- The majority of passengers were between the ages of 25 and 60. It was found that younger passengers (less than 60 years of age) were more likely to agree to complete the questionnaire.
- By airport, the passengers traveling for business purposes only ranged from 49.6% to 63.9%. Passengers traveling for pleasure-only ranged from 27.1% to 41.6%. Passengers traveling for both pleasure and business ranged from 3.0% to 8.3%.
- The majority of passengers at each airport, from 57.7% to 67.7%, checked only one item of baggage.
- The majority of passengers at each airport, from 29% to 42.2%, take 10 or more flights per year.
- The percent of passengers with business tickets ranged from 10% to 18.7%. Alternately, the percent of passengers with economy tickets ranged from 81.3% to 90%.

A large number of passengers with varying characteristics were encountered during the research. This data, along with other flight specific information are being used to determine what factors influence a passenger's perception of the BHS.

4.3 Evaluation of Time and Space Standards

4.3.1 Time Standards

Organizations, including the BAA, IATA, Schiphol Airport Authority, and Aeroports de Paris suggest design space and time standards for the baggage reclaim area (Ashford 1988). These organizations set limits for the passenger's waiting time to create standards for the service being provided. The BAA, IATA and Aeroports de Paris use a design standard of a maximum of 25 minutes between the arrival of the first passenger and the arrival of the last bag on the conveyor. IATA also stipulates that 90% of the passengers should wait less than 20 minutes for baggage.

The research demonstrated that three of the six airports investigated exceeded the 25-minute time limit at least once. Additionally, only SMALL served at least 90% of the passengers in less than 20 minutes for all flights.

4.3.2 Space Standards

Two variables commonly used for space standards include square metres per passenger and conveyor belt frontage per passenger. The Aeroports de Paris consider that a reclaim frontage of 1.0 m for every 5 passengers is a reasonable standard. The design space standards used by the BAA state that 1.25 m^2, 2.0 m^2 and 3.25 m^2 be provided in the reclaim area per domestic, short haul international, and long haul passenger, respectively. The IATA design standards state that 0.8 m^2 be provided per domestic and short haul international passenger, and 1.6 m^2 per long haul passenger. The TC and

IATA space standards used to distinguish between levels of service A through F are in Table 2.

The research indicated that all flights except one of 19 observed flights at MEDIUM3, exceeded (met or improved on) the standard of 5 passengers per metre used by the Aeroports de Paris. Also, it was found that all flights at SMALL and MEDIUM2 met both the BAA and IATA design standards. However, a number of flights at the other four airports did not meet the BAA and IATA standards.

With reference to the Transport Canada (TC) standards for the LOS provided in the reclaim area, the results indicated that, with the exception of MEDIUM1, a LOS of A was provided by more than 89% of the flights at each airport and in three instances, 100% of the flights provided a LOS A. Similarly, the space standards suggested by IATA for the levels of service A through F were analyzed. SMALL and MEDIUM2 provided LOS A to 100% of observed flights. However, MEDIUM1, MEDIUM3 and LARGE provided LOS F for at least one flight.

According to the above time and space standards, a high percent of the total flights provided a reasonable LOS. However, from the passenger responses, obtained through the use of the questionnaire, the percent of people satisfied with the service was *less* than the number of flights providing at least LOS C. Thus, the standards used by these agencies do not reflect the LOS *perceived* by the passengers.

4.4 Summary of Passenger Responses and Perceived LOS

Respondents were asked to indicate the amount of time they took to walk from the arrival gate to the reclaim area, and the amount of time they *actually* waited and *expected* to wait for baggage in the reclaim area. Respondents were also asked to evaluate various aspects of the BHS by indicating which level

of service was being provided using 'excellent', 'high', 'good', 'adequate', 'inadequate', or 'unacceptable'. The best response of 'excellent – LOS A' was given a numeric coding of '1' in the software, while the worst response of 'unacceptable – LOS F' was given a coding of '6'. Thus, a low numerical value indicated a better LOS than a high numerical value.

The respondents also rated eight aspects of the BHS:

- the walking *distance* between the arrival gate and the reclaim area,
- the walking *time* between the arrival gate and reclaim area,
- the time spent waiting for baggage in the reclaim area,
- the amount of space provided along the conveyor belt ,
- the overall amount of space in the reclaim area,
- the amount of seating provided in the reclaim area,
- the level of personal comfort and safety perceived in the reclaim area, and
- the overall baggage handling system LOS.

The results obtained from the research are summarized below.

Perceived Waiting Time: The average ranged from 4 min. (SMALL) to 13 min. (MEDIUM4). The *longest* perceived waiting time was 15 min. (SMALL) and 55 min. (MEDIUM4).

Expected Waiting Time: The average ranged from 7 minutes (SMALL) to 12 minutes (MEDIUM4). On average, respondents at MEDIUM4 *expected* lengthy waiting times and *actually perceived* lengthy waiting times.

Perception of Walking Distance: SMALL, with the shortest average walking distance of 97 metres, received the best rating of 2.11 (~LOS B). MEDIUM2 & LARGE, with average walking distances of 218 and 216 metres, respectively, received the worst ratings of 3.1 and 3.09, respectively (~LOS C).

Perception of Walking Time: Ratings ranged from LOS B (SMALL) to just less than LOS C (MEDIUM2 and LARGE).

Perception of Waiting Time in Reclaim Area: The perceived waiting time ranged from LOS B (SMALL) to LOS D (MEDIUM1, LARGE). Some respondents had a preconceived notion that the baggage delivery times would be lengthy and thus evaluated the service based on this notion rather than on the actual delivery time present at the time of this research.

Perception of Conveyor Belt Frontage: SMALL, with an average of 0.6 people per metre of conveyor length, received the best rating of 2.3 out of 6, between LOS B & C. MEDIUM1, with the worst average of 1.8 people per metre, received the worst rating of 3.4, between LOS C & D.

Perception of Overall Space in Reclaim Area: Ranged from LOS between B & C (SMALL) to LOS between C & D (MEDIUM1) .Of the six airports studied, 3 airports have been renovated during the past decade and are operating under capacity. These 3 airports received better ratings for the overall space than the three airports operating at or over capacity.

Perception of Personal Safety and Comfort in Reclaim Area: Ranged from midway between LOS B & C (SMALL) to midway between LOS C & D (MEDIUM4 & LARGE). Respondents at the 3 recently renovated airports provided the best ratings.

Perception of Overall Level of Service Provided by BHS: SMALL received the best average rating, followed by MEDIUM2, MEDIUM3, MEDIUM4, and LARGE. MEDIUM1, with high waiting times, the worst evaluations for reclaim frontage and overall space received the lowest LOS rating.

Overall, the three airports that were upgraded in the past decade (SMALL, MEDIUM2 and MEDIUM3) received better ratings than those airports not recently renovated.

4.5 Regression Analysis

Historically, waiting time has been used to define the LOS standards for B. Thus, the relationship between waiting time and the passenger's evaluation of LOS has been analyzed. For each of the six airports, regression analysis was used to measure the relationship between the perceived waiting time in minutes (TIMEWAIT) and the user perceived LOS rating for the overall BHS (UPLOS). Recalling the equation introduced in Section 3.2 for UPLOS, for simple regression, using the two variables noted above, this equation can be rewritten as $UPLOS = a + b(TIMEWAIT)$. The overall UPLOS rating is the dependent variable, with a value between 0 (unacceptable) and 10 (excellent).

Regression analysis indicated the weakest relationship was at SMALL where the waiting time only accounted for 4.2% of the variation in the dependent variable, UPLOS (Table 3). MEDIUM3 showed the strongest relationship with almost 40% (39.1%) of the variation in the UPLOS explained by the perceived waiting time. Thus, for MEDIUM3, more than 60% of the dependent variable remains *unexplained.* As this research postulated, more factors affect the overall LOS perceived by passengers vis-à-vis the baggage handling system. Thus, more than just waiting time must be evaluated to indicate the overall LOS perceived by the passengers.

Table 3: Relationship Between the Perceived Waiting Time (independent) and the Perceived LOS (dependent).

Airport	Significance	R squared
SMALL	0.024	0.042
MEDIUM1	0.000	0.209
MEDIUM2	0.000	0.133
MEDIUM3	0.000	0.391
MEDIUM4	0.000	0.214
LARGE	0.000	0.104

Preliminary analysis of other variables has shown that the difference between the expected waiting time and the perceived waiting time influences the overall LOS evaluation. At MEDIUM2, where the longest average walking distance was measured, there exists a strong relationship between the perceived LOS rating for walking *distance* and the overall LOS rating. A strong relationship also exists between the perceived LOS rating for walking *time* and the overall LOS rating. The relationship between other factors collected during this research and the overall LOS perceived by the passengers needs to be analyzed further.

5 CONCLUSIONS AND FUTURE RESEARCH

This paper presented a review of the current status of BHS's at Canadian airport, which is representative of its worldwide status. Based on this review the need to develop a national strategy for BHS's was established. The factors affecting the LOS as perceived by the passengers were presented and a new LOS model considering these variables was proposed. Information pertaining to the BHS at six Canadian airports was presented and data regarding LOS as perceived by more than 800 passengers were summarized. Results from regression analysis indicated that, in fact, waiting time alone is not an adequate indicator of the LOS perceived by passengers. Factors such as a passenger's *expected* waiting time and the walking distance between the gate and reclaim area influence the overall LOS evaluation. The need for more analysis is evident, as it will lead to the refinement of the LOS model.

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