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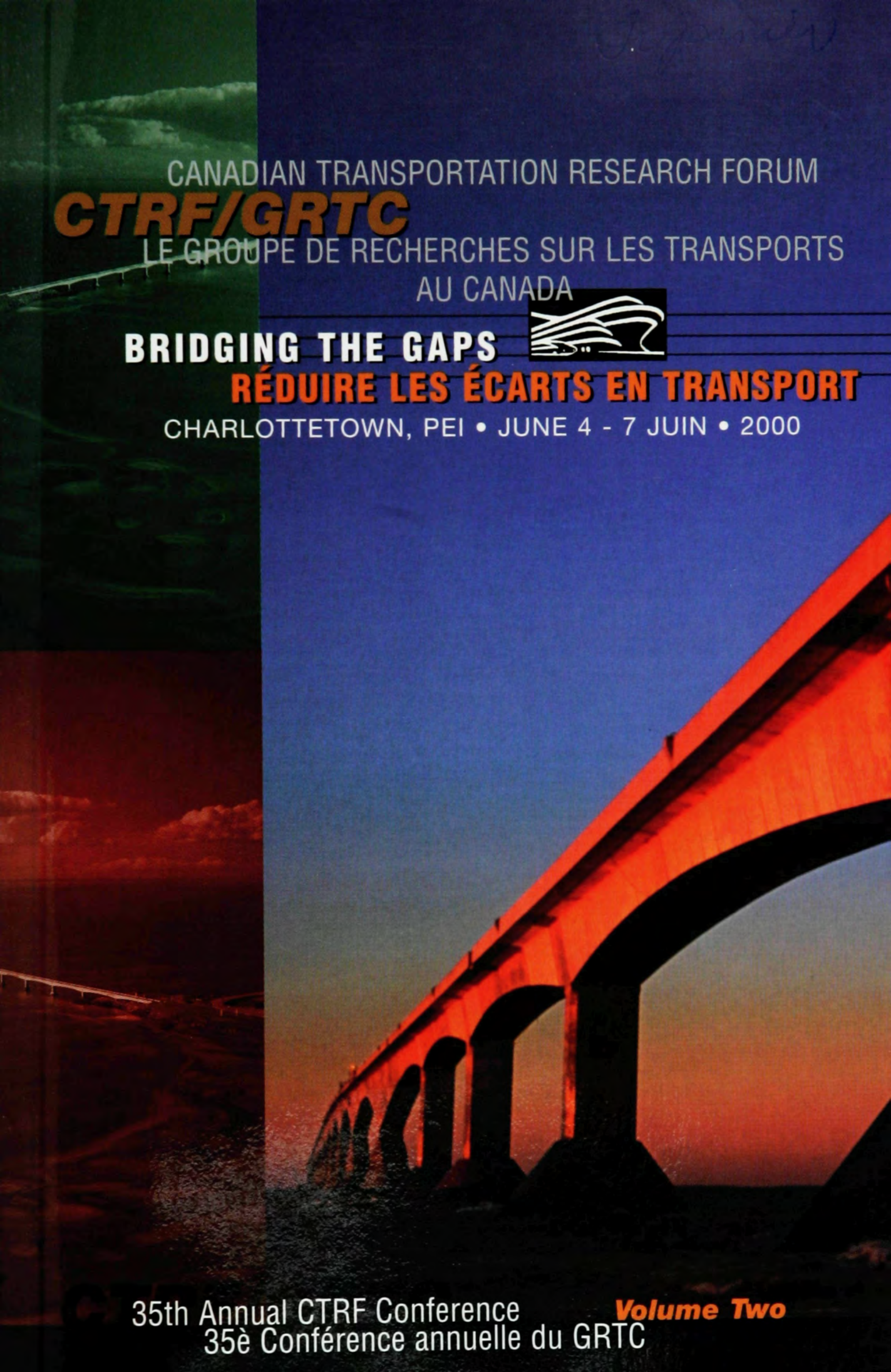
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LE GROUPE DE RECHERCHES SUR LES TRANSPORTS AU CANADA

BRIDGING THE GAPS

RÉDUIRE LES ÉCARTS EN TRANSPORT

CHARLOTTETOWN, PEI • JUNE 4 - 7 JUIN • 2000



35th Annual CTRF Conference
35è Conférence annuelle du GRTC

Volume Two

Volume II

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

PROCEEDINGS
of the 35th Annual Conference

ACTES
de la 35è Conférence annuelle

BRIDGING THE GAPS
Réduire les écarts en transport

Charlottetown, Prince Edward Island
June 4-7 juin
2000

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President's Message

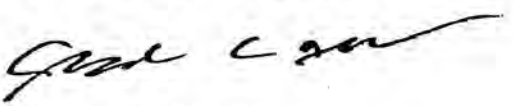
Welcome to CTRF's 35th Annual Conference. Depending how you view such matters, this year is either the last conference of the second millenium or it is the first of the third. Viewed either way, our organizers have prepared a highly relevant event that is truly geared toward Canada's changing transportation challenges and opportunities. "Bridging the Gaps" is about overcoming adversity, showing innovation and responding to needs.

These proceedings are the official record of this meeting, compiled through the efforts of our membership, presenting here, at the 3 and 1/2 days of formal sessions. These articles will be broadly distributed and read, throughout Canada, by many people who have not had the opportunity to attend in person.

The two principal organizers of this event, and their supporting teams, deserve our special thanks. Dr. Eric Hildebrand, of the Department of Civil Engineering, University of New Brunswick and Gordon Tufts, formerly of PEI Transportation and Public Works, and now with Manitoba Highways and Government Services, have assembled an intellectually stimulating forum, and a congenial social program as befits this year's historic setting -- Charlottetown.

It is a profound honor to serve this year as your president. On your behalf, I look forward to the 2000 Annual Canadian Transportation Research Forum, with thanks to the panelists, paper presenters and all of the many volunteers who have contributed to this year's success.

Yours sincerely,
CANADIAN TRANSPORTATION RESEARCH FORUM



Lloyd L. Ash, P.Eng., P.Log.
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Message du Président

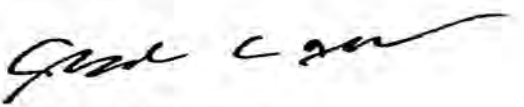
Bienvenue à la 35è Conférence annuelle du GRTC. Selon le point de vue que vous adoptez en la matière, cette année est celle de la dernière conférence du deuxième millénaire ou la première du troisième. Quelle que soit l'opinion, nos organisateurs ont préparé un événement de la plus haute pertinence, véritablement adapté aux défis et opportunités que soulèvent les changements en matière de transport au Canada. « Réduire les écarts » signifie surmonter l'adversité, faire preuve d'innovation et satisfaire des besoins.

Ces Actes constituent le relevé officiel du contenu de la présente rencontre, compilé grâce aux efforts déployés par nos membres sur place, durant les trois jours et demi de séances formelles. Ces articles seront distribués et lus à grande échelle, partout au Canada, par beaucoup de gens qui n'ont pas eu la possibilité d'assister en personne.

Les deux principaux organisateurs de cet événement et leurs équipes de soutien méritent nos chaleureux remerciements. Dr Eric Hildebrand, du Département de génie civil de l'université du Nouveau-Brunswick et Gordon Tufts, anciennement du ministère des Transports et des travaux publics de l'IPE - et actuellement au département manitobain des routes et du transport - ont mis au point un forum intellectuellement stimulant ainsi qu'un agréable programme social qui convient au cadre historique de cette année, Charlottetown.

Je suis profondément honoré d'être votre président cette année. En votre nom, j'émets le ferme espoir d'une excellente Conférence 2000 du Groupe de recherches sur les transports au Canada, et remercie les panélistes, les conférenciers et l'ensemble des nombreux volontaires qui ont contribué au succès de cette année.

Yours sincerely,



Lloyd L. Ash, P.Eng., P.Log.
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Country Loyalty Among Air Travellers: A North American Perspective

Edward R. Bruning, Transport Institute, University of Manitoba
Barry E. Prentice, Transport Institute, University of Manitoba
Victor M. Rueda, Transport Institute, University of Manitoba

Introduction

Country-of-origin is considered an important factor in numerous purchase decisions. Previous research has indicated the strength of its role in textiles and fashion clothing, automobiles, fine wines, consumer electronics, and services to name a few of the many applications among product categories. In particular, research over the past five years has reported that air travellers consider country-of-carrier origin in evaluating options and arranging travel plans.

Will Canadians, Mexicans and Americans remain loyal to carriers from their own-countries when provided alternatives for air travel? How price or service sensitive are they? Is country loyalty significant as a factor in the purchase decision? Are air travellers from a country biased in favour of an own-country carrier? These questions establish the core issues directing our research.

Literature Review

Country-Of-Origin Studies

The findings of hundreds of Country-of-Origin (COO) studies have been reviewed and investigated through meta-analyses by several researchers (e.g., Peterson and Joilbert 1995, Al-Sulaiti and Baker 1998). The research shows that consumers hold distinct images of

various nations and use them to evaluate product quality, cope with complex market information, and assess the social acceptability of their purchases (e.g., Wall, Heslop, and Hofstra 1990). They recognize the specific strengths and weaknesses of various countries and generally rate products from developed nations higher than those from developing ones. Furthermore, the relative influence of COO varies depending on the situation (Ahmed and d'Astous 1993, Alpert et al. 1995, Haubl and Elrod 1999), and Han (1989). Lee and Ganesh (1999) have shown that consumers rely on COO more heavily if their product knowledge is low.

Concerning foreign consumer attitudes toward Canadian products, the only relevant COO studies that include Canadian products for evaluation are several carried out in the U.S. in the 1980s. Canadian products were rated consistently lower than U.S. ones on most attributes (e.g., Garland, Baker, and Crawford 1987). More recently, Liefeld, Heslop, and Wall (1994) discovered that U.S. consumers did not rate products from some developing nations, including Mexico, as significantly different in quality from those of Canada. Labrie, Propeck, and Arellano (1994) studied a sample of 50 Mexican business people and found a view of Canada as less advanced than the U.S., but also of Canadian executives as easier to do business with. Lastly, in a study in Ivory Coast, Ahmed, d' Astous, and d'Almeida (1994) found that Canadian products were rated quite strongly in absolute terms but lower than those from six other industrial countries.

Several works have appeared in print over the past several years documenting the work on air traveller loyalty and the role of carrier country-of-origin. Bruning, Prentice, and Bellamy (1998), and Bruning (1994) have reported findings that suggest carrier country-of-origin is a significant factor in the carrier evaluation and purchase decision. In most studies, the country factor was ranked among the top three drivers explaining air travellers' perceptions of carriers and their likelihood to select them in an actual choice situation. Although price and specific service items (i.e., number of stops) were more frequently rated first and second, country was usually a third of fourth

level factor competing with on-time performance, in-flight services, and frequent flyer mileage programs. The contributions of these works lies in their linking carrier country-of-origin—a form of brand name—to the air purchase decision. Although economic factors tend to dominate the preference formation and choice processes, nonetheless, when all other things are equal (and in a competitive market they tend to become equal) loyalty, specifically country/carrier loyalty, was noted as a factor determining choices between air carriers.

In summary, the traditional COO research has focused on identifying the role performed by the country cue in product evaluation and choice. Researchers have been seeking to explain choice preferences without asking the more fundamental questions, namely, why, and to what extent, would a consumer form such a preference and behave economically the way he or she behaves? Research in the area of consumer ethnocentrism focuses attention on these questions. In this study, we are integrating COO and consumer ethnocentrism research in developing the logic for airline choice among Canadian, American, and Mexican air travellers. Our argument posits that a preference for local versus foreign products or services, in this study airline services, is a function of one's strength of national identity which is dependent upon the influence of social identity in defining one's self. The test carried out on the international air carrier market is an attempt to confirm our theoretical views.

Methodology

Research Instruments

The approach in this study is to derive conjoint part-worth estimates of the several flight-specific attributes and their levels. We then focus on the relative values of the part-worth estimates for the three levels of the country of carrier variable.

Conjoint Experiment. The focus point of the conjoint exercise is an hypothetical 2000 mile trip between two unspecified points. The

instrument for the conjoint exercise involves twenty scenarios with various trip attribute combinations and a rating form for subjects to indicate trip bundle preferences based on a nine-point preference scale. Attributes selected for inclusion in the experiment are suggested by previous research in marketing and transportation (Bruning, Prentice, and Bellamy 1998; Bruning 1994; Bruning, Lockshin, and Lantz 1993; Bruning and Hu 1984; and Green and Wind 1975). The six attributes are: price, in flight service, number of stops, on time performance, country of carrier, and whether a flyer mileage program is offered. The country of carrier attribute is our proxy for the relative importance of the country of origin (COO) factor in the air carrier selection process. Levels of each of the attributes are identified in Table 1. Attribute-specific part-worth coefficients are determined based on the relative importance of each level of each attribute relative to levels of other attributes presented in the choice scenarios.

Table 1
Conjoint Experimental Attributes and Attribute Levels

	Attribute Level		
Attribute	Low	Moderate	High
Price	$560	$685	$779
In-flight Service	Low	Medium	High
Number of Stops	2 Stops	1 Stop	Non-Stop
On-time Performance	70%	85%	95%
Flyer Program	No		Yes
Carrier Country	Mexico	US	Canada
	Japan	Switzerland	Canada
	Malaysia	New Zealand	Canada
	Singapore	S. Africa	Canada
	Spain	G. Britain	Canada

Pre-tests of the price range confirm that subjects identify $560 as the low price, $685 the moderate level price, and $779 the high price. In-flight services are defined as low, moderate, and high based on the

travel scenario. Low in-flight service is defined as the scenario of poor selection of magazines, no newspapers, no meals, too-few attendants for quick service, poor music quality, noisy aircraft, and inhospitable staff. Moderate service is defined as the scenario of at least one interesting magazine, no newspaper, cold sandwich and dessert, satisfactory speed of service, reasonable music quality, aircraft not too noisy, and congenial staff. The high in-flight service is characterized as having a good selection of newspapers and magazines, a hot meal, quick service, clear music and a movie, quiet aircraft, and excellent staff. All other attributes are self-explanatory. Pre-tests indicate service attribute levels are appropriate for the study.

The country of carrier attribute possessed three levels--namely, three carriers from different countries. In order to ascertain whether negative biases exist for study respondents, five different combinations of countries were included as stimuli. Five different versions of the conjoint instrument were employed to account for each of the five country pairings. One-fifth of study respondents received conjoint exercises that required evaluations between Canadian, Mexican, and U.S. carriers. Another one-fifth completed exercises where Japan and Switzerland were represented. Thus, each of the five combinations were equally distributed among respondents in each of the sample sites in each of the three countries. The inclusion of thirteen different country of carrier stimuli in the conjoint analysis provides us with the ability to determine whether positive or negative biases exist with respect to the thirteen countries for the Canadian, Mexican, and U.S. sample respondents.

The specific attribute level combinations are determined based on a fractional factorial design yielding 18 combinations (Cochran and Cox 1957). Orthogonal arrays are used to determine the appropriate combinations necessary for effectively estimating main effects. Individual ratings based on the nine-point preference scale serve as the dependent variable while the various attribute levels are effect coded (1, 0, -1) independent variables representing the six flight-specific attributes. OLS regression is employed to estimate individual as well as aggregate part-worth coefficients associated

with each attribute level (i.e., low, medium, and high price; low medium and high service, etc.).

Sampling Design. Data were collected at major Canadian airports in Halifax, Montreal, Quebec City, Winnipeg, Calgary, and Vancouver. The U.S. sample was collected from airports in Seattle, Denver, Phoenix, Birmingham, Columbus, and Syracuse. The Mexican sample was collected in Houston. A convenience sample design was employed to identify and collect information from the sample units. A total of 4,701 (2,244 from the U.S, 1,855 from Canada, and 602 from Mexico) air travellers took part in the conjoint exercise and follow-up survey during a six-month period in 1998.

Results

Table 2 reports descriptive information for the aggregated samples across the three countries.

Table 2
Descriptive Statistics for Selected Traveller Variables

Traveller Variable	Canada	U.S.	Mexico
Age	44	42	39
Gender			
Male	62%	53%	60%
Female	38%	47%	40%
Air Travel Knowledge	4.9	5.0	3.2
Average Annual Trips			
Domestic	3	5	0
International	1	1	1

Importance of Flight Attributes

Respondents from the three countries varied in terms of the relative importance placed on each of the six flight attributes used in the conjoint exercise. Table 3 reports the mean importance figures.

Table 3
Relative Importance of Six Flight Attributes:
Canadian, U.S., and Mexican Samples

Attribute	*Canada*	*U.S.*	*Mexico*
Price	24%	29%	18%
Service	25%	20%	28%
Number of Stops	26%	26%	20%
On-Time Performance	14%	11%	28%
Mileage Program	5%	6%	2%
Country of Carrier	6%	7%	4%
Adj. R-square	.404	.414	.363
SEE	1.677	1.787	1.956
n	1855	2244	602

Differences across the three samples are evident from data presented in Table 3. Canadian travellers place equal weight on price, service, and number of stops. Compared to Canadian travellers, U.S. travellers place greater importance on price and less on service. Mexican travellers, on the other hand, exhibit an ordering different from both of their neighbours by indicting a priority for service and on-time performance and considerably less emphasis on price. With respect to mileage programs and country of carrier attributes, all samples report very similar weightings. In all three instances, mileage programs and country of carrier attributes were considered significantly less important in comparison to price and service attributes.

The regression analysis statistics reported in Table 3 are near identical for the three samples. Measures of goodness of fit are hovering around .400, standard errors of the estimates are respectably low and consistent across the three countries. The slightly larger value for the Mexican sample is due to the smaller sample size from that country. In short, the diagnostic indicators suggest a consistent and reliable modeling of the conjoint choice ratings.

Part-Worth Country Attribute Comparisons

Japan and Switzerland. Table 4 reports part-worth values for the Canadian, Mexican, and U.S. samples for the sub-samples presented the conjoint exercise with Japan and Switzerland as alternative carrier choices respondents evaluated along with Canadian, Mexican, and U.S. air carriers.

Table 4
Part-Worth Attribute Values for Country of Carrier Variable: Canada, U.S., and Mexico compared to Japan and Switzerland

	Canada	*U.S.*	*Mexico*
Japan	-.280	-.178	-.161
Switzerland	.037	-.079	.044
Canada	.230		
U.S.		.245	
Mexico			.118

The Canadian sample valued air carriers from the three countries quite differently. Canadians reported a perceived disutility of -.280 on the nine-point scale when presented with scenarios with Japanese carriers. However, a positive increase in utility was reported when scenarios included a Swiss (.037) or Canadian (.230) air carrier. The greatest gain in utility occurred for this group when scenarios included a Canadian air carrier. Respondents from the U.S. also indicated a disutility whenever the Japanese carriers were included in the conjoint scenarios. Unlike the Canadians, however, U.S. respondents also perceived a disutility whenever a Swiss carrier scenario was presented, although the effect was not statistically significant. Mexican respondents were similar to the two other samples--disutility associated with the Japanese scenarios, indifference with respect to the Swiss scenarios, and positive utility whenever own-country (Mexico) was included in the scenarios. The Canadian sample reported experiencing the greatest disutility with the Japanese scenarios. The U.S. sample exhibited the greatest positive utility with the own-country carrier scenarios (not significantly

different from Canada). Finally, the Mexican sample reported the smallest utility increase with respect to own-country scenarios.

Malaysia and New Zealand. Table 5 reports the effects upon respondent utility functions from the presentations of scenarios including Malaysia and New Zealand as travel options. The pattern is very similar to that reported in the case of Japan and Switzerland. The Canadian sample reported the greatest disutility associated with scenarios expressing a Malaysian carrier as the travel option. Also, both the U.S. and Mexican samples reported negative values (disutilities) with respect to the Malaysian scenarios. The U.S. sample reported the greatest utility gain (.501) from scenarios including a U.S.-based air carrier while Mexico reported the lowest utility gain (.223). Furthermore, the U.S. sample reported a net disutility with scenarios including New Zealand as the country of carrier. Both Canadian and Mexican samples were neutral with respect to the New Zealand scenarios.

Table 5
Part-Worth Attribute Values for Country of Carrier Variable: Canada, U.S., and Mexico compared to Malaysia and New Zealand

	Canada	*U.S.*	*Mexico*
Malaysia	-.457	-.139	-.230
New Zealand	.073	-.330	.006
Canada	.342		
U.S.		.501	
Mexico			.223

Singapore and South Africa. Table 6 organizes the part-worth attribute values for each of the countries (Singapore and South Africa) based on respondents assessments from the three NAFTA samples. Both Canada and the U.S. reflect disutilities with scenarios including Singapore as the country of carrier. In both cases the disutilities are quite pronounced although not statistically different from one another. The Mexican sample reports a weak positive utility with respect to the Singapore carrier scenarios. Only Mexican

respondents report a statistically significant disutility based on assessments of the scenarios that included South Africa as the country of carrier. Canada reported the largest positive gain in utility (.419) associated with scenarios representing own-country of carrier. The U.S was second (.345) while the Mexican sample reported no substantial gain in utility from scenarios with own-country carrier.

Table 6
Part-Worth Attribute Values for Country of Carrier Variable: Canada, U.S., and Mexico compared to Singapore and South Africa

	Canada	*U.S.*	*Mexico*
Singapore	-.361	-.356	.084
S. Africa	-.013	.014	-.116
Canada	.419		
U.S.		.345	
Mexico			.003

Spain and Great Britain. Respondents from all three countries reported disutilities with scenarios which included Spain as the country of carrier. Table 7 reflects that the Canadian sample reported the greatest disutility while the U.S. and Mexican samples were near identical but reporting considerably lower disutility than Canadian respondents. Both the U.S. and Mexican samples indicated disutility with scenarios including Great Britain as the country of carrier while the Canadian sample report positive utility with the same scenarios. The Canadian sample expressed the greatest gain in utility with scenarios that included own-country of carrier. The Mexican sample, on the other hand, reported very weak positive utility with own-country of carrier scenarios.

Table 7
Part-Worth Attribute Values for Country of Carrier Variable: Canada, U.S., and Mexico compared to Spain and Great Britain

	Canada	*U.S.*	*Mexico*
Spain	-.340	-.111	-.107
G. Britain	.126	-.179	-.107
Canada	.345		
U.S.		.294	
Mexico			.015

Canada, U.S., and Mexico. Table 8 presents the part-worth attribute values associated with scenarios requiring respondents from the three samples to evaluate Canada, U.S., and Mexico as country of carrier. As reported in the table, Canadian respondents reported the greatest increase in utility associated with scenarios that included Canada as the country of carrier. That is to say, Canadians tended to rate scenarios higher (.421) when Canada, rather than the U.S. or Mexico, was presented as the country of carrier. Interestingly, the Mexican sample reported the second-largest increase in utility from own-country scenarios while the U.S. sample indicated the lowest positive increase in utility (.267). Canadian respondents reported significant disutility with scenarios reflecting Mexican and U.S. country of carrier (-.186 and -.204, respectively). Likewise, the Mexican sample reported disutility associated with scenarios that included either Canada or the U.S. as the country of carrier. The U.S. sample reported the largest disutility with Mexican scenarios (-.342) although Canadians also reported net disutility with Mexican scenarios.

Table 8

Part-Worth Attribute Values for Country of Carrier Variable: Canada, U.S., and Mexico

	Canada	*U.S.*	*Mexico*
Canada	**.421**	.057	-.107
U.S.	-.204	**.267**	-.205
Mexico	-.186	-.342	**.312**

Table 9 organizes the information from the conjoint exercise so that relative comparisons between the three NAFTA countries can be made. For the country of carrier variable in the analysis, the difference between the highest and lowest utility for each scenario assessment summed would provide a general magnitude of preference for own-country versus other country scenarios. For instance, with respect to the Canadian respondents, if we summed the difference between the highest and lowest utilities for the Japan-Switzerland-Canada scenarios, the New Zealand-Malaysia-Canada scenarios, the Singapore-South Africa-Canada scenarios, the Spain-Great Britain-Canada scenarios, and the Mexico-U.S.-Canada scenarios, we would arrive at the value of 22.300–the amount associated with the Canadian sample in Table 9. In a similar manner, we could derive the value for the U.S. (18.467) and Mexican (9.180) samples. The derived summed values reflect the extent to which the three country samples prefer their own-country carrier to carriers from other countries. The larger the summed value, the greater the own-country bias. The Canadian sample incurs the largest value which is 21% and 243% higher than values for the U.S. and Mexican samples, respectively.

Table 9

Summated Range of Part-Worth Attribute Values Across all Samples: Canada, U.S., and Mexico[1]

	Part-Worth Summed Range	***Ratio: Canada to U.S. and Mexico***	***% Difference***
Canada	22.300	**1.000**	**0.0%**
U.S.	18.467	**1.209**	**20.9%**
Mexico	9.180[1]	**2.429**	**242.9%**

[1]Only one sample was drawn from the Mexican population. Therefore, to make comparisons to Canada and the U.S., the average range for the single Mexican sample (1.53) was multiplied by six.

Discussion

Data reported in Tables 4 through 8 reflect several patterns. First, both Canadian and U.S. samples reported disutilities with respect to scenarios including Asian countries as the country of carrier attribute. The Mexican sample was quite similar to the other two, however, the pattern was broken with a positive utility associated with scenarios including Singapore as the country of carrier. It is interesting that such a negative perception exists for the Asian carries as both Japan and Singapore are very prosperous, well developed societies with respected air carriers operating throughout the world. Malaysia, while perhaps still in the early-to-mid stages of commercial development, nonetheless, has gained wide-spread respect for its economic "miracle" and rapid progress over the past two decades. Furthermore, its national airline has garnered wide-spread respect as a value-based carrier and a vital member of one of the prominent air alliances. Thus, the low evaluation the three NAFTA samples report is likely a reflection of social distance and cultural biases rather than inferiority with respect to flight-specific attributes.

A second pattern evident in the results is that the Canadian sample consistently reported the greatest disutility associated with Asian country scenarios and the greatest utility increase with own-country scenarios. In each evaluation that included an Asian carrier, the Canadian sample always reported the greatest disutility. Furthermore, in three of the five conjoint evaluations the Canadian sample reported the greatest utility increase associated with own-country scenario evaluations.

In conjoint scenarios comparing Canada, U.S.. and Mexico, the Canadian sample reported a greater own-country utility (.420) compared to the U.S. (.267) and Mexican (.312) samples. Furthermore, the Canadian sample indicated a greater disutility with respect to U.S. country of carrier scenarios (-.204) compared to the U.S. sample's evaluation of Canadian country of carrier scenarios (.057). A similar pattern is evident in comparing the Canadian and Mexican samples--the Canadian sample's disutility with Mexico-

based scenarios (-.186) is greater than the Mexican sample's disutility evaluation of Canada-based scenarios (-.107). In essence, Canadian respondents assigned higher utility to own-country scenarios relative to respondents from the other two countries, and greater disutility to non-own-country based scenarios relative to the other two samples.

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Tourism Research in the United States

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Introduction

In the past decade, tourism research at the national and international level has progressed significantly. National statistical agencies in western nations, in conjunction with the United Nations' World Tourism Organization, have worked to rearrange data in national accounting systems into Tourism Satellite Accounts (TSAs). As a result, researchers have carefully defined tourism, identified its economic significance and mapped recent economic trends.

Attempts to institute tourism research at U.S. universities have been less successful. University-based tourism research centres, created in the 1970s and 1980s, have had to struggle to maintain adequate funding. Many of them have ceased to exist. National and international research strategies have succeeded because they have had dedicated funding from federal governments and because they have made use of existing government infrastructures. In contrast, tourism research Centres at universities have had to rely on uncertain support from industry and state governments. Centre funding has not been part of a coordinated strategy on the part of government or industry and, except for the Centres at mid-western land-grant institutions, there is very little infrastructure to sustain relationships between the Centre and community.

This paper will begin with a brief account of recent tourism statistics. It will progress to an overview of national and international tourism research initiatives. Then it will outline how university tourism research could supplement and enhance the work already done. Finally it will discuss attempts to institute tourism research in

universities in the U.S. and provide an analysis of why some Centres have succeeded while others have not.

Tourism Growth

The World Tourism Organization calculates that, between 1989 and 1998, tourism arrivals have increased worldwide at an average annual rate of 4.5 percent and international tourism receipts[1] have increased by 7.9 percent annually over the same period.[2] By 1997 tourism receipts accounted for 35 percent of the total world exports of services.[3] Between 1989-1998 the value of tourism receipts worldwide increased by U.S. $218.2 billion. 27.4 percent of the increase was in the Americas and 51.8 in Europe.[4]

Tourism is growing at faster rates than other sectors and it contributes significantly to the U.S. economy. In 1992, expenditures for travel and tourism accounted for 4.6 to 5.3 percent of U.S. GDP.[5] Value added in travel and tourism is estimated at 1.9 to 2.2 percent of U.S. GDP.[6] International tourism is particularly important to the U.S. economy because it helps balance U.S. trade accounts. In 1993, the U.S. travel trade surplus was $22.2 billion, equal to the U.S.'s trade deficit to Japan in motor vehicles.[7] In 1998, the U.S. ranked first in tourism earnings, capturing 16.2 percent of the global total. Italy was a far second with 6.9 percent. This of course partly reflects the high value of the U.S. dollar relative to other currencies. The U.S. does in fact need to be concerned about losing its market share of international tourism – earnings decreased by 2.9 percent between 1997 and 1998.[8] The U.S., with 7.3 percent of total arrivals, ranks as

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[1] Excluding transport, a major expenditure
[2] World Tourism Organization, *Tourism Highlights 1999*, May 19, 1999.
[3] *Ibid*, p. 3.
[4] *Ibid*., p.9.
[5] Sumiye Okubo and Mark A. Planting, "U.S. Travel and Tourism Satellite Accounts for 1992", *Survey of Current Business*, U.S. BEA, July 1998 p. 9.
[6] *Ibid*.
[7] Tourism Policy Council, *Tourism Putting the Pieces Together*, 1995, p. ii.
[8] *Ibid*, p. 15.

the third top destination for tourism – down 2.8 percent between 1997-1998. France is first with 11 percent and Spain is second with 7.5 percent.[9] At the same time, U.S. citizens are the biggest tourism spenders, responsible for 13.5 percent of the global total, up 6.6 percent between 1996 and 1997. Given its rate of growth, its contribution to the U.S. trade balance and GDP tourism is a significant enough industry to warrant research.

U.S. National and International Tourism Initiatives

Tourism research has progressed significantly in the past decade. The World Tourism Organization (WTO), the Organization for Cooperation and Development (OECD) and national statistical agencies in various countries have been working to define the tourism and to develop the means to measure its economic significance at the macro level – both national and international.

Measuring the economic performance of the tourism industry has been facilitated by the creation of Travel and Tourism Satellite Accounts (TTSAs). The purpose of a TTSA is to provide a framework for analyzing expenditures on tourism goods and services. Satellite Accounts rearrange the data contained in the national accounting systems in order to measure industries such as tourism and transportation that are not directly reflected in the Standard Industrial Classifications (SICs).[10] In 1998, researchers at the U.S. Bureau of Economic Analysis created a prototype TTSA using 1992 data.

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[9] *Tourism Highlights 1999*, p. 14.

[10] The United Nation set out the guidelines for satellite accounts in the *System of National Accounts* 1968, revised in 1993. Satellite Accounts help to determine the impact of economic activity on the environment, the value of research and non-market activities or goods and services sold for less than the cost of production – i.e. government and non-profit. *Technical Note on OECD National Accounts*, "The Conceptual Framework Underlying the National Accounts. http://www.oecd.org/std/natechn.htm

The objective of the TTSA is to re-present existing data to reflect tourism expenditures, supply, demand and employment. Prior to extracting data from the input-output (I-O) accounts for the TTSA, researchers had to define a tourism industry, a tourist or visitor and a tourism commodity.[11]

- A **'visitor'** is defined as "someone outside of his or her 'usual environment' – the place of normal activities, residence, leisure, study and work or an area within 50-100 miles from home – and includes both business and leisure travellers.
- A **tourism commodity** is "a good or service *typically* purchased by a visitor" determined by surveys of U.S. travellers – hotels and transportation services are the most obvious ones.
- A **tourism industry** sells "a significant" portion of its output to visitors, its revenues and profits would be seriously affected if tourism ceased to exist.[12]
- **Tourism demand** includes "travel-related expenditures made by all visitors, before, during and immediately after each trip" including business, leisure, international and domestic travel.
- **Tourism supply** is "the total amount of a tourism commodity available to be purchased by business, households and government and to be exported."[13]

Once tourism categories were defined for the TTSA the categories could be applied to the data in the I-O accounts. I-O data have been crucially important to the creation of the TTSA. They provide measures of output by commodity and industry, they contribute estimates of industry and final use expenditures necessary for identifying tourism expenditures by type of visitor and they link expenditures to industry output and GDP. Consequently, the data in

[11] "U.S. Travel and Tourism Satellite Accounts", 1998 p. 11.

[12] The WTO or OECD definition of a tourism commodity is slightly different, it is "the share of commodity purchased by visitors or produced primarily as an attraction for visitors." *Ibid*, p 11-13.

[13] *Ibid.*, p.15

the I-O accounts have made it possible to assess the significance of tourism and compare it to other industries.[14]

In order to incorporate I-O data into the satellite account, ratios for the tourism component of selected industries (SIC) had to be determined. For example, while hotels and lodging places and passenger rail and air transportation can attribute virtually 100 percent of their revenues to tourism, other important tourism industries cannot. Eating, drinking, recreation, entertainment and retail establishments owe only a portion of their revenues to tourism. The TTSA also had to disaggregate resident and nonresident purchases from the I-O accounts and the outputs of nonprofit institutions (parks, museums and government) had to be included.[15] Tourism industry ratios are important measures because they facilitate the calculation of tourism value added and employment. The ratios are applied to data on industry value added and employment in order to produce estimates of tourism employment and value added to GDP.[16]

How did researchers come up with the ratios? The calculations for the tourism industry ratios are derived from data collected in the Bureau of Labor Statistics' *Consumer Expenditure Survey* (CEX). Data from and different categories within the I-O Accounts had to be reorganized. In the I-O accounts business travel data are included as intermediate purchases, travel by government employees is in government final expenditures, non-resident expenditures are reported as exports and all other travel expenditures are allocated to the Personal Consumption Expenditures (PCE) category.[17] The PCEs include expenditures by U.S. residents in foreign countries and exclude the spending of foreign travellers in the U.S.

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[14] *Ibid.*, p. 13.
[15] *Ibid.* The TTSA has them as admissions paid by visitors rather than as current expenditures, as they are in the I-O accounts.
[16] *Ibid., p. 16-17.*
[17] *Ibid.* p. 18.

The CEX is the only way of separating visitor and non-visitor spending. The problem with this method is that estimates drawn from the CEX are 30 percent lower than the ones from the PCE. Why? Because the CEX is a general household survey, not a travel survey. The sample size is small (5,000 for the entire U.S.). The survey is detailed and complex – tourism data is only a very small component at the end of it and there are high rates of non-response and involves significant recall error. Tourism expenditures are likely to be under-reported – the most reliable reporting is for large (i.e. autos) or regular purchases (rent). Surveys designed to measure travel specifically produce higher estimates than the CEX.[18]

A Note on Transportation: Canada's Tourism Satellite Account

Canada and Norway were the first countries to develop tourism satellite accounts (TSAs). With the *Canada Travel Survey* (CTS), Canada is also ahead of the U.S. in collecting tourism specific data for the TSA. For tourism statistics in Canada there are now two data sets – from the 1988 and 1992 Tourism Satellite Accounts respectively. In order to provide timely updates on tourism trends, Canada has also created National Tourism Indicators (NTIs) to provide tourism industry data on a quarterly basis.[19]

Transportation, accounting for 40 percent of tourism demand[20] in Canada, is one of the most significant components of tourism. Passenger air and rail transport, inter-urban bus transport, vehicle rentals, vehicle repairs, parts and fuel as well as boat, urban transit, taxis and parking are all very important indicators of tourism activity. For travellers, transportation is the biggest tourism expense, especially when it involves overseas air travel or for business travellers.[21] Air transportation alone accounts for over half of all

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[18] *Ibid. p. 19.*

[19] Statistics Canada, *Guide to the National Tourism Indicators: Sources and Methods*, 1996 p. 10.

[20] Statistics Canada, *Tourism Statistical Digest: 1999 Edition*, November 1999, p. 59.

[21] *Ibid.* p. 24.

transportation expenditures.[22] In 1997, Canadian airports received 6.6 million international visitors, a 45 percent increase since 1990! The Open Skies Agreement between Canada and the U.S. and the introduction of new international routes and more direct flights to Canada explain that growth. The U.S. air travel market expanded 36 percent between 1990 and 1997.[23] While transportation accounts for 17 percent of tourism jobs[24] (food services provides the greatest number), it provides the best jobs in the industry, especially the air transportation sector.[25]

Statistical Research – Necessary But Not Sufficient

Notwithstanding the very significant work done on the national level to calculate the value and significance of the tourism industry, it is clear that more work is required just to improve estimates of tourism's impact on the national economy. Travel specific tourism surveys need to be administered, investment in tourism industries, including the cost of providing public facilities such as parks, museums and other government supported attractions needs to be incorporated into the TTSAs.[26] The latter is not currently done. Finally, travel and tourism expenditures need to be carefully broken down by region or state.

The creation of tourism satellite accounts for the statistical measurement of tourism has gone a long way to improve our understanding of the tourism industry. Tourism is a complex industry involving natural and cultural assets, other public goods and large corporate businesses as well as small and medium sized enterprises. Tourism research needs to be interdisciplinary. The impact of tourism

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[22] *Ibid.*, p. 61.
[23] *Ibid.*, p. 32.
[24] *Ibid*, p. 62.
[25] Travel Industry Association of America, *A Portrait of Travel Industry Employment in the U.S. Economy.* http://www.tia.org/research/summemploy.asp
[26] *Ibid.*, p. 22.

on the environment and on communities needs to be explored in order to determine the true costs and benefits of tourism development. Tourism marketing and development should involve research that measures human motivation that cannot be reduced to economic reasoning. The costs and benefits of infrastructures required to fully develop tourism need to be planned and assessed.

In fact, the need to go beyond statistics is recognized. In 1995, the Tourism Policy Council, a federal department, came out with a strategic plan for tourism development in the United States. The plan identified the need to coordinate federal government initiatives with regional or state organizations and plans. The Policy Council's plan targeted nine strategic areas for tourism development including:

i. Research – to provide information on number of travellers, trip or traveller characteristics and motivations, economic impacts, market trends and forecasts

ii. infrastructure development – to coordinate services, maintain attractions and transportation networks and develop intermodalism

iii. product development – development of tourist products and services – tours and destinations

iv. promotion – providing information to potential customers

v. facilitation – provision of signage, documentation, electronic information and visa processing

vi. reduction of barriers -- to make laws, regulations and policies that encourage tourism

vii. training – hospitality, marketing, visitor services, natural resource and destination management

viii. the environment – to ensure that natural and cultural attractions are sustainable, not damaged by tourism

ix. safety and security – to prevent problems by ensuring travellers have adequate information about health hazards and crime

The Policy Council laid out a strategy to coordinate national research and policy initiatives with local governments, businesses and community groups. Oddly enough the universities were not considered in the plan. Yet university Tourism Centres and departments in the U.S. are already doing research related to much of the work set out in the Policy Council's strategic plan.

University Tourism Centres: Origins and Purpose[27]

University based Tourism Centres were instituted in the 1970s and 1980s to help promote the growth of the tourism industry in their states, either by providing appropriate training programs or research in business management, natural resources management and marketing. The Centres' research was designed to help government agencies promote and develop state recreation and tourism resources, to aid tourism businesses with planning and marketing and to provide legislators with the research necessary for them to make informed policy decisions. The economic data collected by Tourism Centres is necessary to supplement national statistics with state and regional data.

Tourism Centres collect, manage and analyze data on the tourism industry. They formulate economic and statistical models that can be used by consultants for feasibility and economic impact studies; in providing tools of analysis to consultants, university centres

[27] The findings presented in this section come from a survey of Directors of university-based Tourism Centres in the United States. Of the 20 Centres we identified, we were able to interview the Directors of 17. Questions focused on the Centres' start-up and annual funding, administrative structure, research and relationships with the community – within the university, with the government agencies, tourism consultants and the tourism industry. The Centres are at universities in Arizona, Colorado, Florida, Illinois, Indiana, Massachusetts, Minnesota, Nebraska, Oregon, Pennsylvania, Rhode Island, South Carolina, Texas and Wisconsin.

differentiate their research and raise the overall standard of consultant research. They also provide technical assistance, training and independent assessment of government policy relating to taxation, natural resources and community economic development. They assess the environmental, social and political impacts of tourism development and tourism events. Through academic journals, university researchers communicate recent developments in tourism research. The most important journals relating to tourism studies and economic or statistical modeling related to tourism studies have emerged out of university work. The Centres use academic research and methods to solve problems encountered by the tourism industry and communities with a stake in tourism development.

The Centres are interesting case studies of problems that arise within industry/university or university/government partnerships. Virtually all of the Centres work to support the development and marketing of the tourism industries in their states. In many cases, research agendas are driven by industry needs. The Centres rely heavily on the advice of external advisory boards composed of representatives from government and industry. The Centres' research agendas are sometimes driven by the interests of researchers, but more often by contracting parties or through representatives on their advisory boards. These boards provide the Centre with problems that industry needs to have solved. In offering feedback to the Centre, they informally set the research agenda and evaluate the Centres' work.

The Ideal Tourism Centre

Our criteria for a successful Tourism Centre are:

i. the security of funding

ii. ability to link academic research with the needs of the community

iii. the independence of research findings – academic integrity and significance

iv. ability to provide research as a public good

v. ability to differentiate its research from that of consultants

At their best, university-based research centres provide research, technical assistance and training to the community as a public good. Users do not pay or pay only minimal fees for university provided services. This is only possible when the Centre has secure base funding, either through the University Extension Department and/or Agricultural Research Station, from the state legislature or from their state tourism agency. Untied funding enables these Centres to provide high quality, academically credible, and independent research.

Funding and Administration

As funding and administrative models, the Centres can be classed as:

i. Extension based

ii. Legislature funded

iii. Contract based

Centres in Extension Departments at the land grant institutions in the Midwestern United States have stable funding, the capacity to do non-proprietary research and support in the community. The Extension model involves a very important commitment by the university and benefits from the fact that there is a pre-existing infrastructure in both the university and a presence in communities throughout the state. Base funding exists for extension-based Centres and tends to be much more stable than that provided in the other models.

The two most successful extension-based Centres are at Michigan State University (MSU) and the University of Minnesota (UMN). These Centres each have between $400,000-$600,000 funding per year. 30-50 percent of it is untied. The MSU Centre collects, manages and disseminates information on the Michigan tourist; demographic and economic information is collected for each county in the state, much of the information is destination specific. The

information is kept in a database. UMN specializes in the creation of economic models for tourism economic analysis.

Legislature funded Centres can be well financed and certainly depend on sustaining support from the community – industry and government. They can do real academic research. They provide independent assessment of tourism policies and they manage databases on the economic and sometimes social impacts of tourism on local attractions and communities. The Montana Centre, for example, maintains a database on the social impact of tourism – how citizens in local communities perceive tourism development. The Centre also specializes in assessing the environmental impact of tourism. The Centre at Texas A&M manages a database on the economic impacts of tourism statewide.

Centres reliant on funding through either their state agency or their state legislature are amongst the best funded of centres. These Centres average about $300,000- $400,000 a year in total funding, 50 percent of it from the state legislature. Unfortunately legislative funding, partly because it tends to come from some form of dedicated tax, is subject to the vagaries of politics.

Two important Tourism Centres no longer exist because the state legislatures pulled their funding.[28] The University of Wisconsin-Madison Centre was housed and administered by the university extension department but its research budget came from a special allocation from the legislature. While it existed, the Centre collected and disseminated statewide economic data; it also produced educational materials for tourism businesses and offered extension seminars. Partly because of the success of tourism initiatives in Wisconsin, the state tourism agency's mandate was expanded and the Governor, in search of funds to administer new programs, seized the funds allocated to the Centre. The University of Wisconsin-Madison

[28] The University of Montana Centre is funded from a 3 percent tax assessment on all hotel/motel receipts in the state. Its funding, for the moment, is secure.

Centre was then disbanded for lack of funding. Funds that had gone to research now go for promotion.

The University of Colorado-Boulder centre depended on funding granted by legislation that allocated 1/10 of 1 percent of all tourism-related receipts to university research. This Centre, housed in the Centre for Business Administration, had been doing tourism research since 1910 but in 1993 its funding was cut. Funding for the Colorado Tourism Board was voted down in a statewide referendum. The Centre got its funding from the Board's budget. Even so, the Colorado Centre started up and continues to edit an important tourism journal, the *Journal of Travel Research.*

Centres that rely on contract funding essentially compete with consultants. Contract based Centres are not viable. In the U.S. legislation prohibits universities from actively competing with consultants – they can only do work consultants cannot do or when they are approached with a special request. Contract-based Centres are within departments that teach tourism studies. Consequently contract research can give students the opportunity to obtain practical work experience in some aspect of tourism research and can provide university researchers with necessary data for academic work. Otherwise, the university gets very little benefit from doing contract work and it is likely not the best use of university resources.

The long-term interests of the industry and communities would be better served if the expertise to be found at universities was used effectively – for primary information gathering, management and critical analysis. The Centres with stable base funding do not compete with consultants for projects. These Centres take on special contracts related to their primary research or as a means to obtain data necessary for building new economic or statistical models or for testing or improving the quality of their databases. The relationship between these centres and consultants tends to be mutually beneficial and cooperative. The Centre sometimes hires consultants to work on specific projects and Centre researchers provide outside consultants

with improved models for their conversion studies and economic impact studies.

Extension based centres have been the most successful because they have dedicated funding, administered through the university system. They are also visibly active in counties throughout their state and can draw from infrastructure support within those communities. Legislature funded Centres have sufficient but not secure funding. Neither has been able to secure funding necessary for growth.

Why Is There No Money for Tourism Centres?

Given the objectives set out at the national level by the Tourism Policy Council and given the recognized importance of tourism to the U.S. economy, it is odd that university-based tourism Centres have not been more successful, especially since they are doing work policy-makers have targeted as necessary. While Tourism Centres are scrambling for funds, it is estimated that U.S. Federal Government funding for travel, tourism and recreation totaled $1,014,000,000.[29] Why is there such a discrepancy?

All the directors interviewed complained about the industry's inability to understand the significance of research, that industry tended to want short-term research with a predetermined outcome. Lacking stable funding, once vibrant centres have ceased to do any work with the community outside of the university. Others have become one man operations within a university department. Of the 17 Centres studied, ten of them are inactive, defunct or scraping by on contract-based funding. Some of the most important problems encountered by the Centres include:

i. Lack of awareness on the part of industry or governments of the value of high quality (long-term and critical) research.

[29] Tourism Policy Council, *Tourism: Putting the Pieces Together*, p. 100. This is based on an inventory of programs conducted in 1993-4.

ii. University administrations often do not consider tourism research a serious or academically acceptable field. Consequently, universities balk at funding tourism research and professors doing tourism research do not necessary get promoted within the university system.

iii. Dependent on funding from government agencies or sectors of the tourism industry, university Centres are sometimes at the mercy of their funding source. This potentially compromises academic credibility and can jeopardize the Centre's existence.

iv. Given the requisites for promotion within the university system, tourism professors sometimes do, or are perceived to be doing research not relevant to the needs of the industry. Failure to keep in touch with the industry or to do research considered relevant to industry needs was part of the University of Wisconsin-Madison Centre's problem.

Conclusions

Recent work to develop means of measuring the economic significance of tourism at the national level has been successful. The development of Tourism Satellite Accounts in the U.S. and Canada has significantly improved our understanding of the tourism industry, its pattern of growth and its value to national economies. Much more research needs to be done if tourism attractions, businesses and infrastructure are to be properly developed and maintained. The real costs and environmental and social impacts of tourism still need to be carefully assessed. Tourism Centres within the universities are already doing much of the work that, at the federal level, has been deemed necessary. State legislatures, state tourism agencies and the tourism industry have not provided reliable support for the Centers. The Federal Tourism Policy Council, state tourism agencies and legislators and university-based Tourism Centers should coordinate their efforts.

"Quit Yanking My Supply Chain" – The Challenges Facing Travel Agencies in Canada

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Abstract:

Travel agencies in Canada enter the new century with many challenges. The gap that they must bridge is a possible erosion of both revenue and customers. The aviation industry has been imposing caps on commissions resulting in the requirement for agencies to sell more travel products to generate the same revenue. At the same time, selling more travel products could be more difficult as air carriers, hotels, car rental firms and cruise lines are increasingly offering more direct sales on the Internet. This web presence has enabled the travel product "suppliers" to sell directly to their customers, bypassing the travel agencies in the supply chain. There is also increased competition from travel sales web-sites that attempt to attract the business that local travel agents once could have considered as their own. The paper will examine the nature of the challenges facing this service industry and the possible responses.

The Present Situation

In 1997, almost 27% of Canadian travel agencies operated at a loss and some in the industry saw more trouble ahead.[1] "At least half of

the 35,000 jobs held by travel agents across Canada will vanish in a restructured airline industry that is already eliminating travel agents by slashing commissions and steering the public into direct and Internet bookings" was the forecast of past-President of the Association of Canadian Travel Agencies.[2] In a debate in the House of Commons, one MP suggested that "Travel agents should probably start looking at college and university courses for a new career because electronic commerce is pretty well going to make them redundant".[3] What are the reasons for these predictions?

In the past, travel agents have been important for transportation carriers, hotels, car rental firms, tour operators and cruise lines, to sell their products and services to the public. In the supply chain, travel agents have traditionally been the final link to the actual consumer. "Travel agents are by far the most important distribution mechanism for air travel, accounting for more than 75 percent of ticket sales by scheduled airlines in Canada".[4] This importance of travel agents to transportation carriers was mirrored by the carriers' commission payments to the travel agents.

Commissions & Service Fees

The compensation that travel agents received from transportation carriers has typically been their largest revenue source. Table 1 shows that these accounted for over half of the travel agency revenues in 1997.

Table 1
Canadian Travel Agency Revenues by Source, 1997

Source of Revenue	Percentage
Transportation fares	53.3
Tour packages	25.8
Insurance products	5.2
Cruise packages	5.1
Accommodation	4.0
Other commissions	1.9
Auto rentals	1.6
Service fees	0.4
Other	2.7
Total	100.0

Source: Adib Farhat, "Profile of Canada's travel agency industry", Services Indicators, Statistics Canada catalogue no. 63-016-XPB, Vol. 6, No. 3, page 34

Transportation fares revenue, is typically paid to travel agents on a commission basis. One major challenge facing this industry is that of declining transportation commissions and commission caps. The commission is typically a percentage of the selling price of the service sold. For domestic air travel, caps or a maximum dollar amount per transaction on the commissions paid were introduced in 1996. To cushion travel agents somewhat to the introduction of these caps, the domestic commission rate was raised from 8.25% to 9%. However, by the fall of 1999 this had been decreased to 5%.[5] Falling commission rates and commission caps mean less income for the same amount of product sold. To avoid a decline in income, a travel agency would have to:

- increase the amount of product sold;
- sell more expensive or alternate products or complimentary products to customers;

- add a service fee to transactions.

It does appear that there has been more product sold but there were still negative revenue implications. From 1998 to 1999 Air Canada reported an increase of 10.9% in passenger revenue, an increase of 4.8% in food and beverage supplies. Despite these indicators of increased passenger traffic, Air Canada reported a decrease of 9.5% in commissions paid.[6]

The recent emergence of an Air Canada that no longer has to compete with Canadian Airlines has also had an impact on travel agents' commission income by affecting the traditional manner in which "override commissions" are calculated. Carriers can pay an additional commission referred to as an "override" commission to encourage travel agents to book clients on their flights rather than on a competitor. They are typically awarded on the basis of total revenue sales or "greater market share or number of segments booked.".[7] "For example, if a carrier's market share based on sales for a particular city is 55 percent, the airline would only pay the override if the travel agent books 55 percent or more of its total sales with that carrier".[8] Effective February 2000, Air Canada announced that there would be a change in the calculation of the domestic override commission. As they no longer must compete with Canadian Airlines for market share domestically, the override will only be awarded for bookings to the United States and internationally.[9]

Selling more expensive or alternate travel packages or complimentary products to customers are other options for travel agents. The equivalents of "Do you want fries with that order" are products such as travel, cancellation and medical insurance. Table 1 shows that insurance, accommodation and auto rentals generated 10.8% of travel agent revenues in 1997. If airline compensation is insufficient due to commission cuts and capping, agents could "stop selling airline products".[10] Emphasis could be made on other

complimentary products such as cruises, auto rentals, tour packages and hotels. The suppliers of all these travel products are also using the Internet for more direct selling of their services. This will be discussed later in the paper.

Adding a service fee to transactions to make up for less commission revenue is the response that appears to have garnered much attention. While it has been reported that "more than 50% of travel agents in Ontario charge service fees", the impact still has not been pronounced.[11] While the "proportion of revenues that travel agencies derived from service fees almost doubled in 1997" these fees still compromised less than 1% of Canadian travel agencies' revenues (see Table 1).[12] While some firms see the service fee as the solution for travel agencies, there are chains that state that "Having no service fees will be the point of difference between us and the competition".[13] It may also be difficult to get consumers to accept the service fee unless the travel agencies can demonstrate that they are providing extra value for the fee. Otherwise travel agencies could lose business to new competitors such as those selling travel services via the Internet.

The Internet: Threat or Opportunity?

If one looks at the topics of discussion at meetings and conferences of travel agents, there seems to be equal weight being given to the Internet as both the biggest threat and the biggest opportunity to travel agencies. The threat comes from increased competition from travel web sites and virtual travel agencies which consumers can easily reach to book travel. It also comes from the actual suppliers of the services (airline tickets, tours, car rentals, cruises and accommodation) that travel agencies sell, offering their product directly to consumers and by-passing travel agents in the supply chain. How big is this threat? A Vice-President of the Alliance of Canadian Travel Agents was reported as saying that "Internet sales are only about 1%" of all the tickets sold.[14]

If Internet ticket sales are so low, why are travel agents worried? They are concerned that there will be fast growth in this area. The United States based on-line travel site Travelocity states that "since its launch in March of 1996, Travelocity.com has registered more than 9 million members and logs more than 100 million page views per month.[15] A report, released by the Travel Industry Association of America in the United States, claims that 52.2 million customers used the Internet for travel planning and 16.5 million actually made travel reservations over Internet in 1999. (These estimates were based on a sample of 1200 in August 1999 in the United States.)[16]

In 1997, Air Canada and Canadian Airlines began to directly sell heavily restricted discount fares via the Internet. This has since been expanded to their full product range. "There are many reasons that the air carriers would be attracted to this method of selling their services. Among the attractions are:

- a cost effective means of reaching many potential clients;
- the direct selling aspect can reduce commissions;
- personal computer users tend to be higher income and have a higher propensity to travel;".[17]

The potential client base for direct Internet sales is quickly growing in Canada. In 1998, "Fully 45% of households reported having a computer, almost twice the proportion from five years ago when 23% reported owning a computer. ... 25% of households reported having access to the Internet from home compared with only 17% in 1997.".[18] "Higher income households were nearly five times more likely than the lower income households to be regular users of computer communications in 1998".[19] Home computers with Internet access are being quickly adopted by higher income families and "There is a strong relationship between income and the tendency of people to travel by air".[20] Thus, the risk to travel agencies of

being by-passed in the supply chain by their suppliers selling directly to the public is increasing.

But bypassing travel agencies could hardly be described as strengthening the supply chain. In the mid-1990's it was suggested that "Supply chain performance is measured by the ability of logistics systems to improve customer service, lower costs and increase market share for not only the firm; but, all participants in the supply chain.".[21] By the late 1990's a different philosophy was being expressed namely "organizations must now consider scrapping rather than optimizing their value chains... In fact, many are pre-emptively destroying their own value chains...They use digital technology to break the rules, implicit or explicit, that dictate how buying, selling or producing goods and services is done. They form new relationships with customers...The company will not need an expensive sales or distribution function because it will outsource order processing to the customer.".[22] In his appearance before the Standing Committee on Industry, the Executive Director of the Association of Canadian Travel Agents summed up the situation as "competition between affiliated retailers and suppliers does exist and is increasing".[23]

There is not universal agreement as to whether bypassing the travel agency link in the supply chain leads to savings for the suppliers. While "In the U.S., Delta Airlines calculated that Web sales were four times cheaper than selling tickets through a travel agent, the most expensive method for the airlines."[24] it has also been stated by the Saskatchewan branch of the Association of Canadian Travel Agents that "it is probably less expensive for the airlines to pay travel agents than to set up a system to handle all of their own ticketing".[25]

As mentioned earlier, SABRE (the reservation system provider that operates the Internet travel web site Travelocity.com) claims to have sold over 3 million airline tickets online since 1996 and "logs more

than 100 million page views per month".[26] These two figures perhaps provide support for the travel agencies' claim that there are many costs not presently born by airlines, hotels and cruise lines that a pronounced move into direct selling to the public could incur. The Travelocity numbers show that for every passenger purchase there was a very high volume of looking and researching before, or even without, buying. If directly selling to the consumer, the travel supplier will need to provide infrastructure, with the related costs, to enable all this searching, looking and booking. When a travel agency does the selling, the airline, car rental firm, hotel or cruise line must pay a commission only on the actual sale regardless of the amount of time that the travel agent has spent finding possible routings, prices and options. When a sale cannot be completed, the cost is solely the travel agent's.

Whether or not there are savings for the carriers, car rental firms, hotels or cruise lines, there may be other reasons to directly market electronically. One is to obtain information on customers or potential customers. For example, "Continental [Airlines] plans to harness technology that will track visitors' e-mail addresses to register which flights they request when they visit the site".[27] By directly marketing and developing a better understanding of the requirements of their customers, this may facilitate better products, services, prices and marketing.

Travel agencies themselves can also adopt the Internet as a lower cost means of reaching the public and to expand their potential markets. This was the general advice of the CEO of United Parcel Service to industries that were essentially middlemen: "this new model doesn't mean that all middlemen in the supply chain simply go away. They'd just better be wired and ready to respond fast when the end user pulls the supply chain.".[28] Travel agencies can deliver value to customers in terms of product knowledge, a greater choice of products and possibly better prices. With respect to prices, for example, "An American Express report in November said domestic air fares had increased 34% since February 1996, but that the

average fares actually paid had increased much less than that because corporations were using "a sophisticated travel agency's low-fare search tools and requiring employees to accept the lowest logical air fare".[29] Despite recent developments, travel agencies may still hold competitive advantages. Travel agencies can employ new technologies for wider access to other markets, fast consumer access and easy dissemination. These can be combined with the value of knowledge of products, prices, and destinations that they have traditionally had. This may be the evolutionary solution required for them to survive.

Conclusion

Travel agency revenues in Canada are threatened by commission cuts and caps. Another potential threat is increased competition from their traditional suppliers bypassing them with more direct sales to their customers, especially by means of the Internet. A possible response for travel agencies appears to be their adoption of the Internet to widen their geographic reach and to provide better service to customers so that they can remain a viable link in the supply chain.

Note:
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Overview: Railways and the Environment Workshop

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A Renaissance

Major players in the railway industry gathered for *the Railways and the Environment Workshop*, held in Winnipeg, June 1999. The purpose of the workshop was to assess the challenges facing Canada's environmental concerns. Workshop participants emphasized that the rail industry offers a means to reduce the environmental impact of moving freight in Canada.

Transportation originated emissions can be reduced by changing human activity, modal shifts and technological innovation. While it is difficult to change human activity, a modal shift from truck to rail is practical and feasible. The application of existing technology will make a major contribution to emissions reduction. The future promises a renaissance for railways.

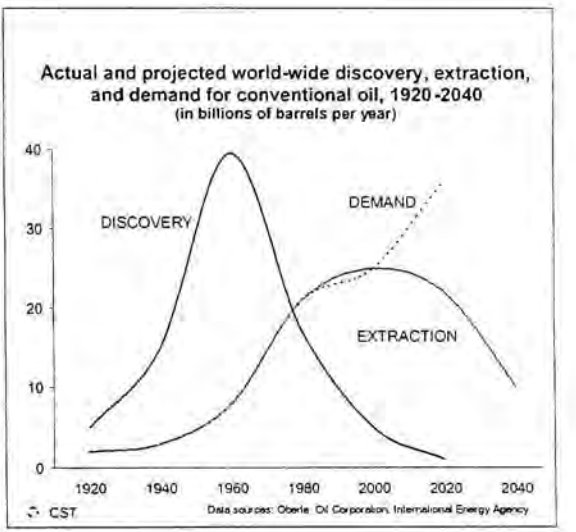
The Problem

Richard Gilbert, from the Centre for Sustainable Transportation, focusing on the relationship between transportation and the environment, discussed "sustainable transportation" defined as: "Transportation that meets our economic and social needs without harming human health or the environment. In short, transportation that does not mess up the planet for our grandchildren."

Transportation is responsible for, most of Canada's local pollution, one-third of Canada's contribution to global pollution, over half of the current increase in greenhouse gases and more than two-thirds of Canadian oil consumption. Dramatic changes in the environment and

oil consumption are expected. The surface temperature of the Northern Hemisphere over the past 1,000 years demonstrates the warming trend since 1900. 1998 was the warmest year in recorded history and measured the largest incremental increase from the previous year. Global warming, no longer disputed in knowledgeable circles, is an issue that must be addressed.

The demand for petroleum products for transport has grown steadily with worldwide access to cheap oil. The situation is about to change dramatically. Major oil discoveries peaked about 1960. Prediction models indicate that the access to cheap oil will end in the next decade. Oil production will shift to more expensive sources such as the oil sands projects. The mechanical means to extract oil from conventional wells will become more costly. The graph of predicted discovery, extraction and demand curves highlights the problem.



A negative economic impact of higher oil prices can only be avoided if demand for fuel is reduced. Technology is likely to be less than half the solution. The other half must come from profound changes in

mode shares and activity changes. The OECD sees the effort to attain sustainable transportation concentrated in these areas:

Area	Passenger	Freight
Technology	41 %	47 %
Occupancy	15 %	10 %
Mode shifts	7 %	24 %
Activity	26 %	19 %
Downsizing	11 %	0

Increasing oil prices will have significant effects on oil production. Rising prices will lead to increasingly unconventional oil production. The cost of energy extraction will become greater than the value of the energy extracted. Correspondingly, the environmental impact of energy production will worsen.

Canada's Railways Today and Tomorrow

Bob Ballantyne, Railway Association of Canada, placed Canada's railways in the transportation emissions environment. Under the Kyoto Accord, Canada must reduce its greenhouse gas emissions by 6%. Transportation contributes to 27% of the emissions while railways represent only 4% of the transportation sectors emissions.

Railways have been operating in Canada for 162 years on privately financed infrastructure. The history of the industry reflects major economic and social changes – the role of trade unions, world wars, bankruptcies, nationalization, highway construction, civil aviation, seaway construction, dieselization, free trade, partial deregulation and recently, the privatization of Canadian National. Social change and economic globalization have consolidated North American railways into 4 "mega" class 1's and 500 short-line or regional carriers in the United States and 2 class 1's and 42 short-line or regional carriers in Canada.

Revenue per tonne kilometer has fallen from 2.54 cents in 1989 to 2.35 cents in 1997, a drop of 7.5%. This benefit to shippers has been accomplished through major productivity gains, an increase in

revenue tonne kilometer (RTK) per employee of 93% since 1988. An all-time high of 304.2 billion RTK has been generated. The $458.9 million bill for fuel, property and other sales taxes is responsible for the reduction in revenue per RTK. It amounts to 19.5 billion RTK of the 304.2 billion RTK. Rail fuel taxes are disproportionate across Canada, do not reflect infrastructure investment and ignore the reality of the emissions problem in the transport sector. The following table compares rail and truck fuel consumption levels.

	Billion RTK	Fuel Consumption (litres)
Rail	304	2.15 billion
Truck	233	10.9 billion

Rail is ten times more efficient than truck because it has lower rolling resistance – the percentage of weight on the axles. Rolling resistance for trains is approximately 0.1%, for trucks 0.5% to 1.5% depending on tire and road conditions. For competitive traffic rail is three times more fuel-efficient.

Rail emits fewer greenhouse gas emissions. Rail carbon dioxide emissions have declined from 39.86 Kg/1000 RTM in 1975 to 27.956 in 1997. Fuel consumption has declined at an average rate of 1.9% per 1000 GTK since 1990. Technological changes are responsible for the improvement – new locomotives, train handling, rail lubrication, more productive freight cars, increased gross weights and continuous research and development on all aspects of rail operations.

Canadian Railways are actively working to reduce emissions. In 1995 a voluntary MOU between Environment Canada and the RAC was reached to limit NOx to 115 KT/year subject to traffic growth levels of 1.5% per year. In 1997, NOx emissions were 121 KT with traffic growth averaging 4.3% since 1990.

Railways make more efficient use of land relative to increasing levels of traffic. The railways can double track a single-track corridor and expand capacity without further land requirements. This is not possible in congested truck corridors.

Over the past 50 years there has been a dramatic shift in market share between the railways and the trucking industry. In 1955 rail enjoyed just over 80% of the market. By 1995, rail's share had dropped to less than 40%. Public policy on pricing for the use of publicly provided infrastructure, taxation levels and regulations have favoured truck.

Fuel taxes and capital cost allowance rules have disadvantaged the railways and limited their ability to invest in new equipment. A comparison of tax burdens between industries graphically highlights the disparity between modes within Canada and between Canada and the United States:

Industry	Tax as % of Revenue	USA
Marine	2.9%	
Manufacturing	4.9%	
Air	6.3%	3.2%
Motor Carrier	7.9%	8.1%
Railway	14.2%	8.1%

Meeting Canada's greenhouse gas emission targets will require us to look at the discrepancies between the trucking and rail industry. Reversing the trend to increased trucking will help Canada achieve its goals. Trucks produce 22.8% of the GHG from approximately half of the GTK; rail produces 3.8% of GHG from the other half of the GTK. Rail performance is six times better than truck's.

Harry Gow, Transport 2000 Ottawa, focused on passenger rail arguing that the decline of rail passenger service in Canada (VIA) is attributable to public policy decisions. New rail passenger operations are entering the market such as Great Canadian Rail Tours but the passenger business has suffered from public policy decisions over the past several decades. Now that there is one auto for every two people in Canada passenger rail service must fill niche markets.

Anthony Perl, University of Calgary, focusing on rail's potential contribution to sustainable transportation argued that it has three advantages over other modes:

- **Energy use** - railways are 3-5 times more energy efficient than other modes and have the best potential to use alternative energy sources (e.g. electrification).
- **Land use and impacts** - because they own their own infrastructure, railways make the most efficient use of land. They prevent urban sprawl and help create "green and livable cities."
- **Infrastructure financing** - because they provide their own infrastructure, railways offer the best opportunities to save on the social costs of transportation.

The American Perspective: New Regulations

Charles Moulis, USEPA Office of Mobile Sources, noted that the primary focus for emissions standards in the United States was NOx emissions. Locomotives emit 5% of all NOx in the US or about 1 million tons per year. Emissions standards regulation, promulgated in 1998, applies to most locomotives at the time of manufacture or remanufacture. The standards required a dramatic reduction in NOx:

Category[1]		NOx Reduction Required
Tier 0	(built 1973-2001)	34%
Tier 1	(2002-2004)	49%
Tier 2	(2005+)	62% with 50% PM & HC reduction

Rigorous standards are applied during remanufacture. Both manufacturers and railroads are responsible for compliance to this system. Given current technological advances, standards at all three levels and periods can be met.

[1] Passenger locomotives are not required to comply until 2002-2007.

Walter Brown, Engine Manufacturers Association, focused on the relationship between fuel consumption and NOx emissions. Current diesel engines lower fuel consumption but produce more emissions per litre of fuel consumed. Other concerns include: (1) Tier 1 limits are based on On-Highway capabilities rather than rail issues, and (2) secondary and tertiary limits have been set before the results of the first have been measured.

Steven Fritz, Southwest Research Institute considered the shifts in engine testing that have occurred since 1987. Between 1978-1987, testing focused on fuels research. Since 1989 testing has focused on emissions. The three types of testing to ensure that locomotives meet guidelines are pre-production certification, production line testing and in-use testing.

The Locomotive Unit

Alain Mercier, Alstom, maintained that of all the locomotives in service in Canada, most (about 2000 units) will continue to serve for at least the next ten years. Remanufactured units will have to meet standards. Therefore the standards will have a dramatic economic impact, mainly because Canada's depreciation rates extend the life of locomotive units rather than opting for early replacement. A unit built after 1970 has a 40-50 year life expectancy. Alstom engines already meet Tier 1 standards and will achieve Tier 2 standards as technological innovations are implemented.

Daniel Hubert talked about Bombardier Corporation's High Speed NEL (non-electric locomotive). The NEL is designed for passenger service. The NEL reduces the upgrade costs for high-speed rail because it can use existing track infrastructure. The High Speed NEL already meets EPA 2004 emissions rates.

Lloyd Crocker, Cummins Eastern Canada Inc., presented the K2000E, a medium speed engine that is both fuel-efficient and EPA compliant. The engine produces some 15-30% fuel savings over older medium speed engines and meets EURO 2 (On-Highway) standards.

Other Technology

Chris Holloway, The Trans Group, discussed the use of GPS (global positioning systems). GPS facilitates automatic train control and collision avoidance mechanisms. While the cost of GPS technology is prohibitive, the system is being used in special markets in Canada. A strategic application may be to concentrate on passenger operations.

Martin Hammerli, Natural Resources Canada, gave a broad overview of the development of fuel cell technology. The fuel cell is still at the (costly) prototype stage. Other questions remain regarding the fuel cell's capacity to operate in cold climate and its reliance on hydrogen supplies. The "engineering" problems of fuel cell technology are likely to be solved.

The LaCHIP or Late Cycle High Injection Pressure Dual-fuel engine developed by GasRail is a liquified natural gas locomotive that produces fewer emissions and operates at lower cost than the deisel engine. The LaCHIP was tested on a commuter route in California. The goal was a 75% reduction in NOx without loss of fuel efficiency. Only a 50% reduction could be achieved with no loss in efficiency. At 75%, fuel efficiency was penalized by 8-10 %. In each case, other emissions were kept at current baseline diesel levels. Non-technical issues are holding the project back.

It is clear that future locomotives will comply with the standards that have been set. Bob Dunn, National Research Centre, argued that diesel fuel is the largest single line item in a railway's operating budget. Consequently, efficiency and performance concerns must be traded off against emission concerns. Increasing fuel consumption to achieve emission reductions is not an option in today's environment.

Most North American railways have worked to reduce fuel consumption. However, given the level of competition in the industry, strategies to reduce emissions will have to be cost effective.

Instead of regulating the industry, policy makers should provide it with incentives to take proactive measures.

The Brotherhood of Locomotive Engineers brought up the issue of the air quality in cabs, particularly when crew members must ride in the second and third units of a consist. CO emissions could be a factor in crew fatigue but the TSB conducted a 5-sector study on factors affecting fatigue on crews and CO issues were not included in the recommendations. The Canadian rail industry has spent $3 million on fatigue management studies focusing mostly on circadian rhythms (time on duty).

The Environment

Anne Tennier, outlined CPR's Responsible Care program. The program has been adopted by the chemical industry in 43 countries. It involves the company in outreach and partnership with local communities and its customers. Its objective is to provide a framework to improve environmental health and safety performance in chemical management.

Responsible Care has codes of practice for distribution, manufacturing, hazardous waste, transportation, research and development and emergency response/community awareness. Each Code has a 'champion' – a senior level official who is responsible for the its implementation across the country. All codes require thorough assessments of the process of management. For example, in the 'distribution' code, the selection of suppliers, distributors, short-line companies and facilities are assessed. The ultimate goal is to integrate this type of thinking and process throughout CPR in its Safety Plan Process.

Chris Ludwig, CP Rail, discussed site management environmental issues. CPR hired an environmental engineer and created an Environmental Affairs department to meet stringent environmental regulations, identify environmental issues for liability reasons and move to a proactive stance with respect to these issues.

Research involved questionnaires, historical review, subsurface investigation, qualitative risk assessment, remediation planning, remediation implementation, monitoring and closure. Sites were classified into five classes. Action was taken to remedy all high-risk sites. Currently, work is underway with the assessment, development of plans and remediation activity in each class of site.

Bill Aird, Canadian Transportation Agency, considered the handling of noise pollution complaints. With the RAC, the Canadian Transportation Agency has developed guidelines for investigating complaints. The amount of land separation between a rail area and a population is the most important barrier to noise. Both CPR and CNR follow a 950 - foot benchmark. Noise complaints have been reduced because of this strategy.

Railways have become conscious of the environmental impact of working near water. CPR has hired an environmental biologist to implement changes in the company's practices. Pam Ladyman, CP Rail, discussed how the Fisheries Act provides rail companies with broad guidelines for working near water with fish populations. Environmental knowledge has been incorporated into the planning, design, construction and operation of a site near water. As with site management, up front expenditure entails fewer costs in the long run because penalties are severe.

Rick Masterton, CN Rail, presented CN's new waste management program. Historically, waste management has been fraught with complexity and confusion. It involved a large number of service providers and responsibility for waste management was local. A national strategy for waste management was created because of the safety, environmental and liability issues involved. The national waste management guidelines involve contracting with local contractors while national guidelines and policies govern cleanup standards and liability. Savings of $ 0.5-1.0 million per year have been achieved.

Environment Canada has created a database and guidelines for new and used railway ties. Barry Munson revealed that the preservatives in the creosote in wooden railway ties, 1.4 million of which are replaced each year are in fact pesticides. A new system will be implemented in 2002. All stakeholders will provide report cards in 2003 and 2005. It is not possible to eliminate all the ties and poles in service today because the life cycle of the materials is too long for a planned phase out in the short and medium terms but continuous improvement can be made over the long term.

Edgar Ladouceur described Transport Canada's program to create a database of emergency response contractors capable of providing a full range of services. The four-step identification process included self-identification via classification standards, self-assessment; verification and cooperation through the trade association.

Brent Laing, CP Rail, noted that no national policy exists for brownfield site cleanup. Brownfields are abandoned, idle or underused sites. Typically brownfields contain creosote, asbestos, fuels, heavy metals and an unbelievable number of foundations. The move from steam to diesel, industry decline and related track abandonment and relocation to non-urban areas has left Railways with a number of unused facilities that, if made environmentally sound, could be redeveloped for commercial use.

Passenger Rail

As cities exceed their capacities to handle automobile traffic, alternative passenger systems must be built. Railway rights of way, particularly ones that carried passengers before the modernization of passenger movement systems must not be permitted to lapse.

Peter Lloyd, GO Transit, presented a history of GO Transit, its successes and its future. GO currently achieves an operating ratio approaching 85-90%. However, GO Transit faces a combination of capacity, funding and political issues at a time when forecasts

indicate a near doubling of ridership on existing services in the next 20 years.

John Pearce, Transport 2000 Atlantic and Tim Lane, Transport 2000, Ottawa discussed the opportunities and problems that have emerged for commuter rail in Western Canada. Access to rail corridors is particularly important. Without them the opportunity for a light rail passenger transportation system is also lost.

Climate Change and Air Quality Issues: The Process

Lionel King, Environment Canada, explored the process for emissions monitoring in Canada. Monitoring began in November 1990 when the Canadian Council of Ministers of the Environment (CCME) published Phase 1 of a management plan for NOx and VOCs calling for a 115,000 tonne cap on total NOx emissions from locomotives effective in 1992. In December 1995 an MOU was signed between EC and the RAC calling for the implementation of a number of monitoring and reporting activities. Reporting is focused on three Tropospheric Ozone Management Areas (TOMAs); Quebec/ Windsor Corridor, B.C. Lower Fraser Valley and Saint John N.B.

NOx emissions have fluctuated with economic cycles but have been reduced over time and are close to meeting the 115,000 tonne cap despite the current economic upturn. N0x emissions will likely be reduced by a further 15 percent during the next decade. Similarly, CO_2 emissions have been reduced by more than 25 percent over the same period. As progress is made on NOx, more attention will be given to particulates (PM).

Catherine Conrad, Federal Climate Change Secretariat, discussed the Kyoto challenge, the national process and the progress made towards achieving goals set during the 1990s, the National Implementation Strategy (NIS). The Kyoto challenge was very defined in terms of megatonnes of CO_2 equivalent emissions. In 1990, baseline emissions were 599 Mt. Without a change in behaviour, it was predicted that

CO_2 emissions would rise to a range of 703-748 Mt in 2010, a gap of 20-25% above the Kyoto target of 563 Mt.

Conrad looked at the unequal distribution of greenhouse gas emissions between regions and sectors of the economy. Ontario and Alberta are the greatest polluters and have exceeded their 1990 levels by 23 and 35 percent respectively. Although at much lower levels, every province and territory had exceeded 1990 levels of CO_2 equivalent emissions. Transportation was by far the most significant contributor to the generation and release of CO_2.

The National Implementation Strategy (NIS) has two key components: (1) Alternate future paths that will meet the -6% Kyoto target. (2) An initial package of immediate measures (common to all paths). By the end of the year it is hoped that an agreement will have been reached by the Ministers on the key elements of the process: an approach to strategy, immediate measures for 2000-02, selection of alternate paths and an implementation plan.

John Spacek, Government of Manitoba, focused on the Issues Tables and the work plan of the Transportation Table. The Issues Tables included eight Horizontal Tables (International Mechanisms, Analysis & Modeling, Public Education, Technology, Emissions Trading, Sinks, Credit for Early Action and Voluntary Actions) and seven Sector Tables (Transportation, Electricity, Agriculture, Industry, Municipalities, Forestry and Buildings).

The Transportation Table's mandate is twofold: (1) To identify and assess costs, benefits and impacts of greenhouse gas reduction measures and (2) to build incremental packages to reach the Kyoto target and beyond. The idea is to begin with the easier, cheaper options and to progress to more difficult, more expensive options. Spacek stressed that 'everything is on the table': regulation, incentives, taxation, technology, promotion, emissions trading and modal shifts.

Two rail freight studies have been commissioned. The first reviews the socio-economic, regulatory, policy or taxation issues affecting the railway's ability to improve greenhouse gas emissions performance. The second is a survey of rail industry technological and operation improvements and alternatives.

The conclusions are favourable. Anticipated savings will come from ongoing cost-effective measures such as new locomotives, automatic shutdown devices/ reduced idle time, lubrication between rail gauge and wheel flange and freight car improvements (heavier payload & less tare weight). Changes have been recommended in capital cost allowance rates that would serve as added incentives for further introduction of new technologies and infrastructure improvements needed to reduce greenhouse gases.

The main goal of the Options Paper is to establish effective measures to reduce the emission of greenhouse gases. The challenge is serious as demand is currently outstripping efficiency. In establishing these mitigating measures, government must assess the costs of the measures and upon whom the major portion of the associated burden will lay. As Conrad stated earlier, no region or sector should be asked to bear an unreasonable burden of action. The ministers will review and assess the Options Paper in the fall of 1999.

The Political Reality

Darren Praznik, Minister of Highways and Transportation, Province of Manitoba, focused on the need maintain the highway system and to find cost-effective, realistic solutions to environmental problems. Manitoba has a total of 12,000 km in its road network. Each year about 200 km or roughly 1/60th of the system is replaced. Since the average life of a road in Manitoba is 20 years, the province should be replacing three times as much road as it is in order to keep its highway system maintained.

Few areas of transport have been more significantly impacted by change than rail. Rail's future will be in the development of short-line

railroads. In Manitoba there will be the growth, development and expansion of the Churchill line and the Port of Churchill – an alternative to the Mississippi River system. Given the replacement rate of highways and the current rate of rail line abandonment, it is essential that Manitoba support the short-line industry. The highway structure cannot take the added traffic from the abandonment of rail branch lines.

The federal government collects fuel taxes but does not contribute to the maintenance of road infrastructure. Manitoba collects about $147 million in taxes and spends the same amount on roads. The federal government collects $5 billion from fuel taxes and only returns $300 million, virtually none of it for the Western Provinces. Taxation revenues must be dedicated to highway, road and intermodal infrastructures that will meet the needs of the future.

In Canada, many people commute over an hour to work each day. No elected public official is going to support a flat out increase of 10 cents per litre for fuel. Transportation originated environmental problems must be solved by maximizing efficiencies and reducing delays because Manitoba has to remain competitive in its marketplace.

Conclusions

Global warming is a scientific fact. The *Railways and the Environment* workshop explored how the rail industry has worked to help meet the Kyoto accord's targets for reducing greenhouse gas emissions. The railways, regulators, locomotive manufacturers and remanufacturers and engine testing experts have all worked to meet environmental standards. With equitable public policy and continued self-monitoring railways will contribute to meeting Canada's Kyoto targets. As Bob Ballantyne stated "railways are part of the solution rather than the problem".

"Getting Back to the Basics": Transportation, the Environment, and *Some Recent Reflections on Corridor Initiatives In light of the Monumental "November Options Paper"*

A Paper Presented to the 35th Annual
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by
Michael Butt

As a signatory to the Kyoto protocol, if ratified, Canada as an Annex A Nation is expected to reduce its GHGs to slightly less than 6 percent of 1990 levels between 2008 and 2012. At present, by 2020 we are en route to overshooting 1990 levels by the neighborhood of 26-28 percent (or 32-33 percent above where we should be).[2] Nowhere has the gap been so enormous between preaching individual responsibility and refusing to address the consequences of global warming than in Alberta.[3] Only recently did Klein allocate a couple of million dollars to establish an office to work in a liaison capacity with businessmen. In fact according to one source at the Pembina Institute in Calgary this step was only taken following the cajoling of some progressive businessmen who made a trip to the Premier's Office.[4]

In terms of industrial polluters of GHG and GHG-related emissions on a per-capita basis shamefully Canada is a world leader. Our resource-based economy, our cold climate, our great distances, as well as the recent refusal of the UN commission to accept reforested lands in any credit scheme and a similar refusal to credit us for Cando reactors sold abroad puts us in a very precarious position.[5] Indeed, a recent report from St. Louis consultants suggests that out of all of the so-called western democracies Canada's economy will take *the* most significant

hit if we follow through on our commitment to meet our targets. These facts seem to be confirmed by a recently released study by Charles River Associates.[6] And yet the time to act is now.

The main goal of this paper is to sharpen my analysis of recent corridor initiatives by pulling into my discussion a critique of the November Transportation Table Subcommittee's *Options for Action* paper. Even though we are about a year behind schedule now in the process (according to some pundits) surely the question upon everyone's mind must be *synthesis*. How do we take the 15-24 tables— the options reports and principle submissions, both the sectoral and methodological (or analytical ones) — and apply them to real everyday experiences and move forward?

I propose to tackle this problem by: 1) emphasizing the historical origins of the larger environmental question and reminding the reader that this dimension should always remain fixed in the back of our mind; 2) then focusing on what I consider are some major methodological flaws both in terms of approach and analysis in the studies and their implications and; 3) provide a potential roadmap with a specific focus on the highway transport sector to redirect and encourage future study and movement towards implementation. As historians William Cronon reminds me that we are ill-equipped to make predictions about the future with any degree of certainty. However, we are trained to provide some analytical tools to uncover the past which helps to shape, frame, and influence the types of questions we ask of it. I am going to raise some methodological issues and what I sense are gaps and silences with the obvious disadvantage of being an "outsider" to the process. To the extent that some of my points are valid only those involved may know.

However, I want to be clear on one issue and state up front that overall I believe that both the transport *Options for Action* paper and the entire package are milestones in the search for a coherent strategy to reduce GHGs. The *holistic* approach was a useful exercise but clearly it is

time to take the general and in moving forward return to the specific. My comments therefore should only be taken in a constructive and positive light. For me this paper is important because it is an attempt to synthesize and digest some of the sectoral material released last fall in light of recent developments while exploring some ideas vis-a-vis the technical and methodological reports.[7]

1) *Intellectual Origins of the Problem*

Surely before we can even begin to discuss such methodological matters as *most promising/promising* or *portfolio approaches* to reducing Canada's GHGs we might be well served by trying to locate the intellectual origins of the problem.[8] For our purposes, I believe that to do this we have to turn back to the 1950s and 1960s. If we wanted to pursue the matter even further I am confident that we would eventually turn back as early as the 19th century to the obscure writings of people such as William Lloyd "a mathematical amateur" who in 1833 debated the political economy of population, labour, and the poor laws in England in several unknown tracts.[9] In fact the issues we are trying to resolve today have historical antecedents in 19th Century Malthusian debates. They are also rooted even earlier in fundamental matters such as Locke's, Smith's, and Hume's very understanding of human relations and society in general. In sum, they are tied into longstanding debates over the very meaning of "citizenry" and participation in government above and beyond their purely seemingly environmental concerns as Susan Flader has recently demonstrated.[10]

No matter where we chose to begin our search, our study and analysis of ties to the past, at some point our discussion of necessity would arrive to 1968 when biologist and human ecologist Garrett Hardin published a theory he called the "tragedy of the commons". By the 1970s this theory had become *the* dominant paradigm for scientific understanding of environmental and resource issues.[11] His work's applicability to the very fundamental challenges that global warming poses are simply too significant to overlook. And yet I would be very

surprised if many of us today in our hurry to come up with a series of workable solutions have really given his work its due consideration.[12] The road to a 'green', 'clean' future, however, necessitates that the current crisis in global warming be understood as an extension of land and water resource issues of earlier periods. This is the second point worth keeping in mind, one that is all too easily forgotten.[13]

I want open up my discussion by suggesting several ways in which the *tragedy of the commons* as Hardin and others understood it is by its very nature similar to the problem transportation faces in global warming. Hardin, like others, had felt that in some issues of great importance such as nuclear war and the global crisis of overpopulation that *certain dilemma's* ***had no*** *technical solution.* That if the superpowers continued to look for solutions in the 'area of science' and 'technology' only, the result will be to 'worsen the situation.'[14] What distinguishes Hardin's reasoning from current thinking on transport pollutant reductions obviously might be described as the equipment involved. Much of our hope today in achieving GHG reductions is increasingly rooted in a faith in scientific and technological solutions. There are good reasons to hold such values, also some less so. I will return to these themes momentarily but first I will briefly restate Hardin's thesis which developed in the following way:

Imagine a group of herdspeople share a common pasture. For centuries they keep adding cattle but disease and functions such as war or poaching keep population numbers well below the *carrying capacity* of the land. However, eventually *social stability* is brought to the land and it is that point that the *commons remorselessly generates tragedy.* Each individual herdsperson as a rational human being has two considerations to evaluate -- one is a positive and the other a negative utility. The positive is that by adding to their herd each additional animal has a net gain (or positive utility) of nearly +1 since the individual herdsperson gets the full return from the sale. The negative utility of each decision is only a small fraction of -1. The herdsperson realizes that there is little to be saved by protecting the commons

resource and a great deal to be gained by increasing the size of their individual herd. The result is that each herdsperson comes to the same realization and keeps adding an additional animal and another and another and so on and so forth. In sum: "Each man is locked into a system that compels him to increase his herd without limit; in a world that is limited. Ruin is the destination toward which all men rush, each pursuing his own best interest in a society that believes in all freedom of the commons. Freedom in a commons brings ruin to all."[15]

Such was Hardin's 'tragedy of the commons'... Now since then we have moved in a myriad of directions beyond this problem and have come to realize that the puzzle is much more complex than it first appears.[16] We have explored it in innumerable settings: marine tenure in Papua New Guinea, the Maine lobster industry, grazing lands of Botswana, swamplands of Southeastern Borneo, and yes at home too among peoples such as the Cree Indian's and their fisheries in Subarctic Canada. These are just a few commons issues as examples that had been explored and drawn together in a single source. In fact, by the mid 20th century the concept was already gaining some notoriety and being applied to the crisis in the fisheries, eventually other land issues, and we should immediately come to recognize its significance for pollution too.[17] In the case of pollution, as Hardin himself was quick to point out it was not a matter of removing something from the commons; but putting it in. Sewage into rivers, industrial pollutants at workplaces, smog, and of course, by extension, greenhouse gases.[18]

Canada had by this point recently come off of the BC/ Washington Trail Smelter case which had established the principle of 'polluters pay' in an international context, and in so doing set a North American precedent. At the same time it revealed the degree of complexity in negotiations and interests of the various parties concerned.[19] The history of the Great Lakes in this period too, and in fact from the 1920s through the 1970s according to Stephen Bocking in some sense is also similarly a commons problem between nations and regions linking both the physical and intellectual dimensions of parties concerned. It

is also the story of a narrowly constructed understanding of what science's 'role' in the region should be until it was too late.[20]

The most sustained critique of the Commons theory is perhaps found in the work of M. Patricia Marchak. My reading of it is that there is some validity in the author's claims that the very idea of 'common property' is problematic to say the least. However, I would argue that much remains left in the realm of semantics (despite the author's claims to the contrary) and furthermore that the argument put forward stands better when addressing timber rights and set longstanding resource issues then it does in addressing more recent problems of pollution. It is a paper deserving of a full critique and worth highlighting for the reader.[21]

Often most significant in these "tragedy" studies, (not Marchak's however), is the way in which the commons was originally tied into the market. From the earliest of these it was not at all inconsequential that the tracts which first raised commons (Malthusian) questions had begun in the 1830s and 1840s. This period was one distinguished by the arrival of rail in England and slightly later on in America. It was the period of the famine in Ireland and also the enclosure of the English commons. It was also one in which a system of arbitrage threatened the autonomy or independence of local markets through much of North America (and parts of Europe) and began the steady process of homogenization of commodity values between communities. No longer did the price of bread, eggs, or meat differ substantially between towns. The shift was essentially completed with the development of transportation networks, the arrival of the telegraph, which separates information from human transport for the first time in history, and also ultimately creates a new market for speculation in futures.[22] In other words, Von Thunen's rings pushed further and further outward as distances opened up and regions were themselves increasingly commodified. In fact it is no surprise that his work is a product of this very process, published first in 1826 and then significantly revised and extended in 1842.[23]

The change was indeed, enormous, in this early period. But the point I want to draw out here is that the cries heard in opposition to change in these early periods were in many ways similar to those heard more recently in Calgary (and elsewhere) last fall in articles such as "Crediting ethereal emissions: can Canadian marketers get their heads around selling products that never existed?" In both eras there was this ephemeral fear that something happening was "unnatural" which is the way change is often characterized when in reality change is the one constant. The 21st Century fear of "commodifying nature" or the "unnatural" (in this instance emission credits trading) was also the fear of its rationalization through a relatively new technology (the internet and electronic markets) which had its historical antecedents in the early 19th century which dovetailed not so neatly with the rise of capitalism.[24]

2) *Methodological Questions*

Now that I have perhaps preached a little too forcefully where I think the intellectual origins lay, I will remind us in passing that great strides have been made in Canada. Toronto and Montreal in particular were North American leaders in addressing these very issues back in the 1980s when they hosted several conferences on *Commons* problems.[25] In other words there is a considerable academic tradition here in Canada in exploring these issues in an anthropological, sociological, political and historical context well in advance of the major turning points at Montreal, Rio, Kyoto etc.,

Part of this success is rooted in a willingness to 'drop the gloves' as it were and take a jab at what seems to be working and what is not. In this section I will cut to the chase and put forward some quick criticisms of the *Options* report vis-a-vis the process and other papers. I do so realizing that I have not seen everything (only a drop in the bucket a couple thousand pages of available material) nor am I fully cognizant of the linkages between the various sub-committees. I will

focus my discussion on several problems I see emerging or that have already taken place: 1) *Timing and Coordination Between Reports*; 2) *Looking South But Not Really Looking: Canada's Position vis-a-vis the United States* and; 3) the notion that *Making Easy Choices Now Are In Fact Difficult Ones.*

My main argument is that the way the process was conceived and the *a priori* value judgements made could lead only to the conclusions that the study produced. In particular, assumptions about culture (and work culture in particular) meant that in many instances the intangibles became the cheapest measures to implement. The framers of the tables and reports (if there was any consensus among them) wanted to produce an 'opt in' result which would encourage future consultation and public involvement. There is nothing wrong with wanting processes to go forward but I would suggest that the problems associated with the impact of the US and our own culture have been so greatly marginalized or unexplored by the process that they tend to devalue the final product. In fact, I will argue that moving forward in the process necessitates that we begin to apply additional techniques and tools social scientists have developed over the last 20 years since the demise of large-scale planning in transport in the 1960s and early 1970s "getting back to the basics."[26]

-i) *Timing and Coordination between Reports*

Though this most recent initiative began about two and a half years ago, it seems to me that it began in a planned and increasingly coordinated manner. In other words, the tables, the various subcommittees, were struck within weeks or several months of each other and work was initiated soon after. I imagine that initial lists of participants were drawn up, offers to join were made in an effort to broaden participation and to add depth in understanding and analysis. In some instances encouraging prospective candidates to sit the various committees likely required considerable cajoling to convince them that their time would be well spent. Some members likely sent

proxy's to many of the meetings held and other participants were added only as the process expanded.[27] In other words it was likely a fairly inclusive program, much more so than other studies had been in earlier periods. At one level it was off to a good start.

But it also seems to me that having some of the Analytical and Methodical options reports run simultaneously with the sectoral reports quickly became problematic to say the least. Take the *Enhanced Voluntary Action Issue Table 'Options Report'* as an example. On the one hand this report was released early enough so that there could be some effective tinkering with each of the sectoral options reports in the process and in the 11th hour. On the other hand, I would draw you attention to the following comment within the report: "Because our work proceeded concurrently with that of all the other Issue Tables and, in some cases, in advance of them, we were not able to test these initiatives with other Table representatives to determine how they could be applied."[28] So as a result much remains speculative or in the realm of the hypothetical.

I am not singling out this table, nor this report, but rather simply referring to it as a representative example. Other similar cases certainly can be found with each of the tables. This, of course, is partially one of the trade-offs in trying to adopt a *holistic* approach that is both multi-methodological in scope and transcends several sectors at the same time. Inevitably what it also produces, however, is a project design not of putting the cart before the ox but rather trying to run both alongside one another. I think the failure to have the methodological and analytical papers finalized before the sectoral reports were done was probably a mistake. I will return to this point and its implications below.

-ii) *Looking South But Not Really Looking: Canada's Position vis-a-vis the United States*

A second criticism I have with the reports (tied to the first) is their obfuscation of Canada's position vis-a-vis the US and developments taking place there. Recognizably, the obvious and fair criticism that can be returned is that by spelling out clearly our position on issues we are opening our hand or at least playing cards that are not in our best interest. A second return is that Canada's position is constantly changing and that addressing this issue would impose sort of a rigid or fixed stance which is both detrimental to our interests again and would only present an unrealistic appraisal of where we stand in any meaningful sense at a particular historical juncture (ie., the precise date the passages were written or even more importantly the knowledge generated). A third is simply that it was not part of the mandate of the committees struck as spelled out by their terms of reference.

I would agree to a limited sense that these responses are fair enough but ultimately the failure to address the "American Question" skewers the findings and results of the sectoral reports so much so that it calls into question the benefits of *holistic analysis*. Let me take the Transportation *Options for Action* report as an example to try to make my case. The conclusion I drew from that report was that so much depended upon the position that the US took that many of the figures, the projections, and estimates, the results of predictive modeling on the Canadian side were called into question. I turned to newspapers accounts and articles in the popular press to confirm my suspicions that during the past year the balkanization of Canadian positions on GHG reduction has increasingly come to echo the American. In fact, my reading is that the global consensus on the Cando matter and the reforestation credit issues has resulted in Canada's moving towards embracing the US position vis-a-vis capping. Similarly, we are now more sympathetic than ever to the budget mechanism concept (another US supported initiative) which enables us to delay implementation of GHG reduction measures under the premise of national right to self-determination in the hope that major technological breakthroughs will be forthright. We are buying into the delayed reduction/ delayed

implementation rationale which is a dominant ethos in many circles south of the 49th parallel. Surely we need to be more fully cognizant that 'science' and 'technology' are conditioned by culture, they operate in the same realm and intersect with the very same processes that condition other areas of existence. What I am arguing here is that we should be 'stepping out of the box' to use that terrible pseudo-political jargon and recognizing that what seems more 'natural' (ie., the US position) is really a derivative of an economy that is fundamentally different than ours and which bases its growth in the matrix of military-industrial advances.[29]

What does this mean for the transportation sector? Well, to reach the 54 MegaTonne CO2 reduction equivalent I think it means a lot of things. Accelerated fleet replacement in Aviation is dependent on international markets. Radical technological innovations in rail "are unlikely in Canada, especially in the absence of domestic locomotive engineering." Not surprisingly it adds, "The most promising change to diesel locomotive technology would therefore involve adopting the U.S. Nox regulations..." Similarly, the International Maritime Organization (IMO) is responsible for shipping so the report only deals with freight and ferry activities. Like other subsectors we learn that marine initiatives to address climate change in the domestic sector "should take into consideration the international context and future activities by the IMO and the US." Similarly in trucking "There might be some negative competitiveness impacts if speed limiters were mandated on Canadian trucks travelling into the US without a similar requirement in the US Drivers and owner-operators would strongly object to reduced speeds, as it could decrease their income. Fleet operators might support the initiative if it was applied equally and consistently to all trucks." Again take the case of the of the 'green procurement model'. It too requires US participation in the Toronto/ Chicago corridor.[30] In other words, if I was a company owner, I might not be sleeping too well at night. In fact, I might be having nightmares with the thought that at any moment some drastic measures might be adopted that flew in the face of reality. Or that a bunch of consultants

might show up with a new scheme to introduce a series of 'temporary' measure on a trial basis and if I didn't like it (provided I was still in the marketplace) I could pull out at later date.[31] In sum, I think that neither the US position, nor its strategies, are adequately addressed in the reports. Furthermore, Canada's positions vis-a-vis the US is also not spelled out nor clearly defined. Therefore the relevance of the Canadian modeling for a second reason becomes all the more questionable.

-iii) *Making Easy Choices Now Are In Fact Difficult Ones*

Beginning in about November of last year as the Bonn Conference was winding down, with the release of reports from four of the sectors alongside a series of analytical and methodological ones, a new language began to appear with increasing regularity in the Canadian press. It was as if all of a sudden a new mantra was being spewed by PR gurus. It resonated south of the border and I could hear it down in Kansas, Missouri, then after Christmas in Madison, Wisconsin. To a certain extent the new language had been adopted globally. Canada was in step with others at Bonn. Conference president Jan Szyszko said: "The discussions were frank and open, marked by a positive spirit and a common commitment to move forward." "Big Business" was "coming on board". Juhani Santaholma, chairman of the International Chamber of Commerce's joint working party on climate change, added: "I think we are developing all the time" and that "there already had been tremendous change in business sentiments."[32]

But how much has really changed? The *Enhanced Voluntary Action Issue Table- Options Report* - 16 July 1999 indirectly gropes towards finding solutions to a number of these and similar questions.[33] While it provides strategies for the development of voluntary measures it also provides a blueprint for business "eco-speak". A cynic might say that it offers little more than a politically-correct map for big business to opt in when it suits their interests. Need convincing? The underlying rationale of change at Bonn according to the International

Chamber of Commerce is the following: "Years of resistence by business to measures aimed at limiting climate change is slowly starting to ebb, with major industries and companies beginning to focus on the benefits they can derive from steps aimed at global warming and the possible new market opportunities."[34] Similarly, a February or March 2000 text delivered by William Clay Ford, President, Ford Motor Co reveals a similar driving engine.[35] The context, of course is important. The speech is released in the days surrounding Martin's Budget which promises about $140 million dollars to be spent on developing new engine technologies pushing capital into companies such as Ford.

The message is clear in both William Clay Ford's title and in the highlight of his speech. Environmentalism makes sense for both 'moral' reasons and from 'a long-term business perspective.' As a community and industry leader, in keeping with the theories espoused in the VI reports, it is hoped that Ford's voice will resonate throughout the business world. He promises that 3/4ths of the cars they sell this year will 'meet or exceed' stringent US emission standards. The message is also clear: like Ford, Toyota, and Toronto Hydro are industry leaders because they have a new environmental basis. Toyota's wastewater treatment standards are 25 percent tougher than the regional governments and Toronto Hydro plans to build windmills along the harbour. A consultant from a local agency Energy Advantage Inc., suggests that "There's a new way of doing business now and if you don't understand the way of doing business, your long-term survival is going to be compromised." I am less certain of this fact than I was prior to reading the committee's analytical and methodological options reports. The fundamental question should be why aren't the other 25 percent of Ford vehicles going to be up to standard and what about SRVs? How many mini-vans and SRVs are these people going to produce in the coming year? Furthermore, as one article out of Calgary several months ago asked, how many cabinet ministers are still planning to drive them? Bread and butter issues as well as perplexing cultural ones seem to me are being

ignored. These are issues that have been touched upon in Transport Canada's *Annual Reports* of recent, which is a tremendous credit to that department, but they need to remain front and centre.

In sum, I am not denying that change is taking place in work cultures but to celebrate an apparent revolutionary outlook in industry seems a bit trite.[36] One can only second-guess what spins will be put on events should developments sour (which I certainly do not hope for) in the ensuing months. Perhaps a better question is who will care to remember?

Endnotes

[1]. Although none of them know what I am working on exactly and the faults are all my own I owe thanks to Dr. Barry E Prentice, Don Worster, Bill Cronon and Greg Kealey. Also most recently the faculty and staff at the Department of History at University of Wisconsin, Madison.

[2].First draft of this paper was originally 45 pages long. Hopefully a much fuller and richer treatment will be published shortly. For brevity's sake and due to length restrictions much is assumed. Annotated references can be provided upon request contact me at Butt_Michael@hotmail.com.

[3]. To be fair to Klein, Peter Foster, author of the 1979 bestseller The Blue-Eyed Sheiks in a recent article suggested that it is not without some good reason that Klein takes the position he does. Economic nationalism and its assault on Alberta in the 1980s (in the NEP) has been replaced: "Petroleum politics is not dead in the 1990s... it has merely taken a different form. The attack on business comes now not from nationalists but from environmentalists." See, "The new breed of blue-eyed sheiks: The National Post's Peter Foster finds the new boom is just like the old boom, only all the rules have changed," National Post, 13 November 1999, FO1.

[4]. "Emissions strategy off to pragmatic start: But Alberta will need more than desks and a water cooler for the real gas-reduction push," Calgary Herald, 5 November 1999, A27.

[5]."Emissions Proposal Denounced," Canadian Business and Current Affairs, v.24 (79) 17 November 1999; "A challenge to the way we sell reactors," Toronto Star, 27 November 1999.

[6]. "Kyoto will cost Canada dearly: study: Few low-cost options: Environmentalists reject trading pollution credits," Financial Post, C03.

[7].Voluntary Trading Primer, Enhanced Voluntary Action Issue Table Options Report, the Public Outreach on Climate Change Foundation Paper, the Using Tradeable Permits to Help Achieve Domestic Greenhouse Gas Objectives: Introduction to Concepts, Options and Issues, and the Analysis and Modeling paper.

[8].Transportation Climate Change Table Options for Action report; Chris Rolfe in *Turning Down the Heat, Emissions Trading and Canadian Implementation of the Kyoto Protocol*, Vancouver, The West Coast Environmental Law Research Foundation, 1998.

[9].Quote taken from Garrett Hardin, "The Tragedy of the Commons," *Science*, 162(1968), pp., 1243-48; also Bonnie J. McCay and James M. Acheson, "Human Ecology of the Commons," in McCay and Acheson [eds.] *The Question of the Commons: The Culture and Ecology of Communal Resources*, Tucson: University of Arizona Press, 3rd ed., 1996.

[10].Susan L. Flader, "Citizenry and the State in the Shaping of Environmental Policy," *Environmental History*, vol.3,1(January 1998), pp.,8-24. Like Flader my goal here is a call, a push for the return to the local. In particular, a return to where the decisions are made within industry itself in offices and on the shop floor.

[11].Hardin, "Tragedy", 1243-48.

[12]. "Using Tradeable Permits", pp., 2-3

[13].Look at the Railway Association of Canada's (RAC) Winnipeg Conference papers as an example.

[14].This is how Hardin began his paper. He had quoted J.B. Wiesner and H.F. York, *Scientific American* 211 (No.4), 27 (1964); In Hardin, p.1243.

[15].Hardin, p.20; also Tradeable Permits report, called Principles and Criteria for System Design, pp., 16-17.

[16]. McCay and Acheson, [eds.] *The Question of the Commons.*
[17].Bonnie J. McCay, in "Everyone's Concern; No One's Responsibility: A Review of Discourse on the Commons", unpublished paper Prepared for Symposium Capturing the Commons, Annual Meeting of the Society for Applied Anthropology, Toronto, Ontario, 14-18 March, 1984; a paper held in the Land Tenure Center Library holdings, University of Wisconsin, Madison; Donald Worster, *Dust Bowl: The Southern Plains in the 1930s*, New York: Oxford University Press, 1979; Arthur McEvoy, *The Fisherman's Problem: Ecology and Law in the California Fisheries, 1850-1980*, New York: Cambridge University Press, 1986; also M. Patricia Marchak, "What Happens When Common Property Becomes Uncommon?" *BC Studies*, 80(Winter 1988-89) pp., 3-23.
[18]. On urban industrial pollution in a historical perspective see Andrew Hurley, Environmental Inequalities; and his [ed.] Common Fields: An Environmental History of St. Louis (1997).
[19]. John D. Wirth, "The Trail Smelter Dispute: Canadians and Americans Confront Transboundary Pollution, 1927-41," *Environmental History*, vol.1,2 (April 1996), pp., 34-51.
[20].Steven Bocking, "Fishing the Inland Seas, Great Lakes Research, Fisheries Management, and Environmental Policy in Ontario," *Environmental History*, vol.2,1 (January 1997), pp., 52-73.
[21]M. Patricia Marchak, "What Happens When Common Property Becomes Uncomnmon?" *BC Studies, 80*(Winter 1988-89), pp., 3-23.
[22].William Cronon, *Nature's Metropolis: Chicago and the Great West*, New York: W.W. Norton, 1991. Other ideas come from writings on technology in the work of Innis and Grant.
[23].Peter Hall [ed] Von Thunen's Isolated State, [an English edition of Der Isolierte Staat],rpt., London: Pergamon Press Ltd., 1966.
[24].If we wanted to we could draw connections to E. Wallerstein; F.J. Turner's Frontier Thesis, J.M.S. Careless and most recently even more locally Gerald Friesen.
[25].In other words parallel traditions have emerged. For instance, the Symposium, Capturing the Commons, The Annual Meeting of the Society for Applied Anthropology, Toronto, Ontario, 14-18 March,

1984.

[26].Again see Flader above. (Although the quote is my own).

[27].The official total of participants was 450. Likely through consultation, submissions etc., that number really was in the thousands. It was inclusive in other words.

[28].Enhanced Voluntary Action Issue Table "Options Report" Prepared for: The Enhanced Voluntary Action Issue Table, by Resource Futures International, 16 July 1999. p.28.

[29]This is a loaded statement about the US but factual and not derogatory. There are a hundreds, if not thousands, of books that recognize this point left and right, see for instance, Carroll W. Pursell, Jr., [ed.,] *The Military-Industrial Complex*, New York: Harper & Row, 1972.

[30].Options For Action, chap.4 pp., 4-5, 7, 13, 22, 34.

[31].The report is littered with such warnings, chapter 4, p.34, "If revenues were not used to offset other taxes, Canadian industries would experience an increase in costs relative to other jurisdictions if the other countries (notably the US) did not adopt similar policies. That could reduce Canadian ability to compete with goods and services from those markets."

[32]. "Changing Business views helps underpin steps to tackle global warming," Deutsche Press-Agentur, 5 November 1999.

[33].Enhanced Voluntary Action Issue Table - Options Report.

[34]. "Changing Business views helps underpin steps to tackle global warming." Deutsche Press-Agentur, 5 November 1999.

[35]. "More and More people on the Ford team came to realize that preserving the environment is not only the right thing to do, it's the best thing to do from a long-term business perspective." *Canadian Business*, 6 March 2000, p.63.

[36]If history teaches us one thing it is often that the silent changes that business make are the most significant. The RAC, its clean-up programs, its ecosystem monitoring strategies which explore issues such as damage to rivers etc., and the replacement of ties is a perfect example. You don't read about it in the paper but it will make a tremendous difference.

Enhancing Competition In The Presence of Monopoly An Assessment of Air Policy Options Facing Canada

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A decade of adverse financial performance has resulted in the emergence of a single national carrier in Canada. The single-carrier outcome was both unavoidable and predictable. This paper explores available policy options to enhance competition in this environment.

Section 2 begins by examining the industry during the decade or so following deregulation. Section 3 then considers the likely impacts of this monopoly outcome on the domestic air transport markets. We anticipate increases in real air fares, a reduction in capacity, and a diminished range of consumer choice as the future of these markets. We also anticipate intense competition in the international markets among the various strategic alliances.

Section 4 proceeds to a discussion of a variety of alternative policy options which government has adopted in attempting to protect the interests of the traveling public. We reject the options of 'do nothing' and the 're-regulation of the domestic industry' out of hand as the former seems untenable politically while the latter seems unworkable given the high connectivity among the domestic, trans-border and international segments of a large number of flights. Alternative measures are examined. One is the prohibition of anti-competitive behavior but which, from the economic perspective, are really rent-seeking activities on the part of competing firms. Events have overtaken us, and many of these issues have already been addressed by Ottawa. A second alternative is the potential for open skies and/or cabotage which seems to have been rejected by the Federal Government. A third alternative would be to ensure that airport

capacity, particularly runway slot and gate capacity, is available on an equitable basis to all competitors (both actual and potential).The following section evaluates this option from the perspective of rate control. A final section of the paper will draw conclusions from the analysis.

2.0 The Industry in Perspective:

If one is assess the potential impacts of the monopolization of the domestic scheduled airline industry, some examination of the recent past is a sine qua non. We trace the beginnings of Canadian airline deregulation back to the 1984 CTRF Jasper Conference where the keynote address (delivered on behalf of the Minister of Transport) offered hints of what was to come. Canadian airlines were advised to prepare for deregulation by applying to the CTC to have all of their sundry licenses amalgamated. This speech represented the beginning of the restructuring of the Canadian airline industry. Where data availability permit, we examine structural changes since that time.

2.1 The Family Structure :

It is prudent to begin by considering the experiences of the 'family' structure which has evolved in the Canadian airline industry. To do this, data were extracted from **Canadian Civil Aviation** for the 1988 through 1997 period. These data were then combined to reflect the operation of a single carrier. Data for the affiliates, parents and families were considered separately.

In 1988, the Air Canada family attracted 53 per cent of the passengers, and accounted for 49 per cent of the passenger kilometers. The Canadian family accounted for 38 per cent of the passengers and 39 per cent of the mileage. Wardair captured 5 per cent and 11 per cent respectively. Other carriers made up the balance. Within the families, Air Canada's affiliates accounted for 8 per cent of the passengers, but only 2 per cent of the passenger kilometers. In the case of Canadian affiliates, the shares were virtually identical. The role of the affiliates was to act as feeders and to provide service

on the short-haul routes. Revenue data were not published for 1988. However, in 1990, the Air Canada partners accounted for 8 per cent of the revenues while those of Canadian accounted for 5 per cent.

By 1997, the Air Canada family accounted for 60 per cent of the passengers, 58 per cent of the passenger kilometers, and 62 per cent of the passenger revenues. The industry now being a duopoly, the Canadian Airlines family accounted for the rest. Air Canada affiliates accounted for 11 per cent of the passengers while Canadian partners accounted for 12 per cent. The affiliates experienced a growth rate in excess of their parents from this perspective, suggesting some route reallocation had occurred. The shares of passenger kilometers rose to 2.5 per cent and 3.4 per cent of the market respectively. This is also evidence of route reallocation. Finally, on the revenue side, the Air Canada Partners accounted for 7.3 per cent of passenger revenue while Canadian Partners accounted for 8.1 per cent. The Air Canada partners experienced a relative decline of modest proportions in the period while the Canadian affiliates saw significant relative growth.

The behavior of average revenue per passenger kilometer over time is relevant as well. In real terms (1992=100), the affiliate carriers were almost able to maintain their real fares , experiencing a decline of only about 3 per cent between 1990 and 1997, with average revenues per passenger kilometer being 26.7 cents in 1997. The combined parents, on the other hand, saw a decline of about 14 per cent in their real fares, with the 1997 figure being 9.3 cents per passenger kilometer. Combined to the family level, the decline was about 12 per cent, in the final year it was 10.3 cents per passenger kilometer.

2.2 Real Fares Through Time:

Average revenue per passenger kilometer in 1997 adjusted for the forces of inflation was only 67 per cent of the level in 1985. In nominal terms, this average fare rose between 1985 and 1991, and has declined since then. The fact that average revenues per passenger kilometer have declined steadily since 1991 explains in considerable measure why the Canadian airline industry has faced such turbulence.

To increase our understanding of the events of the recent past, it is necessary to disaggregate the data into some of their components. Most obviously, one would want to consider the behavior of fares internationally as compared to those in the domestic market. Beyond that, it is useful to sub-divide each of these markets somewhat so as to contrast the patterns of various fare classes.

With the exception of 1992, domestic full fare economy prices rose each year of the period under review. The increases between 1985 and 1997 were such that prices in this fare category almost doubled. Domestic discount fares tracked about the same as economy fares until 1987. This discount fare index peaked in 1991, and with some fluctuations held that level until 1994. Average discount fares have declined since that time except for an upward blip in 1997. If all domestic fares are included, one finds the real index has a value of 120 in 1985. From there it rises to 1991, and declines in 1992. Since 1991, this index has more or less trended around a value of 140. Fare increases have just been sufficient to keep up with inflation.

The patterns of international fare index changes are not relevant to the present discussion and so are not presented.

2.3 Air Fares and Market Shares:

It is also instructive to examine the division of passengers among fare classes. For present purposes, the analysis will be limited to a consideration of full-fare economy and discount shares. As above, the domestic and international cases will be considered separately. In 1990, passengers travelling on discounted tickets comprised 64 per cent of the market. Full fare economy accounted for 25 per cent and business class for another 7 per cent. The 1993 figures were not substantially different, being 64, 27, and 5 per cent respectively. The situation in 1997 was much different. Discounted tickets accounted for 83 per cent of the domestic total while the full fare economy share had shrunk to 12 per cent and business travel to 4 per cent. The revenue productivity of a passenger (or passenger kilometer for that matter) had dramatically fallen over the period under review.

2.4 Average Trip Length:
It is well known that airline costs per available seat kilometer decline as the stage length increases. It is useful at this point to examine average trip length to determine its importance in the declining revenue per passenger kilometer productivity noted above. The raw data suggest that between 1985 and 1990, the average trip distance increased by 32 per cent, from 1628 to 2146 kilometers. It increased a further 12 per cent (or 47 per cent over the 1985 levels) to 2401 kilometers by 1994. Finally, it rose to 2587 kilometers in 1987. This represents an increase of 8 per cent over 1994, 21 per cent over 1990, and 59 per cent over 1985.

Prima facie, this suggests that the average trip length growth has been accomplished in part through the reallocation of routes from a parent company to a regional subsidiary. For 1994, for example, when carriers from Levels 1 and 2 are combined, the average trip distance falls to 1721 kilometers, an increase of less than 6 per cent over the 1985 levels.

These results agree with the conventional wisdom that in this period, the parent companies were increasing their focus on the longer haul and/or /international routes leaving the shorter haul regional routes to their affiliates. It seems fair comment to suggest that this trend will be accelerated in a period of airline monopoly.

3.0 Assessing the Consequences of Monopoly:

What has emerged in Canada is a single dominant carrier operating in two arenas. The first is the (virtually) monopolized domestic market. The other is a highly competitive international market where there is intense rivalry as firms attempt to increase their market shares. One might segment this external market into two parts. The first would be the trans-border market where Air Canada competes with a variety of US carriers. In the other, the international market, Air Canada as part of Star Alliance, competes with other carriers and other alliances.

It has often been said by airline officials that too much capacity is

being operated. This leads to fare reductions to improve load factors, driving average fares below the levels desired by the carriers. In the Canadian context, the result has been the demise of the financially weaker national carrier leaving a virtual monopoly behind. Economic theory would predict that the impact will differ in different markets. In the domestic market, one would expect a reduction in capacity, and a resultant increase in fares and reduction in fare options. The capacity so released would be transferred to the more lucrative markets externally. In the longer run, this increased activity would tend to lower such fares in real terms. Finally, there is the probability of the establishment of fortress hubs by the dominant carrier to protect its competitive position.

Airlines provide flights in order to service potential customers. In a domestic monopoly, the firm will add units of capacity to the point where marginal costs and revenues are equal. In the competitive international sector, the pattern will be different. There, given the intense competition among the various alliances, one will find a pattern of rent-seeking behaviour as each alliance attempts to exploit the opportunities it perceives in the market-place.

Property rights represent the legal right to exclude others from the use of inputs or commodities. Property rights are well-defined where all resources legally belong to someone and rights legally enforced. There is widespread agreement in the economics literature that property rights arrangements play an important role in determining economic behaviour. By confronting individuals with a variety of resource rights, different institutional arrangements can alter behaviour toward predictable outcomes.

Economic rent has been defined in the literature as a return in excess of a resource owner's opportunity cost. This rent may derive from two sources. It arises naturally in the price system through, for example, shifts in demand and/or supply curves. Here the pursuit of rent is equivalent to profit seeking in that the expect ion of excess returns motivates value-increasing activities in the economy. However, rent can also be contrived artificially through government action as a result

of the lobbying for specific legislation by special interest groups. In the present context, both natural and artificial rents are relevant. Air Canada's control of airport facilities generates artificial rents in the domestic air transportation markets. Its ability to develop fortress hubs will lead to one pattern of behavior. In the international markets, it must aggressively compete for both artificial and natural rents.. As a result, there will be a distinct difference in its behaviour in terms of scheduling activity and fare structure in the these market situations.

Overall, we predict that there domestic fares will rise in real terms as a result of the monopolization of the domestic industry. The consumer will also face additional choice restrictions as the availability of discounted tickets is reduced. Consumer surplus will fall, producer surplus will rise but by a smaller amount. On balance, society will be left less well off. These conclusions are based on the assumption that no changes are made to the institutional structure. Such an assumption is not valid. Attention is now turned to the issues of the business environment in which the industry will function in the future.

4.0 The Regulatory/Legislative Mileau:

Attention is now turned to the legislative/regulatory climate for Canadian air transportation as this exists in early March, 2000 to determine the extent to which the concerns noted above are ameliorated. There are two elements that are important here. The first are the Enforceable Undertakings agreed to by Air Canada and 853350 Alberta Ltd. and the Commissioner of Competition . The other is the lesislation introduced into the Commons by Minister Collenette. They will be considered in order.

4.1 The Enforceable Undertakings:

Despite expressing concerns about the concentration of the domestic airline industry, the Commissioner of Competition agreed to a number of undertakings by Air Canada and 853350 Alberta Ltd and to the takeover. Unless otherwise specified, these obligations are valid for a period of seven years from the "Transaction Date". Only those relevant to the present discussion are considered here.

The most relevant are those related to the surrender of airport facilities With reference to internal airport space, at airports where the combined firm has preferred or exclusive use of more than 60 per cent of such positions, at least 25 per cent of them shall be offered for sale to Transport Canada, the relevant airport authority or otherwise be made available for common use. At Dorval, three gates and associated facilities will be made available, at Winnipeg and Halifax one gate each, and at Pearson, four gates at Terminal 3. These offers are open for a year, with the addendum that where the airport has not been transferred, for 6 months after the transfer date. Except for Dorval, the gates designated shall be at Air Canada's discretion. There is also a slot agreement, limited to Pearson Slots will be made available to the Pearson slot co-ordinator for assignment to other Canadian Air Carriers. Were CRAL to be sold, 8 slots would be surrendered during the morning peak (0700-0900) and 20 given up during the evening peak (1500-2000). If CRAL is not sold, the number of slots would increase by 50 per cent in each instance.
A second undertaking relates to interlining and joint fares. Air Canada has pledged to enter into interlining agreements and negotiate Joint Fare Agreements on commercially reasonable terms with Canadian Air Carrier who is an IATA member and settles interline payments through its clearing house system. The joint fare provisions are straight forward, stating that the agreements must provide for revenue division (prorates), the entitlement to sell the combined services, the display of joint fares on a computer reservations systems, and the right to file the joint fares with a recognized tariff publisher. The only area of potential concern here is with the possibility of screen bias on the crs. This issue will not be considered further.

A third area deals with access to Aeroplan. For a five year period, commencing October 1, 2000, Air Canada has pledged to sell its FFP points on commercially reasonable terms. Some conditions are attached. The most relevant is Condition (f) which sets a maximum size on participating carriers (domestic passenger revenues of less than $250 million) and precludes foreign owned or affiliated carriers from participating. To put this in perspective, the average Level IB/II carrier had passenger revenues of about $50 million in 1997, Canadian

had scheduled passenger revenues of $2.4 billion, and Air Canada had passenger revenues of about $4.4 billion.

The last relevant undertaking deals with Eastern Canada. Air Canada has pledged not to initiate an Eastern discount carrier prior to Sept. 30, 2000. There is the further proviso that should such a service be begun (by a carrier other than Westjet) prior to this date, the prohibition would be extended to Sept. 30, 2001. This prohibition applies to domestic service only. This pledge provides to potential entrants a window of opportunity in which to initiate service and begin the process of building a customer base. Furthermore, Air Canada has undertaken to release space at the John C. Munro (Hamilton) airport at a price equal to Air Canada's cost not only to the regional discount carrier, but also to Westjet. .

4.2 Legislative Amendments:

According to Minister Collenette, the intent of the new legislation is to increase consumer protection and also to enhance competition. With regard to the former, the task of protecting the traveler will be shares by the CTA and an independent observer who would report to Parliament within two years. The Competition Bureau would be responsible for enhancing competition. It would deal with both anti-competitive and predatory behavior, powers seen by the Minister as complementing the undertakings discussed above. Together, these will apparently ensure "access to markets by competitors" The Government sees five major issues or areas in this regard.

The legislation will give the CTA increased authority over air fares. The definition of a monopoly route is to be clarified, and regulatory authority is to be expanded to include all fares, a change from the present situation where only economy fares could be reviewed. Air freight tariffs will also be subject to the same scrutiny. The CTA will also be given the power to order carriers to expand the fare options available on a given monopoly route. It will also have the power to audit carriers for a two year period. Finally, the CTA powers to review the terms and conditions of carriage on domestic service will be

restored. These relate essentially to lost baggage, bumping and services to the disabled. The Government will also strengthen the Competitions Act by providing the Governor-in-Council the power to define both anti-competitive and predatory behavior, and to give the Commissioner of Competition authority to halt such behavior ex parte. The undertakings by Air Canada will be made legally enforcable.

The current constraint on the level of foreign ownership is to be maintained. However, the legislation proposes to give to the Cabinet the power to change it in the future using Section 55 of the Canadian Transportation Act. The limit on individual ownership is to be increased to 15 per cent.

Presently, the second to last and last carriers abandonning service to a community to provide 60 days notice. The amendments increase this notice period to 120 days, as well as tightening the requirements for notification. Closely related is the requirement that there be dialogue between the carrier(s) and the affected community. The community would also have additional time to seek a replacement carrier.

The legislation also incorporates a special review process for airline mergers and acquisitions and provides for the appointment of as monitor who would assess the impacts of airline restructuring and report to Parliament through the Minister within two years. at that time Adjustments might well be made at that time

4.3 Some Observations:

As of early March, 2000, only the capacity-related changes have been initiated. Consider the summer schedule announced by Air Canada on February 9, 2000. According to the press release, domestic capacity will be cut by about 15 per cent while external capacity is increased. Trans-border capacity is to rise by 14 per cent and international capacity by 12 per cent. Together, these changes leave average aircraft utilization virtually unchanged. That press release also notes hub expansions at Toronto and Vancouver and the development of a new hub at Montreal. The thrusts of route expansions appear to be primarily international and trans-border at these hubs. Thus two very

different market situations exist for Air Canada with two very different forms of market behavior.

Furthermore, Air Canada has ceased servicing some points. Effective with the new schedule, for example, it will no longer serve Fredericton or Saint John. Service, however, will continue to Moncton, presumably because it is a competitive point. In the near-term, Fredericton and Saint John will be served by Air Nova and Canadian Regional. Should the latter be sold, the expectation is that only Air Nova would provide service to Fredericton.

Events have not only overtaken us, but also the Government. It is probable that the desired structural changes will have been made by the time the Collenette bill becomes law. Consequently, what is required is an approach to policy which will come to grips with the fait accompli of the restructuring of the domestic industry.

5.0 Dealing with the Airline Monopoly:

There are two issues here. The first of these is what has come to be called "anti-competitive" behavior. The other is airport access. Both the Undertakings and the Legislation do a better job of dealing with "anti-competitive" and "predatory" behavior. The frequent flyer, screen bias, TACO and interlining/joint fare problems are all adequately addressed. On balance, because of the lack of a level playing field in the form of equal access to airport slots and other facilities, Air Canada will remain in a very strong competitive position in the domestic air transportation market. While some limitations have been put in place, they are not sufficiently strong to permit the development of strong , vibrant competition.

A far more important dimension particularly in the long run, is the question of airport access. While the legislation is silent on this aspect of enhancing competition (despite the fact that the Government is the Landlord) the Undertakings do provide some interesting insights. Most disturbing is the implicit position of Air Canada (and apparently agreed to by the Commissioner of Competition) that the airline has

perpetual property rights to all runway slots used by it or by Canadian Airlines. [1] At issue of course, is access to Pearson, the important dimensions being the number of slots and the time frame within which the requests must be made. Taking the latter first, the requests may be made in June or November 2000, providing a potential entrant less than a year from the Undertaking until its expiry. The window, it appears, will close very quickly.

Furthermore, the number of slots being made available at peak is insufficient to provide the opportunity for the development of any serious competition for Air Canada. Eight slots in the morning peak permit 8 operations. Taking a flight as involving an arrival and a departure, this permits 4 flights, an average of 2 per hour. For the afternoon peak, the numbers are 20, 10 and 2 respectively. [2] No mention is made of slots at other airports. While these may not be as congested as Pearson, at many airports there is a measure of congestion during some, perhaps brief, periods of the day. Unless a potential competitor could be ensured of the appropriate slots at both airports, competition is unlikely to develop at Pearson. In fact, one could go further and suggest that the undertakings give tacit blessing to the development of a fortress hub by Air Canada at Toronto.

Turning to internal airport facilities, the Undertakings make some minor concessions. The details have been noted above. There are two aspects which need to be noted. The first is the lack of concessions at Vancouver International Airport. This might preclude the development of competition for Air Canada between Vancouver and points external to Canada. The other area of concern is the fact that the offers will be on the table for only a year (or for 6 months after transfer for those airports still operated by Transport Canada). Little time is available for the development of competition in the domestic market.

The question of an Eastern Canadian discount carrier should be addressed as well. In the Undertakings, Air Canada has pledged to permit a window of opportunity for such a carrier to become established should it initiate service prior to September 1, 2000. Depending on the timing, somewhat more than a year is made

available. The downside here is the apparent need for such a carrier to provide service through Hamilton, a destination chosen by very few.

The Air Canada monopoly will affect two dimensions of domestic air travel. First, with the reallocation of routes between the parent and the affiliates, average fares (average revenue per passenger kilometer) will rise in real terms. It is worth noting once again that this can be accomplished without changing any existing posted fare by rerouting passengers. When the possibility of increasing fares in response to a variety of stimuli is admitted to the analysis, the potential for such increase rises dramatically. Second, the loss of price flexibility is a concern. Competition tends to ensure that prices are more closely related to cost-of-service. Monopoly pricing is more value-of-service based. The result would be a fare structure which was flexible in only the upward direction. The other dimension of interest is the potential for change in the character of service. For peripheral areas, this might well include increased circuitry and/or changes in the type of aircraft, dimensions which some refer to as the quality of service. Given the subjective nature of this dimension of air travel, and the inevitable tradeoff between aircraft type and frequency of service, meaningful discussion is difficult. What is important, however, is the fact that the dominant carrier, in its spring schedule announced in February, has already made dramatic (some would say negative) service changes in many instances. It is apparent that a great deal of restructuring will occur prior to the passage of the amendments to the Canadian Transportation Act and the Competitions Act. In reality the amount of protection provided by the legislation in minimal.

5.1 Policy Options :

What policy options are available to deal with the potential for fare escalation and the likely downward inflexibility of prices ? Drawing on past experience, in Canada and elsewhere, there are four options available. Fares could be controlled by statute, by regulation, by subsidy or by competition. Each needs to be considered not only for its impact on fares, but also for its impact on quality of service.

In Canada, the Crow and statutory rate control are synonymous. From

the perspective of rate control, it worked, shifting the burden of National Policy to the railroads. It resulted in heavy financial losses for the carriers and resulted finally in the branch line subsidy program in the NTA (1967). This subsidy program shifted financial responsibility to the Federal Government, and rates continued at their 1897 levels. From the other perspective, grain shippers increasingly complained about the quality of service, both the lack of grain cars and the timeliness of the service. Ultimately, the program ended The experience illustrates the connectivity between rates (fares) and quality of service, and suggests that this is not a viable policy option for domestic air transportation in Canada. Other Canadian experience with subsidy programs has been equally unsuccessful, and suggests that, with the possible exception of remote communities, subsidy is not an economically viable method of controlling fares either.

A third option would be the re-regulation of all or segments of the domestic airline industry. In fact, the legislation introduced into the Commons deals with excessive price increases, market exit, anti-competitive behavior and predatory pricing. While the provisions may well be politically attractive, there is little evidence that regulation has been effective in protecting consumer interests either in the transportation sector or in other sectors of the economy. The record is sufficiently clear that further discussion is not warrented.

The final option would be to establish a mileau which would maximize the potential for the development of competition. Whereas monopoly transfers consumer surplus to the producer and also results in a deadweight loss, competition has the opposite effect. As is well known, the competitive outcome maximizes the sum of consumer and producer surplus, and eliminates deadweight loss. Prices become flexible in both directions, service competition develops, and the overall well-being of society improves. The real question here then becomes one of how well both the "undertakings" and the legislation promote competition in the domestic airline industry. For reasons discussed below, the answer is at best mixed.

5.2 The Preferred Alternative::
While there is no assurance that there is room in the domestic market for two major competitors, and hence for the development of actual competition, under proper conditions, existing firm behavior might well be modified by the threat of potential competition.

From where might this potential competition come? In the case of the dense routes, competition could arise from the expansion of existing carriers such as Westjet and Canada 3000. Failing this, with a change in policy, the competition could arise from carriers external to Canada under a true open skies policy. The adoption of a such a policy would offer considerable potential benefits to the travelling public. Airlines would compete for market rent by adding flights to major Canadian hubs which have become accessible. The public will benefit from the increased flights and subsequent price competition. In our view, the improvement of airport access for all competitors, whether incumbents or new entrants, will confer improved benefits on the airline traveller. We have argued elsewhere that an auction of available capacity is the preferred means of allocating the available capacity. To make the threat of such competition more probable, adequate access to airport facilities and slots at the major Canadian airports has to be available.

In the less dense markets, access to such major facilities is also a sine qua non for the possible development of a new generation of carriers wishing to service such markets. As above, the auctioning of capacity at major airports provides the optimal solution.

6.0 Conclusions :

This paper has examined the current monopoly situation in the domestic Canadian airline markets. It has speculated on some of the possible impacts on domestic travelers, both from the perspective of fares and that of service quality. It reviewed several policy options which might be employed to counter the emerging trends, and concludes that the auctioning of units of airport capacity provides the most promising approach.

The Use of Economic Analyses in Competition Cases - Analysis of a Predatory Pricing Case and an Intervention in Transportation Cases

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1. Introduction

The underpinnings of Competition law[1] in Canada can be traced in part to economic thought which reflected a certain degree of ambivalence about the virtues of competition vs. combination before the turn of the nineteenth century. At that time, the teachings of Adam Smith and his support for free competition were well known, however, economic thought also saw merit in combinations and aggregation of wealth. This ambivalence in thought was finally resolved in favour of competition and against combinations. It was not only against the common law in Canada but also against the common law in England and the U.S. This is also suggested in the discussions that occurred between Members of the House and Senate during the enactment of the first competition law in Canada in 1889.[2] The underpinnings of competition law also became evident when this law was extended to include other forms of economic behaviour that restrained trade in the decades that followed.[3] Even today, a great deal of discussion occurs among economists when attempts are made to revise the *Competition Act* in light of developments in economic theory. Thus, there

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* The views expressed are those of the author and not necessarily those of the Competition Bureau.

1 The initial Act of 1889 - *An Act for the Prevention and Suppression of Combinations Formed in Restraint of Trade* (52 Victoria, c. 41) - often referred to as the Wallace Act of 1889 was basically concerned with combinations.

2 For example Mr. Guillet, a Conservative MP from Ontario argued: "Competition safeguards the prosperity of the country; it is the life of trade; and all classes have to meet it ... Why, then, should there be combinations in a few lines of manufacture to oppress others? I say it is a condition essential to the prosperity of the country that there should be free competition, and no monopoly to compel people to pay excessive prices," ***Debates*** 1889, p. 114 cited in Baggaley, D. Carman, "Tariffs, Combines and Politics: the Beginning of Canadian Competition Policy, 1888-1900," p. 26 in ***Historical Perspectives on Canadian Competition Policy***, edited by Khemani, R. S. and Stanbury, T. W., The Institute for Research on Public Policy, 1991.

3 For example, succeeding Acts and their amendments included: mergers and monopolization in 1910; predatory pricing and price discrimination in 1935; resale price maintenance and refusal to deal in 1951; discrimination in advertising allowances and misleading price advertising in 1960; deceptive practices pyramid selling, multiple ticketing, etc. and civil reviewable matters such as refusal to supply, tied selling, etc. in 1976. See Gorecki, K. Paul, and Stanbury, T. W., ***The Objectives of Canadian Competition Policy 1888-1983***, p. 7.

is a close and fundamental relationship between economics and competition law.

Despite this close association, the explicit use of economic reasoning and economists in Courts began on a rather uncertain foundation. This can be seen in the jurisprudence. For example, in *Crown Milling Company v. The King*, Lord Finlay stated: "It is not the judge's task to adjudicate between conflicting theories of political economy."[4] This opinion was reiterated in cases such as *R. v. Container Materials Ltd.* and *R. v. Howard Smith Paper Mills Ltd.*; and in one 1976 case - *Allied Chemical et al v. The Queen* - evidence of the Crown economist was not admitted.[5]

Since the release of these judgments, the attitude towards the treatment of expert economic evidence by the Courts has gradually changed[6] and though economic evidence is accepted, the weight to be attributed to it is a matter to be determined by the Court.[7] A more dramatic change in attitude occurred with the inclusion of civil provisions into the competition law in 1976 and the sharp increase in the use of economic experts.[8] These developments were re-enforced with the establishment of the Competition Tribunal in 1986,[9] (a quasi-judicial body, comprising of judges, experts from the business, academic and civil service communities). In fact, provisions for the use of expert evidence are now specifically provided for under sections 47 and 48 of the *Competition Tribunal Rules*. Thus the acceptance of economics and economists have now become firmly established.

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4 See *Crown Milling Company v. The King* [1947] A.C. 394. Also cited in von Kalinkowski, O. Julian, ***World Law of Competition***, Unit A North America Volume A3, Canada by Gordon Kaiser, 1987, pp. 3-42/43.

5 This should not be surprising as Canadian competition law is not only concerned with economics but is also concerned with providing for guarantees of procedural rights as well as substantive ones, together with remedies and sanctions. Further, it encompasses implicit non-economic goals and purposes and was a criminal law in total until 1976.

6 See *R. v. K. C. Irving (1974)* 16 C.C.C. (2d) 49 at 69.

7 See *R. v. Howard Smith Paper Mills Ltd.*, [1954] 4 D. L. R. 161 at 188 (Ont. S. C.).

8 This is not only evident in the increased expenditures incurred by the Competition Bureau on economic experts but also in the need for economic experts in connection with interventions under section 27.1 (of the *Combines Investigation Act* (now section 125 and 126 of the *Competition Act*)) in industries requiring expert testimony. For example expenditures on legal and expert were increased from 971,000 to 2,624,000 from 1978 to 1989. See Table 1 in Stanbury, T. W. "Roles, Responsibilities and Resources: The Bureau of Competition Policy's Budget And Its Activities," May 1996.

9 Part VIII of the *Competition Act* is concerned with Reviewable Matters by the Competition Tribunal.

In this paper we shall illustrate how economic analyses provided the background in the consideration of a predatory pricing case and the basis for an intervention in the case of an application for a licence. Part 2 presents a predatory pricing case and part 3 presents an application by Hillside Auto Carrier Limited to amend its licence to provide additional service. In the predatory pricing case, the complaint will be briefly described together with the background of the industry; the provision of the *Competition Act* involving predatory pricing; and an economic analysis of the case. In the Hillside case we shall summarize: the intervention by the expert witness of the Commissioner of Competition (i.e. the Director of Investigation and Research until March 1999); the decision of the New Brunswick Motor Carrier Board (i.e., NBMCB); the economic analysis behind the intervention; and our comments on the decision of the NBMCB. In part 4 a few concluding remarks will be provided, followed by a brief bibliography.

2. A Predatory Pricing Case

The case concerns a complaint to the Competition Bureau involving allegations of violation of the predatory pricing provision and other provisions of the *Competition Act* (i.e., Act). The analysis here will be confined to the predatory pricing aspect of the complaint and its description is contained in three sections: the predatory pricing provision of the Act; a brief description of the complaint and its evaluation and; an economic analysis of the complaint. First however a brief background to this provision will be provided.

Predatory pricing is a criminal act. This type of deliberately exclusionary activity occurred more frequently in the early 1900s, where such activity was considered as an effective means of obtaining market power and eliminating competition. Tactics such as the use of fighting brands, fighting ships, cut-throat competitors, etc. are reminders of ruthless monopolists who sought to stamp out upstarts in an effort to destroy any threat to their market power. The origins of the predatory pricing provision can be traced to the recommendations of the Royal Commission on Price Spreads which resulted in the creation of a provision in the Criminal Code in 1935. Several years later in 1960 this provision was transferred to the *Combines Investigation Act*.[10]

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[10] Anderson, R. D., and S. D. Khosla, "Recent Developments in the Competition Policy Treatment of Predatory Pricing," ***Canadian Competition Policy Record***, Volume 6, No. 3, September 1985, p. 6.

Since the prohibition of predatory pricing not only protects the smaller firm but also forbids activity that frustrates the competitive process ultimately to the detriment of consumers, its continued prohibition in the 21st century is consistent with the objectives described in section 1.1 of the Act.[11] To ensure that these objectives are met and the statute is complied with, so that total welfare will not be diminished, the statute provides for punitive sanctions of imprisonment for a term not exceeding two years. In addition, other remedies are also available in the form of remedial orders and undertakings to preserve or enhance the competitive process.

a) The predatory pricing provision of the *Competition Act*

The predatory pricing provision is contained in section 50(1)(c) of the *Competition Act* (formerly s. 34(1)(c) of the *Combines Investigation Act*) which states:

> "Everyone engaged in a business who
> (c) engages 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 such an effect,
> is guilty of an indictable offence and is liable to imprisonment for a term not exceeding two years."

For an offence to be committed under this provision, the statute requires four basic elements to be satisfied.[12] First, the alleged predator must be 'engaged in a business'. Second, the predator must engage in a 'policy of selling'. Third, the prices at which the product is sold must be 'unreasonably low'. Fourth, 'design' or 'effect of substantially lessening competition' or the 'elimination of a competitor' must be established.[13]

b) The complaint and its evaluation under the key elements of section 34(1)(c)

In the 1980s, the Competition Bureau received a complaint under section 7 of the *Combines Investigation Act* regarding the tolls for busing services on a provincial government tender. The tender was bid on by several busing companies - Company Y, Company X, Company U and

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11 ***Predatory Pricing Enforcement Guidelines***, Director of Investigation and Research, Competition Act, Consumer and Corporate Affairs Canada, 1992, p. 2.

12 This follows the steps outlined by Linden, J. in the *Hoffmann-La Roche* case and has been adopted in the ***Guidelines***.

13 *Id.* at p. 2.

Company C.[14] Company X's bid (for part of the tender) was 32 percent lower than Company Y and 54 percent lower than Company U. As a result, Company Y alleged that Part V of the *Combines Investigation Act* and section 34(1) (c) (now section 50(1)(c) of the *Competition Act*) in particular was being violated by Company X. A brief description of the industry is given in the accompanying footnote.[15]

First, the accused predator was engaged[16] in a business of providing busing services as was evident not only through its provincial letters of incorporation but also through the bus carrier licence it held and its tolls on file with the Regulatory Agency (i.e., RA). Further, if a bus

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	Company X	Company Y	Company U
Point A	100P/$a	100P/$a+24%a	100P/$a+48%a
Point B	200Q/$b	100P/$b+40%b	200Q/$b+19%b
Point C	200Q/$b	100P/$b+43%b	200Q/$b+39%b
Point D	200Q/$b	100P/$b+43%b	200Q/$b+19%b
Point E	100P/$a	100P/$a+41%a	100P/$a+61%a
(Total Cost for a 2 year term)	$Zm	$Z+37%Zm	$Z+38%Zm

Company C tendered hourly rates at approximately $b+16% per hour for a 200Q bus on three locations.

15 During the 1980s, busing played a small but important role in transportation. A significant part of this busing was related to the Charter services (i.e., 80% of busing revenue hours) and was highly seasonal, with the greatest part of the activity occurring during the summer months. The remaining part of the charter business was generally related to Specialty services. In 1981, busing revenues of approximately $Wm. were earned by N busing companies in Canada operating about M vehicles. The largest markets for these services were British Columbia and Québec and the level of concentration in the industry varied from province to province but was low for the entire nation.

Prior to August 1980, entry into the busing industry was regulated and an application for a operating licence was required. In addition, regulations also controlled the addition of vehicles by a licence holder or the removal of existing restrictions on existing licences, the filing of tolls and tariffs and their approval, the requirement that the tolls be just and reasonable, etc. On August 1, 1980, a trial period of relaxed regulation came into effect, freeing existing bus charter carriers from the requirement to file long term rates for charters of 30 days or more. It also exempted already licensed bus charter and specialty carriers from all but the financial requirements of licencing (including public convenience and necessity). This enabled these existing licence holders to provide service using vehicles for which they were not authorized. Given the partial deregulation that existed in this industry and the dismissal of the complaint of Company Y by the Regulatory Agency (at least temporarily), the application of the regulated conduct defence to this industry was not considered an issue and informal investigation of the complaint began under the *Combines Investigation Act*.

16 In other words the business must be operational. For example in The Thomson Newspaper case the accused claimed that the Tribune had ceased publication and that there was no acquisition by Thomson of the 'business' of the Tribune. The Honourable Justice Anderson concurred stating "In my view, it would be only the purchase of assets from a business which was a going concern which would constitute an acquisition within the meaning of that word as used in the definition of merger".

operator no longer offered service it had to apply to the RA for a suspension of its services. No such application was on file with the RA and since the predator owned several vehicles, earned revenue in previous years and employed a number of individuals, it was actively engaged in business. Thus it was a company that had not seized operation but was operational nor was it an occasional sale by an individual so as to raise an issue as to whether it was engaged in business. Furthermore, since bus service is a form of road transportation it fell within the meaning of 'business' as defined in section 2 of the *Competition Act*.[17]

Second, a 'policy of selling products' must be established. To show that a policy exists, one does not require a formal corporate by-law or resolution approving a particular course of action. All that is required is a planned and deliberate course of action by responsible employees of the company.[18] In this case the bidding on the government tender was made by senior personnel of the alleged predator, as they wanted to be 'competitive beyond relief'. It was a deliberate course of action. In addition, the duration of the sale has to be considered.[19] The tender was for a period of two years. Thus it was not an occasional sale or a sale for a short period.[20] The alleged predator was fully aware of this and the fact that Company Y could become insolvent if it lost one or two key contracts or failed to place some of its larger vehicles that it had recently purchased. Turning to the relevant product in this complaint, it was considered to be busing services as the provincial government tender specially requested the use of bus carriers.[21] In such a situation, it is not necessary to look for other products which are

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17 In section 2 dealing with interpretation, the term is defined as follows:
business includes the business of
(a) manufacturing, purchasing, transportation, acquiring, supplying, storing and otherwise dealing in articles, and
(b) acquiring, supplying and otherwise dealing in services.

18 If one salesman sold items at unreasonably low prices without knowledge or approval of his superiors, this might not be considered as engaging in a policy of selling. If, on the other hand, the sales department as a group did this repeatedly, even without the official authorization of the board of directors or the general manager or the president of the company, this would likely be considered a policy of selling.

19 One or a relatively few instances of prices below AVC are unlikely to satisfy the test. Similarly, prices which may have been applied generally in the market, but for a relatively short period of time are likely to (but will not necessarily) fall short of representing the sort of 'policy of selling' contemplated in section 50(1)(c). See *Guidelines*, p. 12.

20 Though one of the requirements set out in is the *Hoffmann-La Roche* judgment is the requirement of a sale, it should be noted that in this case the closing date for the tender had already occurred and the provincial government had not yet awarded the contract to any of the bidders in light of the complaint to various government departments. See *R. v. Hoffmann-La Riche*, (1980), 28 O.R. (2d); affirmed (1981), 33 O.R. (2d) 694 (C.A.).

21 As noted in one judgment "the tender calls were a relevant market for the purposes of the Act" see dissenting opinion of Laskin, J.A., *Regina v. J.J. Beamish Construction Ltd.*

substitutes and could have a constraining influence on the ability of the predator to exercise market power as their use was not called for in the tender.[22] As far as geographic market delineation is concerned, the province concerned was considered to be the relevant geographic market.[23] This is because there were significant additional costs in providing services from neighbouring provinces. For example, bringing in vehicles to provide services increased cost thereby limiting the extent of competition and price uniformity.

Third, it must be shown that the predator charged 'unreasonably low prices'. As indicated earlier, the alleged predator quoted prices thirty-two percent below that of its nearest competitor. Further, cost estimates of operating particular types of vehicles required were obtained from several sources. These sources suggested that the direct operating cost (or variable cost) could range from $b+21%b to $b+31%b excluding overheads and that the long term cost would be about $b+43%b (b is some constant). This appeared to suggest that Company X's tolls were very near or below AVC. However, before arriving at a conclusion a price/cost comparison is usually undertaken. The comparison lays down a number of specific rules. First, prices above 'average total cost' are not 'unreasonably low' regardless of how much market power is possessed by the alleged predatory. Second, prices below, 'average variable cost' are 'unreasonably low', unless clearly justified.[24] Third, prices below 'average total cost' and 'average variable cost' requires consideration of surrounding circumstances e.g. excess capacity, demand strength, etc.[25] However, before a determination could be

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22 In considering the relevant market, factors such as physical properties of products, observable differences in end uses or consumer preferences, historical price relationships, shipment patterns, transportation and switching costs, institutional barriers and other indicators of product substitutability, etc. are usually taken into consideration.

23 Geographic delineation is an attempt to determine the extent of the territory where there is competition and in which prices for a product tend to uniformity. The latter did not hold as there was limited competition from the busing companies outside the province due to the existence of regulatory barriers. It is worthwhile recalling that busing licences were extremely specific and contained restrictions relating to vehicle group, nature of service, etc. Even though there was a period of relaxed regulation, it applied only to carriers already licenced at that location. Carriers outside the province could not serve that provincial market unless they obtained written permission from the licensed carrier at hat location and concurrence from the Regulatory Agency, the regulatory body. When approval was obtained 'charges' were imposed. These 'charges' provided geographic protection and acted as a barrier protecting the licensed carrier from competing carriers. This would create substantial price differentials between the province and other geographic areas of Canada sufficient to delineate it as a separate market.

24 See *Guidelines*, p. 7.

25 See *Guidelines*, p. 7.

made on whether the prices were 'unreasonably low', the Regulatory Agency issued an Order. This Order dismissed Company Y's complaint, on grounds "that each operator tendered below direct operating costs on at least one of the two points requiring the utilization of a [specific vehicle]". As a result, further action under section 34(1)(c) seemed futile and the investigation was discontinued. However, before closing this file, the final element required in the statute was also considered.[26]

Fourth, it must be shown that there was a '*substantially lessening* [of] *competition*' or a competitor was eliminated or there was a design to have such an effect. In considering substantial lessening of competition, one seeks to confirm that the effect of the pricing policy is to preserve or add to market power and that there is little opportunity for competition in the future because of entry barriers. Further, in deciding whether a competitor has been eliminated, one seeks to establish that a firm has gone out of business or is not in a position to constrain the ability of the predator to raise prices.[27]

In determining the above, a market power analysis was employed. An examination of the suppliers in the market revealed that there were only five companies licenced to operate from a location in the province concerned, one being the alleged predator.[28] Further, the alleged predator and the complainant, the largest two companies, had an operating fleet of 22 vehicles and 21 vehicles, respectively. As a result, the alleged predatory had a market share of 50 percent or more.[29] The complainant, was the only other carrier with a significant market share with the ability to constrain the power of the predator to raise prices. Further, as described earlier, entry into

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26 As indicated in footnote 14, the complainant also filed its complaint with the Regulatory Agency and though the industry was partially deregulated the Committee maintained that existing regulations continued to be applicable. This resulted in a Order asking why the said tolls of Company X should not be suspended or disallowed, as they may be unjust or unreasonable because the tolls did not appear to cover direct operating costs. The Regulatory Agency considered all the financial information submitted to the Committee on a confidential basis which was not released to the public or the Director of Investigation and Research.

27 See ***Guidelines***, p. 13.

28 It is worthwhile noting that one of the other carriers licensed had only a few vehicle and suspended its service later in the year. In addition, one company was licensed to operate from Point F and did not have its licence to operate from the province concerned, though a several months later it obtained a licence to operate from a basis in Point G, in the province concerned.

29 Revenue is a better measure in computing market shares, since it would take into consideration size of the vehicle not captured in the other measures. It is worthwhile noting that the vehicle of Company Y were in the smaller groups. In the larger Group, it was alleged that Company Y had only 25 percent of the total number of carriers.

the industry was regulated by the Regulatory Agency. To obtain a licence to operate a bus carrier one had to meet the public convenience and necessity test. Perhaps, the length of the tenders could be considered as another barrier. Apart from these barriers, in general entry barriers were low for example there were no sunk costs (as vehicles can be easily bought or sold). Thus the effect of the predatory pricing policy could result in a substantially lessening of competition and the elimination of Company Y. This could add significantly to the market power of the predator. Since the effect of the alleged predatory pricing had not occurred, design or intent had to be established.

This is required as motives other than predation might exist for the pricing behavior of the alleged predator. As has been pointed out "[in] the final analysis, the question resolves itself into one of intent and purpose, not a choice of accounting methods."[30] In considering intent a number of factors are considered relevant, for example the magnitude of the price cuts and the losses incurred, the absence of any other rationale for the price cuts and documentary and oral evidence which describes the intent of the alleged predator in carrying out these actions.[31] In this complaint, unlike the *Hoffmann-La Roche* and *Consumer Glass* Cases, there was no long history of price reduction and cutting. All that could be shown is that the prices on the tender of the alleged predatory were considerably lower than the tariffs filed with the RA for hourly service for an earlier period and in comparison to its prices offered in an earlier tender. Further, there was no excess capacity in the industry that could provide a rationale for the observed fall in prices or tolls. There was also no evidence of losses by the complainant as the impact of this tender would be felt in the future. Perhaps, the most convincing evidence of intent was inferential from statements of the alleged predator to the complainant. The alleged predator, wanted to eliminate or merge with the complainant because of the latter's competitiveness and potential threat to its success in the more lucrative adjacent market. In addition, the complainant objected or was planning to object to a merger of the competitor and one of the largest international busing companies which

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30 See Roberts, R. J., ***Anticombines and Antitrust***, 1980, p. 223 (cited in *Ben Hur Coal Co. v. Wells* (1957), 242 F. 2d 481, at p. 486 (10th Cir.) Cert. denied, 354 U.S. 910).

31 *Id.* For example in *Hoffmann-La Roche* the Court of Appeal stated that "...the trial Judge based his finding on intent not only on the statements contained in the documents, but also on the actions of the appellant." It further stated it "would not draw any different conclusion from the evidence from that drawn by the trial Judge," which is to say that the evidence related to the "programme of providing free valium to hospitals" demonstrated an intention "to substantially lessen competition or to eliminate a competitor." Cited in Cairns, James P., "Predatory Pricing: Notes on Hoffmann-La Roche," ***Canadian Business Law Journal***, Volume 9, No. 2, July 1984, p. 253 quoted from *Hoffmann-La Roche*.

was being examined by the regulatory body. Thus if the complainant could be constrained in the provincial market, its ability to be a competitive threat in the adjacent market could be severely impaired. Further, the predator's possibility of being the largest and undisputed dominant Canadian firm not only in the province but throughout Canada, perhaps for several decades or even a century was being lost.

As can be seen from the above and past cases, it is quite difficult to distinguish statements of predatory intent from those of a vigorous competitor. Apart from this difficulty, little direct evidence of design is generally found on the premises or in communications as businessmen are generally knowledgeable about the Act and are often too sophisticated to retain incriminating evidence. As a result, design must be usually inferred. This has led some writers to suggest that the design or intent element of the offence should be eliminated from this section. [32]

c) The economic analysis of the complaint

The economic analysis used in determining some of the above elements is carried out in two stages.

First, a market power analysis[33] is performed to assist one in determining whether the pricing behaviour is consistent with predatory pricing theory, (i.e., a short run price reduction to drive out competing firms or to discourage entry in an effort to gain larger monopolistic profits in the long run). Its starting point generally involves the consideration of market shares and concentration. It is unlikely that an alleged predator with a market share of less than 35 percent would unilaterally have the ability to affect industry pricing. Also considered are the total number of sellers in a market and the trend in market shares. Further, the greater the disparity between the market share of existing firms, the more likely the alleged predator has market power.[34] A conclusive finding also depends on the assessment of the conditions of entry into the industry. If entry is easy it would not make much sense to eliminate a competitor and then raise prices as entry would reoccur. Two types of entry barriers have been specifically noted in the ***Guidelines***; cost advantages and sunk costs.

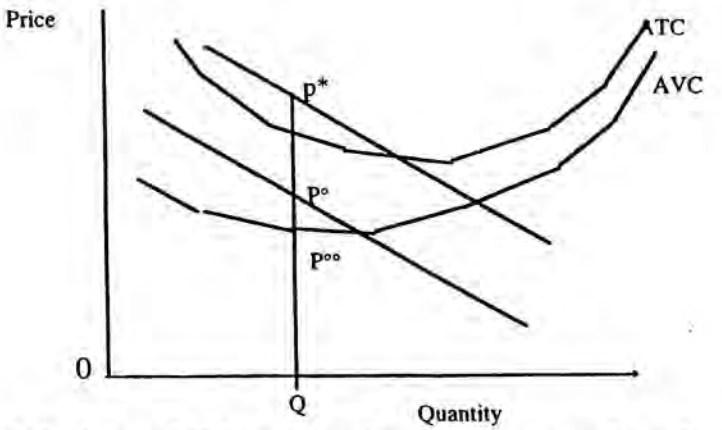
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32 Hayden, Gerald F., "Predatory Pricing: The Combines Investigation Act, Subsection 34(1)(c), a Violation in Search of a Standard," ***Osgoode Hall Law Journal***, Volume 21, No. 3, September 1983, p.553.

33 A market power test was first proposed by P. Joskow and A. Klevorick in 1979 as part of a two-tier test in predatory pricing cases.

34 See ***Guidelines***, p. 7.

Second, in determining whether prices are unreasonably low, a price comparison test is employed. This test was initially suggested by Areeda and Turner[35] who attempted to apply economics to make a determination of some of the relevant price/cost issues in predatory pricing. Though the tests adopted by the Competition Bureau are not identical to the test suggested by Areeda and Turner the underlying rationale is very similar. The economic



rationale for the rules laid down in the price comparison test can be easily seen from the diagram above. A demand curve is drawn above and between the average total cost (ATC) and average variable cost (AVC). The difference between the two is a result of fixed costs.

In the preceding diagram, at a price of P* (or above) the firm is not losing any money and such a price is not unreasonable, under profit maximization theory. At a price of P° the firm is losing money as the total cost is above the price, however, it is not unreasonable under loss minimizing since the firm is recovering a part of its fixed cost and final

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[35] They held that according to economic theory, a firm will maximize its profits, or minimize its losses, by producing at a point where marginal cost equals price. A monopolist, however, will maximize profits when marginal cost equals marginal revenue. Marginal cost is therefore viewed as sound for determining competition from predatory pricing. However, since marginal cost cannot be determined easily, Areeda and Turner used average variable cost.

determination of whether it is 'unreasonable low' requires consideration of surrounding circumstances. At a price below P^{oo} the firm continues to lose money, however it makes no sense to continue to produce. The firm is not only not recovering any of the fixed cost but is also not recovering all of its variable costs, it is therefore considered to be 'unreasonably low'. The above rationale is based on the price/comparison tests suggested in the *Guidelines*. Though there are many other economic tests that have been suggested by economists they were not used in this analysis.

3. The Hillside Auto Carrier Intervention

The intervention chosen for an economic analysis concerns an application by Hillside Auto Carrier Limited to amend its licence to provide authority to transport new automobiles, vans and trucks by road to and from all locations in New Brunswick and to other jurisdictions as authorized. This analysis consists of four sections: a) The provisions authorizing intervention under the *Competition Act*; b) A summary of the intervention by the expert witness of the Commissioner; c) A brief summary of the decision of the New Brunswick Motor Carrier Board (i.e., NBMCB); d) An economic analysis of the intervention, and e) Comments on the decision of the NBMCB.

a) The provisions authorizing intervention under the *Competition Act*

Section 27.1 of the *Combines Investigation Act* (now section 125 of the *Competition Act*[36]) empowers the Director to make representations and call evidence before any federal board in respect of competition, whenever such representations are relevant to a matter before the federal board and to the factors that it is entitled to take into consideration in determining the matter. The Director may also make representation at the request of a federal board or when he is directed to do so by the Minister of Industry.[37] Similar to the above provision is section 126. This section was added to the *Competition Act* in 1986 which enabled the Director to appear before provincial boards. However, unlike the above provision,

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[36] See section 125 in An Act to provide for the general regulation of trade and commerce in respect of conspiracies, trade practices and mergers affecting competition, R.S. 1985, C-34 amended by R.S. 1985, c. 27 (1st Supp.), R.S. 1985, c. 19 (2nd Supp.), R.S. 1985, c. 34 (3rd Supp.), R.S. 1985, c. 1 (4th Supp.), R.S. 1985, c. 10 (4th Supp.) 1990, c. 37. Henceforth referred to as the ***Competition Act*** which was formerly known as the ***Combines Investigation Act***.

[37] The legislation formerly read the Minister of Consumer and Corporate Affairs, however, the amendment was brought about by section 62(1)(d) of the *Department of Industry Act*.

section 126 empowers the Director only to make representations at the request or with the consent of the concerned provincial board.[38]

b) A summary of the intervention by the Commissioner's expert witness

The testimony of the Commissioner's expert witness consisted in establishing three facts: 1) The existence of a monopoly situation in the transport of automobiles in New Brunswick; 2) The absence of a natural monopoly in the road transportation of automobiles; and 3) The inefficiency of the existing situation in the transportation of automobiles in the province of New Brunswick.

On the first point, the Commissioner's expert witness indicated that the market for the transportation of new automobiles within the Maritime provinces and between the maritime provinces and Québec by road is characterized by a virtual monopoly situation. Auto Haulaway/Atlantic Automobile is estimated to control over 75 percent of the road movement of new automobiles in the region. Auto Haulaway/Atlantic Automobile control 100 percent of the market for the movement of imported European automobiles from the Halifax Autoport to the Maritimes by road, 100 percent of the road movement from the Volvo (Canada) plant in Halifax of units destined for delivery in the Maritimes and a large percentage of the road movement in the Maritimes of domestic automobiles and Japanese imports. The only other carrier McCallum (Québec) operates on an interprovincial basis and does not have intraprovincial operating authority in the Maritimes. The competition therefore between McCallum and Auto Haulaway/Atlantic Automobile is extremely limited since for most part they are operating in separate markets. Based on these market conditions the Commissioner's expert witness concluded that a monopoly situation existed.

On the second point, the Commissioner's expert witness indicated that since it is frequently asserted that the for-hire carrier industry possesses all of the necessary prerequisites for the existence of a natural monopoly and that in consequence competition would be harmful to the public interest, the Commissioner's expert witness attempted to show that the proposition was false. He pointed out three conditions were required for a natural monopoly

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[38] Monteiro, Joseph, "Regulatory Interventions by the Bureau of Competition Policy," *Canadian Competition Law And Policy At The Centenary*, edited Khemani, R.S., and Stanbury, W.T., The Institute for Research on Public Policy, Halifax, N.S., 1991, pp. 451-461.

and that it was not true of the trucking industry and especially the auto carrier segment of the industry.[39]

Further, it has been frequently shown that the production of for-hire truckload transportation services is characterized by a cost structure in which variable costs dominate fixed costs, highly divisible capital inputs that have, for the most part, a relatively short life and an absence of scale economies. The presence of economies of scale is important because if it is present, production at a minimum long run unit cost would not necessarily be consistent with the presence of a large number of producers. A number of studies have shown that economies of scale are either absent or unimportant in the production of truckload transportation services. The absence of scale economies, coupled with the highly divisible nature of the production function and the high proportion of variable to fixed costs, means that in the absence of regulatory barriers to entry the auto carrier industry would not be subject to market failure.[40]

Regarding the third point, the Commissioner's expert witness attempted to show the inefficiency of the present situation by describing the present conditions in the transportation of automobiles in New Brunswick. First, automobile imports from Japan to the Maritimes are shipped by rail (mainly CN) from the west coast to Halifax, they are then shipped by road within the region. In 1983, 3000 Japanese passenger cars were backhauled from Halifax to New Brunswick. This means an excess mileage of 600 (300 by rail and 300 by road) compared to a situation where the rail delivery was to Fredericton Junction in New Brunswick. The cost savings would be $125 ($25 rail costs and $100 road backhaul costs) per automobile. This would result in a savings of $375,000 per annum to the New Brunswick economy. It would also lead to time-in-transit savings.

Further, market information indicated that Auto Haulaway/Atlantic Automobile had a monopoly in the transportation of European imports from the Halifax Autoport and from the Volvo (Canada) plant to Maritime points.

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39 In order for a natural monopoly (decreasing long run cost) situation to occur, it must be shown that: 1. Fixed costs must be equal to a large percentage of total costs, 2. Fixed capital assets must have a very long life and be highly indivisible, and 3. The production process must give rise to very large economies of scale. See Kahn, F. A., *The Economics of Regulation*, (New York, J. Wiley) 1971.

40 See Submission of the Commissioner's expert witness to the New Brunswick Motor Carrier Board, p. 5.

The proposed amendment to Hillside's licence would allow it to compete for some of this traffic and remedy the existing monopoly situation.

Finally, Volvo (Canada) shipped approximately 1600 units per annum by rail from Halifax to Québec. The proposed amendment to Hillside's license would allow it to attract some of this traffic especially to the Montreal region. It would also lead to savings in transit times and savings in less damage. Further the carriage of automobiles to Montreal would also lead to a reduction in economic inefficiency due to an imbalance in traffic (empty movement to Montreal).

Based on the above market considerations, the Commissioner's expert witness concluded that "the extension of Hillside Auto Carrier's license would lead to a significant improvement in operating efficiency, reduce the high degree of monopoly power present in the market at this point in time, encourage inter-modal competition and lead to substantial cost savings."[41]

c) A brief summary of the decision of the NBMCB

The Board's decision can be considered as consisting of two major parts: 1. Consideration of the testimony of the Commissioner's expert witness, and 2. Consideration of the evidence in support of the licence.

1. The Board characterized "most of the evidence as being theoretical" with the exception of the treatment of the "inefficiency of the present situation". The evidence on the possibility and implications of establishing a rail facility at Fredericton and the inefficiency resulting from imbalance of traffic (movement of Volvo vehicles from Halifax to Montreal) was considered to be severely flawed. The Board felt that using the reverse onus test as suggested by the Commissioner's legal council was not appropriate. The Board indicated that it had to be mindful of the governing statute and the test set forth therein. "We don't make law, we simply apply the law as the legislature sets it down."[42]

2. The evidence examined by the Board consisted of three testimonies (Mr. McMillan for the Volvo-Subaru dealer in Fredericton,

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41 See Submission referred to above, p. 10.

42 See *In the Matter of the Motor Carrier Act, R.S.N.B. 1973, Ch. M-16 and In the Matter of an application to amend licence No. 1718 by Hillside Auto Carrier Limited*, p. 6.

N.B.; Mr. Vanzuilikom for Nissan; and Mr. Kevin McTague for Dennis Motor Corporation) and three telexes (Mr. Supan for Volvo American Corporation; Suzuki Canada Inc.; and Mr. Leavitt's statutory declaration).

Mr. McMillan indicated that there should be a choice both to the shipper and to the receiver as to who should be the transporter of automobiles. Further, he complained about the delay experienced during high volume periods. Mr. Vanzuilikom's testimony indicated that there was no alternative service and they believed in competition. He also indicated that he would be prepared to use the services of Hillside once he is given a chance to determine its suitability. Mr. McTague's evidence was similar to that of Mr. Vanzuilikom. The telex by Mr. Supan indicated that competition would create reasonable rates and service levels. The telex by Suzuki indicated that by adding a second auto carrier, cost and service to the shippers, dealers, and customers would be improved.

Based on the evidence, the Board concluded that "[it] does not believe it's sufficient to simply say: I believe in competition, therefore, if this applicant can provide as good a service as the existing one I'll give the use of the applicant's service serious consideration. We don't believe that the evidence which has been brought before us has discharged the onus upon the applicant to prove public convenience and necessity as prescribed by our statute. Perhaps in the future the kind of evidence that was brought before us might be sufficient after the onus has been shifted in the statute but certainly not today."[43]

d) The economic analysis of this intervention

The arguments of the Commissioner's expert witness were based on a substantial body of economic theory. This theory shall be explicitly indicated as it was not part of the intervention but was implicitly based on it.

A fundamental concept in economic analyses is efficiency, from the standpoint of society, given the distribution of income. An efficient allocation of resources requires that net social benefits (i.e. total social benefits minus total social cost[44]) from the consumption of goods and

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[43] See Decision of the Board referred to above, p. 10.

[44] Total social benefits are defined as the sum of all individual increments of satisfaction (benefits) enjoyed by members of a society. The total social cost of producing additional units of one commodity is equal to the amount of satisfaction that is foregone because less of another commodity is produced.

services be at a maximum. The maximization of net social benefits occurs when marginal social benefits (MSB) = marginal social costs (MSC) (marginal being defined as a change resulting from a change in an additional unit).

From the standpoint of individual consumption, an optimal position is reached by maximizing net private benefits. Just as for society as a whole, net private benefits will be at a maximum when marginal private benefits (MPB) = marginal private cost (MPC)[45]. Private and social costs and benefits are not necessarily equal.

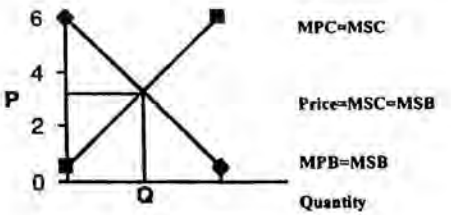
Under most conditions, MPB and MPC schedules are equivalent to demand and supply schedules. MPC is equivalent to the cost that the producer or consumer incurs in the production of goods, and thus in order to maximize private benefits, an individual will purchase units of the goods where MPC = MPB = price.

As stated earlier, the efficient allocation of resources requires that MSB = MSC. If MPB = MSB and MPC = MSC in every market, the market-determined allocation of resources will be an efficient allocation. Marginal social cost pricing is a necessary condition for obtaining an efficient allocation of resources. If all markets are perfectly competitive, the market mechanism will automatically generate prices such that price = MSC = MSB (a result referred to as a Pareto optimal allocation of resources).[46] This is illustrated in the following diagram.

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[45] MPB is defined as the benefit which accrues to the individual consuming the good or service, and MPC as the cost incurred by the consumer or producer in the production of the good or service.

[46] It should be pointed out that the theory of the second best, provides a general caveat about regulation aimed at allocative efficiency. It indicates that Pareto optimal conditions define welfare-maximizing conditions only when they are applicable to all economic activities. "This makes decisions about regulation much less straightforward since good judgment about complicated circumstances rather than formally demonstrable optimal conditions must be relied upon in deciding what to regulate, how to regulate and what the resulting social benefit will be." ***Promoting Competition in Regulated Markets***, Phillips, A. ed. The Brookings Institution/Washington, D.C., 1975, pp. 5-6.

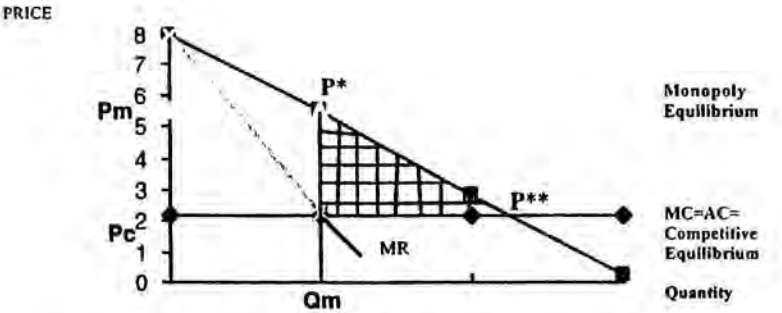


There are three distinct sets of circumstances under which the market mechanism will not lead to an efficient allocation of resources: 1. Monopoly Power, 2. Decreasing Long run costs, and 3. Missing markets (externalities). When a market fails, price does not reflect real marginal social costs or benefits. Market failure causes private [i.e. individual] costs and benefits and social costs and benefits to diverge. The inability of markets to allocate resources efficiently provided a rationale for government-intervention.

Based on the above theory, the Commissioner's expert witness tried to establish that: i) a monopoly situation existed, and ii) there were no decreasing long run costs or a natural monopoly to justify the existence of the prevailing monopoly.

1. Monopoly Power

Within the above theory, it can be easily shown why a monopoly situation is not efficient. The efficient allocation of resources from the standpoint of production requires that price = marginal revenue (MR) = marginal cost (MC). This will not occur where there is monopoly power, since the monopolists profit maximizing output and price do not satisfy the above. In the case of a competitive industry, the intersection of the supply curve (MC = AC -- average cost) with the aggregate market demand curve yields a welfare maximizing output (see diagram) (at this price and quantity, the marginal social cost is equal to the marginal social benefit).



From the above diagram, it is clear that the competitive output is larger and price lower than that which would have prevailed under monopolistic production. Further performance is also superior.[47] Consumer surplus (i.e. triangle above P^C and below the demand curve) is also smaller under monopolistic production, because of the deadweight welfare loss (shaded triangle) caused by misallocation of resources because price is above marginal cost, and transfer of income from consumers to producers (i.e. the rectangle $P^CPmP^*P^{**}$). Welfare would therefore be increased under competitive production. From the dynamic view, the true deadweight-welfare loss is understated, because the lack of competition may cause production costs to rise above their competitive costs because of various reasons: a. X inefficiency, b. money spent on retaining monopoly power, c. extraction by factors of production of higher payments.

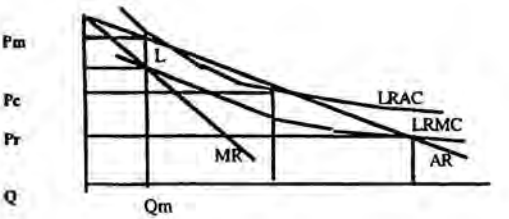
In addition, market power can only exist in the longrun in the presence of barriers to entry, for example absolute unit cost differences, economies of scale, capital cost, product differentiation, regulations, legal barriers, etc. This provided the theoretical reasons why a monopoly situation which existed in the trucking market in New Brunswick market was inefficient.

[47] Measured variously by the height of price relative to the average cost, relative efficiency of plant (compared to the most efficient) and excess capacity, size of sales-promotion costs relative to the costs of production, character of product (choice, quality and variety), and rate of progressiveness (technological change, innovation and diffusion).

2. Decreasing Long-run Costs (Natural Monopoly Situation)

Under decreasing longrun average cost or natural monopoly, it has been argued that price and output under competition is inefficient for the reasons discussed in the next paragraph. Further, permitting entry would lead to destructive competition. The Commissioner's expert witness therefore had to establish that a natural monopoly was absent.

According to the above theory, an economically efficient allocation of resources requires that producer's undertake production where Price = MC. However, with decreasing long-run costs a profit maximizing producer would not operate at this point, since price would be below long run average cost [LRAC] (see diagram) and in consequence the firm would suffer a loss. A profit maximizing producer would set price where MR = MC (i.e., L in the diagram). In this case, economic welfare is not maximized because price is greater than MC, and output is below the efficient level.[48] This is shown in the diagram hereafter.



The third argument that the Commissioner advanced was that the present situation in the motor carrier industry in New Brunswick was inefficient. According to the theory, costs are at its lowest level under

[48] Production at a socially optimal level of output in decreasing cost industries will require the introduction of a two-part pricing scheme. The price per unit must be set equal to MC, and the resulting deficit must be met from a fixed charge imposed on users. One should not force the firm to produce where price equals LRAC, because 1. output is socially suboptimal, and 2. price will be suboptimal, further also actual price will be higher and output lower, because of X inefficiency, Averch-Johnson effects, etc.
Market failure can also arise when a single producer is able to supply a number of different products more efficiently than can a number of firms. The basis for declining costs in the case of multi product firm is that complementarities in production lead to large shared or common costs. In the case of a multiproduct "natural monopoly", policies directed at obtaining an efficient allocation of resources have focused on "Ramsey prices".

perfect competition. If costs are at a higher level, output would be lower and prices would be higher, a situation that is not efficient. This can be easily seen in first diagram by raising the cost curve. Under such a situation both the level of output is lower and price is higher. Therefore by permitting the introduction of competition, costs would be driven to a lower level leading to a more efficient set of outcomes.

e) Comments on the decision of the NBMCB

There are two comments on the Board's Decision worthwhile noting. First, the Board was not interested in economic theory. Public convenience and necessity was not interpreted in a manner to consider competition. Whether there was competition or not did not matter. The evidence that the Board was looking for was not statements about the merits of having an alternative service, what it wanted was direct evidence of demand for the service of the applicant. Namely those supporting the application had to indicate they were prepared to give the applicant so many thousands of dollars worth of business each year. Such evidence is extremely difficult to produce since the purchasers do not have an opportunity to appraise the service of the applicant.

Second, the law was rigidly applied without giving considerations to the changing developments that were occurring. Whether the existing law should be interpreted narrowly, in full knowledge that the laws are being changed leaves a number of questions unanswered.

4. Conclusion

Today economics provides a substantive basis for competition law, and economic analyses often plays an important role in these cases.[49] Economics provides a screening device for identifying practices that undermine competitive behaviour.[50] Judges deciding or reviewing competition cases not only accept expert economic testimony but also seek expert evidence that will point to the correct result as often the economic

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[49] "Competition Law in the Courts," ***OECD Journal of Competition Law and Policy***, Volume 1, No. 1, Paris, OECD, 1999, p. 71.

[50] Wood, P. Hon. Diane, "The Role of Economics and Economist in Competition Cases," ***OECD Journal of Competition Law and Policy***, Volume 1, No. 1, Paris, OECD, 1999, p. 82.

reasoning is quite complex.[51] This was shown it two types of competition law cases: predatory pricing and a submission before a regulatory board.

In predatory pricing cases, several analytical steps are used in determining the outcome of a complaint. First, the predator must be 'engaged in a business'. Second, the prices at which the product is sold must be 'unreasonably low'. The determination of this issue is carried out in two stages: first, a market power analysis is designed to delineate the market, consider market shares and concentration, relative size of firms and number of sellers in the market, and conditions of entry such as cost advantages and sunk costs; and second, a price/cost comparison analysis is undertaken. In evaluating the latter, if prices are above the ATC, the prices of the predator will not be regarded as unreasonably low; if prices are below AVC, prices will generally be regarded as unreasonably low; and if prices fall between ATC and AVC, the surrounding factors are considered in arriving at a conclusion. Third, the prices or pricing behaviour of the alleged predator are considered to determine if it constitutes a 'policy of selling'. Finally, the competitive effect of the pricing policy is considered or the design of the predator. The later is considered particularly important to avoid discouraging vigorous and desirable price competition. Due to the difficulty of proving the elements of this section beyond a reasonable doubt a number of proposals to reform this provision have been made. Some writers suggest that the term 'policy' be dropped from this section together with the 'design' requirement; while other writers have suggested that a similar provision be introduced as a civil provision with less onerous tests; and still others have suggested that the predatory pricing provision be removed from the Act. As a result, amendments to the predatory provision are being considered.

In interventions, the analytical steps are more varied depending on the nature of the problem and the industry. Of fundamental importance is the issue of maintaining or increasing competition.[52] Since, a number of industries in which interventions occur are regulated industries, first an examination of whether the industry is a natural monopoly or whether parts of it that are a natural monopoly are undertaken. Second, the inefficiencies that are likely to occur under the existing structure are reviewed. Third, the misallocation of resources as a result of the exercise of monopoly power

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51 Wood, P. Hon. Diane, "The Role of Economics and Economist in Competition Cases," ***OECD Journal of Competition Law and Policy***, Volume 1, No. 1, Paris, OECD, 1999, p. 103.

52 See sections 125 and 126 of the *Competition Act*.

under the current structure are examined. Fourth, the benefits of introducing a competitive structure and whether this can be achieved in whole or part are often addressed.

As shown in the above cases, the use of economic analyses and expert economic witnesses is not only accepted in the Courts but is also quite normal in the examination of other competition law complaints involving other provisions of the Act. This is just as well as the underlying reasons behind various provisions of the Act can get quite complex. Further, in the new millennium, the increased use of econometrics as a tool in antitrust analysis will be increasingly witnessed in the courts as one attempts to become more objective and scientific.

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Macroeconomic Consequences of Economies of Density in Transportation Networks

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Abstract

Transportation networks are characterized by multiple transportation services to many different types of users. In general, they are subjects to economies of size and economies of density. While economies of size is a network analog for economies of scale, economies of density is a unique feature of a transportation network.

Economies of density are associated with increase in traffic in a transportation network of existing size, and are said to exist if marginal cost of traffic increase is less than average total cost. At a microeconomic level, economies of density result in productivity enhancement of capital and labour in transportation markets. At a macroeconomic level, economies of density improve overall productivity of regional and national economies. Therefore, macroeconomic consequences of economies of density can be traced

through their contribution to economic growth.

The paper presents a simple growth model in order to explain and evaluate macroeconomic consequences of increase in overall volume of transportation on economic growth within existing transportation network. As a result of the model, the first-order difference non-homogeneous equation is derived to simulate the consequences. The impact and long-run multipliers are calculated for the Canadian economy for a simulated one-percent increase in volume of transportation using advanced computer modelling software *Mathcad 8 Professional*.

Introduction

Economies of scale are a long-run phenomenon that arises as a result of industry expansion. They are said to exist when

$$f(tx_1, tx_2) > tf(x_1, x_2)$$

where x_1 and x_2 are factors of production (normally capital and labour), $f(x_1, x_2)$ is production function and $t>1$ is a scalar. The inequality implies that production function is subject to increasing returns to scale.

Expansion of a transportation network implies increase in volume of transportation measured in ton-kilometres and passenger-kilometres as a result of increase in size of the network and/or traffic. Usually by size

of a network we mean number of service points and total mileage between the points. Traffic reflects density (frequency) of transportation services.

In this regard, economies of size are associated with a network expansion in the following way: size of the network and traffic expand by the same proportion. Economies of size are said to exist if average incremental cost of adding new service points is less than average total cost. In some way, economies of size are economies of scale in transportation networks.

Economies of density are associated with increase in traffic when other pieces of transportation capital, such as vehicles and fixed facilities, are not increased proportionally or increased at all. Economies of density are said to exist if marginal cost of traffic increase is less than average total cost.

Economies of density arise as a result of cargo and passenger consolidation which implies increase in all traffic proportionally in existing network or as a result of increase in one flow only, holding all other flows constant (see Boyer, 1998). Intermodal transportation which is the most efficient combination of different modes of transportation is a good example of an activity that results in economies of density.

If transportation is viewed as a factor of production of a manufactured commodity, then increase in traffic, other things being equal, plays the same role as increase in productivity factor in a

generally accepted specification of production function. Below we present a simple growth model that captures this property in a dynamic fashion.

The growth model

We assume one aggregate manufactured commodity in our simple economy with transportation as an input in production of the commodity. After the commodity is produced, it is partially consumed and partially re-invested into economy to achieve economic growth. Therefore, GDP identity requires

$$Y_t = C_t + I_t \tag{1}$$

where Y_t is total output, C_t is consumption and I_t is investment in year t. Consumption is assumed to be a fraction of GDP

$$C_t = (1 - s)Y_t \tag{2}$$

where s is savings rate. Investment is derived from a well-familiar capital accumulation equation as follows

$$I_t = K_{t+1} - (1 - \delta)K_t \tag{3}$$

where K_t and K_{t+1} are capital stocks in two consecutive periods, and δ is capital depreciation. Substituting (2) and (3) in (1) and re-arranging

$$K_{t+1} = (1-\delta)K_t + sY_t \tag{4}$$

We further assume that a manufacturer of the aggregate commodity maximizes profit given production function and GDP identity. The former reflects existing technology in our economy whereas the latter plays a role of budget constraint. The production function is defined as follows:

$$Y_t = T_t^{\alpha} K_t^{\beta} L_t^{\gamma} \tag{5}$$

where T_t is transportation, K_t is capital and L_t is labour with their respective shares α, β, γ. Therefore, the production function explains existing technology that uses three inputs. If volume of transportation is fixed, then the term T_t^{α} becomes constant term A, and production function becomes a well familiar Cobb-Douglas function $Y_t = A K_t^{\beta} L_t^{\gamma}$

Consequently, cost function is

$$TC_t = r_t K_t + w_t L_t + f_t T_t \tag{6}$$

where r_t is the price of capital, w_t is the wage rate and f_t is the freight

rate. Profit function is

$$\pi_t = P_t(Y_t) \times Y_t - r_t K_t - w_t L_t - f_t T_t \quad (7)$$

where $P_t(Y_t)$ is the price of the aggregate commodity as a function of total output or it is demand for aggregate commodity. Profit maximization problem becomes

$$\max[P_t(Y_t) \times Y_t - r_t K_t - w_t L_t - f_t T_t] \quad (8)$$

subject to

$$Y_t = T_t^{\alpha} K_t^{\beta} L_t^{\gamma} \quad (9)$$

$$K_{t+1} = (1-\delta)K_t + sY_t \quad (10)$$

The following difference equation is a solution to the system (8-10):

$$K_{t+1} = (1-\delta)K_t + s\frac{f_t}{P_t} \times \frac{T_t}{\alpha} \times [\frac{1}{1+\frac{1}{\epsilon_D}}] \quad (11)$$

where ϵ_D is elasticity of demand for aggregate commodity. The ratio f_t/P_t is relative price of transportation p, and thus, equation (11) becomes

$$K_{t+1} = (1-\delta)K_t + \frac{sp}{\alpha[1+\frac{1}{\varepsilon_D}]} \times T_t \qquad (12)$$

Equation (12) is the first order difference non-homogenous equation of the form:

$$K_{t+1} = aK_t + bT_t \qquad (13)$$

where

$$a = 1 - \delta$$

and

$$b = \frac{sp}{\alpha[1+\frac{1}{\varepsilon_D}]}$$

are parameters.

Simulation exercise

Even though it is an oversimplified version, the equation (13) captures dynamics of the above discussed economy quite well because it reflects the first order autoregressive process *AR(1)* that can be transformed into infinite moving averages process. The term T_t in (13) can be viewed as either a non-specified exogenous variable or specific sequence that behaves under its own dynamic rules. General structure of series T_t in such processes is

$$T_t = \sum_{i=0}^{\infty} \beta_i e_{t-i} \tag{14}$$

where β_i are constants and e_{t-i} are elements of the sequence $\{e_t\}$ that are not functions of K_t.

Here we assume that T_t is a non-specified exogenous variable that takes on the following form:

$$\sum_{i=0}^{\infty} \beta_i e_{t-i} = T + \varepsilon_t \tag{15}$$

implying $\beta_0 = 1$, $e_t = T + \epsilon_t$ and $\beta_i = 0$ for all $i > 0$. In such a case, T_t is fixed at its current value T and any change in its value is regarded as an exogenous shock ϵ_t at time t. The consequences of the shock can be traced with the help from Impulse Response Function (IRF). Taking (14) and (15) into account, difference equation (13) becomes

$$K_{t+1} = c + aK_t + b\varepsilon_t \tag{16}$$

where $c = bT$ is parameter. Given specification in equation (16), IRF can be defined as follows:

$$\phi(i) = a^i b\varepsilon_t \tag{17}$$

From an economic standpoint, IRF represents a sequence of the short-run multipliers where $\phi(0)$ is the so-called impact multiplier (see Enders, 1995). In turn, the long-run multiplier m_{LR} can be defined as follows:

$$m_{LR} = \sum_{i=0}^{\infty} \phi(i) \tag{18}$$

Therefore, if we were able to identify the direct change in the volume of transportation, we would be able to measure its contribution to economic growth as it is described above. For example, for the Canadian economy we can assume the following values, derived from CANSIM Database and Annual Report by Transport Canada (1998), for the above discussed parameters in order to apply our framework:

$\delta = 0.025$

$s = 0.21$, *which is share of national savings in GDP*

$p = 0.151$, *which is share of transportation expenditures in total consumption*

$\alpha = 0.039$ *which is share of transportation services in GDP*

In addition, we assume

$$[\frac{1}{1+\frac{1}{\varepsilon_D}}] = 1.1 \tag{19}$$

in (12), which is slightly higher than unity under perfect competition when $\epsilon_D = \infty$. Therefore, we assume some market imperfections. Also, transportation investment accounts for 19.9% of total investment (Transportation in Canada, 1998). This means that in general we can assume $T_t = 0.2K_t$, because T_t is a stock variable that reflects volume of transportation in transportation network of existing size. Given all our assumptions, the parameter b in (17) equals 0.74. Therefore, we can trace consequences of a 1% increase in volume of transportation in existing transportation network as exogenous shock to our economic system with the help from IRF as follows. The value of the shock is

$$\varepsilon_t = 0.01 \times 0.2 = 0.002 \tag{20}$$

and IRF becomes

$$\phi(i) = 0.975^i \times 0.74 \times 0.002 = 0.975^i \times 0.00148 \tag{21}$$

where $\phi(0)=0.00148$ is impact multiplier and the long-run multiplier is $m_{LR} = 0.058835$ according to (18).

However, the impact and long-run multipliers were defined with respect to capital stock, which accounts for share β in GDP according to our model specification. Thus, the impact on GDP has to be re-scaled

by factor β. According to the CANSIM Database, β is *0.26* and thus, the re-scaled impact on GDP is:

- the impact multiplier = 0.26×0.00148=0.0003848
- the long-run multiplier = 0.26×0.058835 = 0.015297

What does it mean? It means that a 1% increase in volume of transportation immediately contributes 0.0385% to economic growth or $276 million with overall cumulative effect of $11 billion in the long-run given current value of the Canadian GDP at factor cost in 1992 dollars at $718 billion.

Conclusion

The above presented framework points at significance of the economies of density on a large scale. Of course, in order to study the phenomenon as well as other economic phenomena associated with transportation networks in depth, it is necessary to define and refine our growth model in a rigorous general equilibrium framework. On the other hand, even straight forward simulation shows the need for this analysis in order to develop a robust theoretical approach. In reality transportation services are realized in networks, interregional, intra-regional and national. The networks are indispensable parts of economic systems, and as such, should be analysed based on a systems approach rather than in terms of a microeconomic partial market equilibrium analysis. Computer simulations could help out to handle this problem in the meantime until the factual data become available at both.

aggregate and disaggregate levels, and over time. Data availability is a major concern of all applied transport economists in Canada, however, research in the area should proceed despite such a problem.

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MULTIPLE OBJECTIVES: AGENCY COST VS LEVEL OF SERVICE ON NORTHERN LOW VOLUME HIGHWAYS

by
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1.0 Introduction

Transportation engineers and economists are often confronted with having to make important decisions (i.e. big dollar) in the face of complexity and uncertainty often with multiple competing objectives. Recent developments in analytical methods in the area of Decision Analysis made possible by advances in both computer hardware (speed) and software (specialty applications) now make it possible to analyse multi-objective problems in ways that were not possible only a couple of years ago. This paper illustrates some of these recent developments as applied to selecting the most appropriate level of road service to be provided on low volume northern roads.

2.0 Technical Details

In many parts of the world, low volume rural roads play an important role in the economy. This is particularly true for many regions in Canada, and is particularly true in the province of Saskatchewan.

The rural road network in Saskatchewan consists of a highway network of 26,000 km (which is under the jurisdiction of the provincial highway department) plus a municipal road system consisting of 58,000 kms (which is under the jurisdiction of 300 rural municipal councils). The extensive municipal road system is largely gravel surfaced and provides farm access throughout the southern half of the province. The provincial highway network consists of approximately 10,000 km of structural pavements (5,000 km of asphalt concrete and 5,000 km of sealed base), 8,000 km of thin membrane surfaces, and 8,000 km of gravel surfaced highways.

The gravel highways maintained by the provincial highway department provide a rather interesting challenge in that these roads are primarily located in Northern Saskatchewan (5,000 of the 8,000 kms) and they serve northern resource development (mining and forestry), northern First Nations communities and tourism including fishing, camping, canoeing, hunting, etc. Most of these northern gravel highways were initially constructed to provide access to developing uranium mines. These mining roads were located, wherever possible, to also provide access to previously isolated northern communities. Tourism and forestry development followed once road access was available.

This sequence of development has resulted in this 5,000 kms of gravel highway in Northern Saskatchewan providing service to low volumes of traffic (typically 50 - 200 vpd) with a very high proportion of large trucks (up to 60%) serving the mining and forestry industries. This mix of cars and light trucks with large numbers of large trucks on these gravel surfaced highways results in a low level of service to all users because of rough and dusty road surfaces. There is considerable pressure, primarily from residents in northern communities, to improve the level of service and safety on these roads by improving the smoothness of the road surfaces and reducing the dust.

Many of these northern gravel highways are particularly rough and dusty because of protruding boulders and unstable fine grained sand subgrades. These adverse conditions are attributable to the fact that these roads are located within the Canadian shield region. The protruding boulders combined with the unstable sand subgrade materials make traditional blading to maintain smoothness ineffective to say the least.

The standard approach to improving these roads has been to place a 100-150 mm clay cap on the road surface and then regravel. This approach provides a workable surface that can be cost effectively maintained by blading and regravelling. Dust can be effectively

controlled by treating with calcium chloride or other similar dust inhibitors. This is an effective approach if there is a suitable clay source within a reasonable haul distance (i.e. 20-50 km). The problem is that a large portion of the 5,000 kms of gravelled highways in Northern Saskatchewan are in areas where there are no clay sources within a reasonable haul distance.

In the face of these challenges, engineering staff began a search for an innovative cost effective solution. One possible solution envisaged was to crush the protruding boulders in-place and then use a stabilizing agent to stabilize the insitu sand subgrade materials to either provide a workable (i.e. bladable) surface, or a stable subgrade that could be surfaced with an asphalt seal to provide a smooth dust free surface.

In the summer of 1997, a pilot project directed at determining the technical and economic feasibility of crushing the protruding boulders in place and then stabilizing the subgrade materials was initiated. The second part of the project was completed in the spring of 1998. This was a particularly challenging undertaking in light of the fact that the protruding boulders had an unconfined compressive strength of anywhere from 121mPa - 358 mPa (24,000 - 52,000 psi - good concrete has a compressive strength of about 6,000 psi. The technical feasibility of crushing the boulders in place was demonstrated along with the feasibility of stabilizing the sand subgrade materials with either small amounts of imported clay mixed with the subgrade surface sand (i.e. 100-300 tonnes/km as opposed to the 2,000 tonnes/km required for a clay cap); or the use of asphalt stabilizing agents.

In short, the pilot demonstrated the technical feasibility of substantially improving the quality of northern gravel highways by using a combination of in-place crushing of the protruding boulders and stabilization of in-situ sand subgrade materials. Further, the asphalt stabilized subgrades were sufficiently sable to permit the application of an asphalt seal to the surface. The cost of the resulting sealed road was in the order of $50,000/km. This compares with

approximately $100,000/km using traditional base overlay and seal methods.

3.0 Economic Feasibility

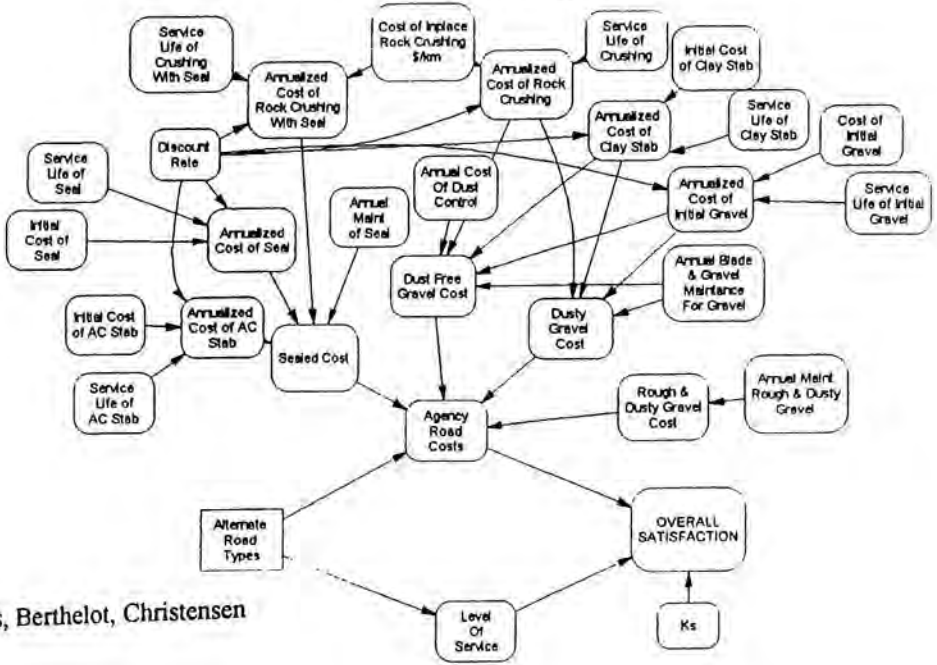
Having established the technical feasibility of the innovative methods along with the fact that the methods were cost effective relative to traditional methods, the next question was whether the methods were cost effective enough to be justified on these low volume roads. The department has not pursued the implementation of these innovative methods simply because they do not have the dollars for the required capital expenditures available within their current budget. This however begs the larger question as to whether these are cost-effective long term treatments for these low volume roads. This problem can be formulated as a multi-attribute, multiple objective problem within the context of a Decision Analysis framework.

Within the context of this type of framework, the attributes would include: (1) agency costs and (2) level of service provided road users, (including user costs, safety, comfort and convenience etc.). The road agency objective might be to minimize agency costs while providing a minimum acceptable level of service. The objective of road users would be to maximize the level of service available (i.e. smooth, paved, dust free surface). Given that higher levels of service usually cost more money to provide, it is clear that there are tradeoffs necessary between the objectives of the agency providing the road and the road users. An appropriate overall objective might be to maximize overall satisfaction which is a balance between cost (to the road agency) and the level of service enjoyed by road users.

4.0 Problem Formulation

This problem can be formulated within the context of a Decision Analysis Framework as illustrated in Figure 1. As illustrated in the influence diagram in Figure 1, the primary nodes include (1) Alternate Road Types, (2) Agency Road Costs, (3) Level of Service and (4) Overall Satisfaction.

Figure 1
Influence Diagram



Alternate Road Types would include:

(1) rough and dusty - which would include the existing situation with protruding boulders and unstable, dusty, fine grained, subgrade soils.

(2) dusty gravel - which would include using the in-place rock crushing methods to remove the protruding boulders from the surface of the subgrade; stabilize the fine grained sand subgrade materials with 5-10% high plastic clay; and regravel. This would provide a workable surface (bladeable) of a quality similar to a typical gravel highway (reasonably smooth compared to a surface with protruding boulders, but still dusty).

(3) dust free gravel - the undesirable dust associated with the typical gravel highway as per (2) above could be reduced by using dust inhibitors. These, while increasing the level of service provided, are relatively expensive but would result in a relatively smooth (nearly) dust free gravel surface.

(4) Asphalt sealed road - would include using the in-place rock crushing methods combined with stabilization of fine grained sand subgrade materials using an asphalt stabilization agent on the top 100 mm of the subgrade and then applying an asphalt seal to this stabilized surface, resulting in a smooth (paved) dust free surface.

5.0 Agency Road Costs

The determination of the costs of providing and maintaining the various types of road surfaces can be estimated using standard engineering economic methods of annualized costs (i.e. $/km/yr). These calculations are completed "behind the scenes" in the Influence Diagram in Figure 1. The cost categories, determining variables and estimated minimum, most likely, and maximum values for these cost categories and determining variables utilized within the Influence Diagram to calculate costs are summarized in Table 1 for each of the four road types.

TABLE 1
Road Types, Cost Categories and Determining Values

Road Type	Cost Categories	Determining Variables	Values (1)		
			Min	Most Likely	Max
Rough & Dusty Gravel	Annual Maintenance Rough & Dusty		2000	2500	3000
Dusty Gravel	Annualized Cost of Crushing Rocks	Cost of in-place rock crushing ----------	10000	15000	20000
		Discount Rate ----------	8	10	12
	Annualized Cost of Clay Stabilization	Initial cost of clay stabilization ----------	1000	2000	3000
		Service life of clay stabilization ----------	5	7	9
		Discount Rate ----------	8	10	12
	Annualized Cost of Initial Gravel	Cost of initial gravel ----	3000	4000	5000
		Service life of initial gravel ----------	2	3	4
		Discount Rate ----------	8	10	12
	Annual Blade & Gravel Maintenance for Gravel	----------	1000	1500	2000

Road Type	Cost Categories	Determining Variables	Values (1)		
			Min	Most Likely	Max
Dust Free Gravel	Annualized Cost of Crushing Rocks	Cost of in-place rock crushing ----------	10000	15000	20000
		Discount Rate ----------	8	10	12
	Annualized Cost of Clay Stabilization	Initial cost of clay stabilization ----------	1000	2000	3000
		Service life of clay stabilization ----------	5	7	9
		Discount Rate ----------	8	10	12
	Annualized Cost of Initial Gravel	Cost of initial gravel ----	3000	4000	5000
		Service life of initial gravel ----------	2	3	4
		Discount Rate ----------	8	10	12
	Annual Cost of Dust Control ----------	----------	1000	2000	3000
	Annual Blade & Gravel Maintenance for Gravel	----------	1000	1500	2000

Road Type	Cost Categories	Determining Variables	Values (1)		
			Min	Most Likely	Max
Sealed	Annualized Cost of Crushing Rock with Seal	Cost of in-place rock crushing ----------	10000	15000	20000
		Service life of crushing with seal ----------	10	20	30
		Discount Rate ----------	8	10	12
	Annualized Cost of AC Stabilization	Initial cost of AC stabilization ----------	10000	12500	15000
		Service life of AC stabilization ----------	10	20	30
		Discount Rate ----------	8	10	12
	Annualized Cost of Seal	Initial cost of seal -------	6500	7500	8500
		Service life of seal ------	3	5	7
		Discount Rate ----------	8	10	12
	Annual Maintenance of Seal ----------	----------	500	1000	1500

(1) Min and Max values represent the 80% confidence interval

6.0 Level of Service

The level of service assumed to be provided by each of the four types of roads are summarized in Table 2.

Table 2
Road Types and Level of Service

Road Type	Level of Service
Rough & Dusty Gravel	0
Dusty Gravel	40
Dust Free Gravel	80
Sealed	100

A "relative" scale has been used wherein the existing rough and dusty gravel roads have been assigned a value of zero, and the dust free, sealed (paved) road has been assigned a value of 100, with the dust free and dusty gravel surfaces being assigned relative values of 80 and 40 on the scale of 0 to 100. Although arbitrary, these scores provide a "relative" measure of the level of service provided. A sensitivity analysis, which will be illustrated later, is an integral part of any decision analysis and could be performed on these arbitrarily assigned scores to evaluate the "sensitivity" of the decision (i.e. which road type is selected) to these arbitrarily assigned level of service scores. (Interestingly, as will be shown later, this issue of scoring the level of service provided by each type of road becomes a non-issue relative to the decision of which road type to select. It turns out to be sufficient to order the road types best to worst.)

7.0 Overall Satisfaction

As noted earlier, the overall objective is to trade off agency costs against the level of service provided by each type of road and thereby maximize "overall satisfaction".

This trade-off might be accomplished mathematically in any number of functional relationships. In lieu of anything better, a proportional weighting relationship has been used for illustrative purposes, where

Overall Satisfaction = (level of service x k_s - agency costs x ((1-k_s))

where k_s is a weighting factor of the level of service as measured on the subjective scale of zero to 100 relative to the differences in annual cost per km per year of providing and maintaining the existing rough and dusty gravel highway relative to a smooth dust free sealed (paved) surface. If k_s = 0.5 then the difference in level of service between the rough dusty gravel highway and the sealed surface (i.e. -100 points) is "equivalent" to the difference between the cost of the rough and dusty road ($2,500/km/year) and the sealed highway ($6,208/km/year), or $3,708/km/year. [1]

8.0 Optimal Policy with Equal Weightings

The software package DPL [2] was used to evaluate the influence diagram in Figure 1 to determine the optimal policy (i.e. which road type is best) if the objective is to equally weight agency cost and level of service in the maximization of overall satisfaction.

Figure 2 illustrates the results which are "decoded" in Table 3 below.

Figure 2
Determination of Optimum Policy

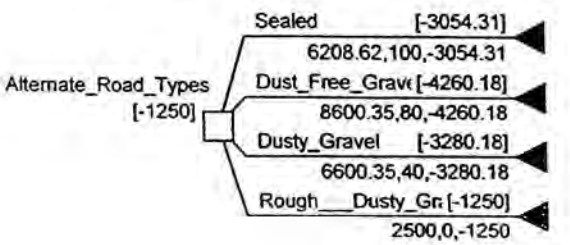


Table 3
Summary of Results

Road Type	Annual Agency Cost ($/km/yr)	Level of Service (0 - 100 pts)	Overall Satisfaction Score	Optimal Policy (maximize overall satisfaction)
Sealed	6208	100	-3054	
Dust Free Gravel	8600	80	-4260	
Dusty Gravel	6600	40	-3280	
Rough & Dusty Gravel	2500	0	-1250	****

9.0 Observations

From Figure 2 and Table 3 it is observed that the existing rough and dusty gravel surface is the optimal policy given the estimated (most likely) agency costs from Table 1 and the assumed (arbitrary) relative scores for the various levels of service.

It is possible to put the differences in costs of providing the paved surface over the existing rough and dusty gravel highway in terms of ¢/vehicle km by noting the difference in costs is $3708/km/year. ($6208 - $2500 = $3708.) If one assumes 100 vehicles per day total (autos, light and heavy trucks) or 36,500 vehicles/year, then the $3708/km/year translates to about 10¢/ km to drive on a paved road versus a rough dusty gravel road. Some part of this (say 3-6¢/vehicle km or 10-20% would be differences in user costs (fuel, tires, maintenance and repair) leaving 4-7¢/km relative to safety, comfort, convenience etc. Obviously this type of quantitative analysis could be pursued to more fully quantify the choices available. These will not be pursued here because of space limitations.

10.0 Sensitivity Analysis

Decision Analysis methods draw heavily upon sensitivity analysis as a key way to more fully understand the situation under analysis and the model representing this situation. In particular, the Decision Analysis approach uses deterministic sensitivity methods to determine which model variables are the most important. More particularly, which uncertainty in the input variables may significantly affect the decisions.

The model used to estimate agency costs for sealed, dust free gravel and dusty gravel were subjected to deterministic sensitivity analysis. The results are presented in the form of tornado diagrams in Figures 3,4, and 5. This analysis is completed by first evaluating each model with the most likely values for each variable as inputs. This provides an estimate of the most likely or expected costs for the road. This becomes the base case. Then, one by one, the sensitivity of the base case value is tested relative to changes in the value of each of the input variables by repeatedly evaluating the model, first by using the minimum and then the maximum values (see Table 2) for each of the input variables. In moving to the next variable, the value for the previous input variable is put back equal to its most likely value. The results of such sensitivity analysis are presented for the sealed, dust free and dusty gravel highways as illustrated in Figures 3, 4 and 5 respectively.

If variations greater than ± 10% of the base case are considered sensitive, as indicated by the vertical dotted lines in Figures 3, 4 and 5, then the costs of the sealed road (Figure 3) are sensitive to: (1) service life of the seal, and (2) service life of the crushing with seal. The costs of the dust free gravel (Figure 4) are sensitive to: (1) the cost of in-place rock crushing, (2) annual cost of dust control, and (3) service life of crushing. The costs of the dusty gravel (Figure 5) are sensitive to: (1) the cost of in-place rock crushing, (2) service life of crushing, and (3) service life of initial gravel. As such, it would be of benefit in terms of reducing the uncertainty in the models of road

Figure 3
Sensitivity Analysis Sealed Road

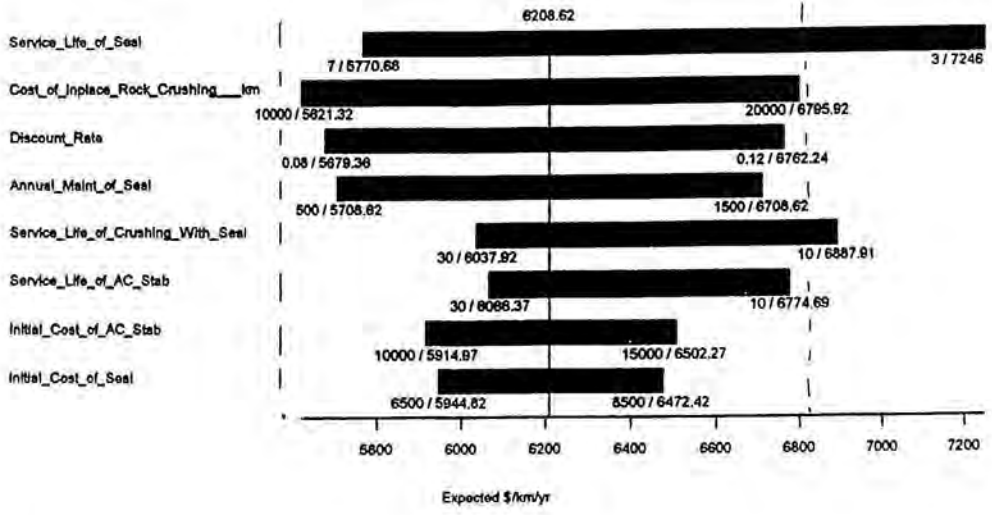


Figure 4
Sensitivity Analysis Dust Free Gravel

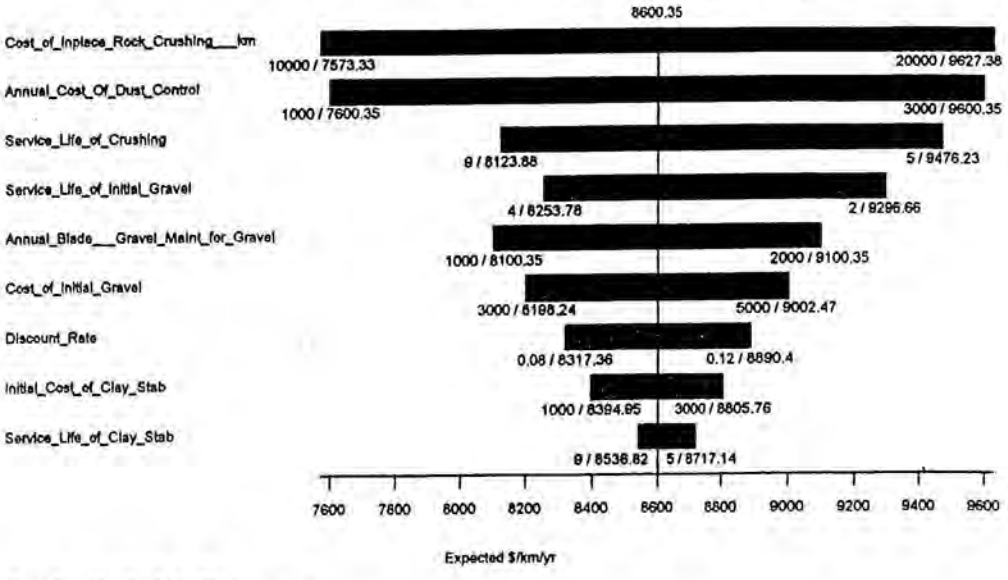
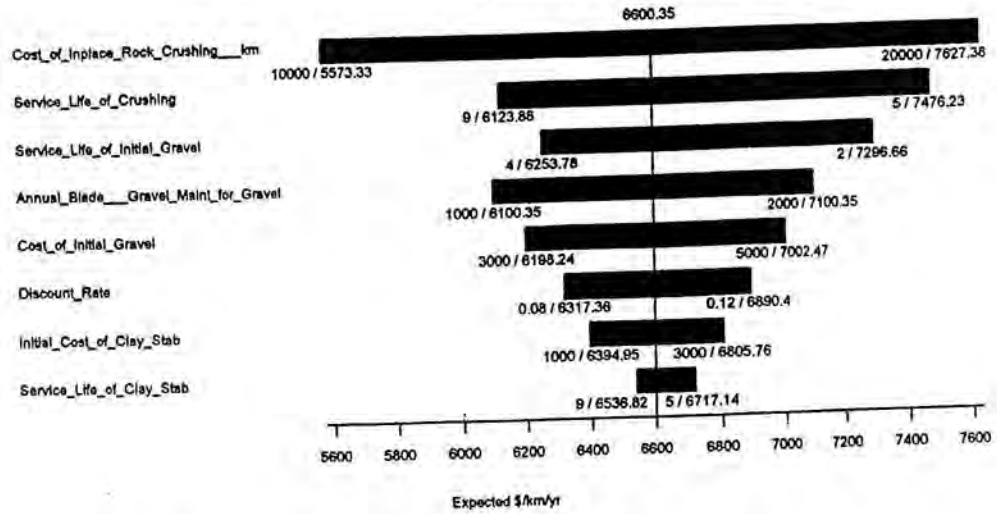


Figure 5
Sensitivity Analysis Dusty Gravel

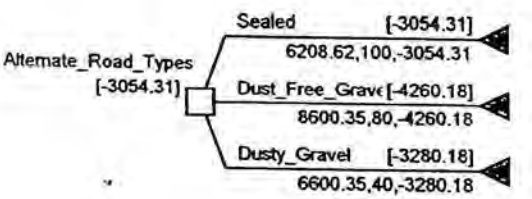


costs to develop more reliable estimates of the values for these sensitive variables.

11.0 Concluding Comments

Space does not permit a discussion of all of the analysis and results possible. It is however interesting to note that the cost advantage of the existing rough and dusty road is so large that in a proportional weight scheme as used herein there is no reasonable value for k_c (i.e. <99) that would change the selection of the road type from the rough and dusty gravel to one with an improved level of service. If on the otherhand, as illustrated in Figure 6, the analysis is re-run assuming that the existing rough and dusty highway is unacceptable (and therefore eliminated from consideration), the optimal policy is then the sealed surface. While the sealed surface has higher initial capital costs it has lower annual costs and higher levels of service, and therefore higher level of overall satisfaction. Because the sealed surface has both lower annual costs and higher levels of service it "dominates" the other alternatives independent of the value for k_c (the weighting factor of level of service relative to agency costs). Therefore, the actual weighting scores become irrelevant in arriving at the conclusion that the sealed surface is the best of the "improved" road type.

Figure 6
Optimal Policy for Improved Road



The discussion and example presented above has only begun to scratch the surface relative to the sophistication now possible relative to modelling of complex, uncertain situations which have both multiple attributes and objectives. For the interested reader, the book by Robert T. Clemen is a highly recommended starting point. The software package DPL is like many such packages, really slick and powerful once you are familiar with the software, but count on some considerable frustration getting up to speed on the software unless you have a resident expert in the next office!

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[1] See page 127, Making Hard Decisions; An Introduction to Decision Analysis, Second Edition, Robert T. Clemen

[2] DPL (Decision Programming Language) Applied Decision Analysis, Palo Alto, California

REGIONAL AND EXTRA - REGIONAL HIGHWAY TRAFFIC IN ATLANTIC CANADA: A REVIEW AND PRELIMINARY MODEL

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Introduction

There is a need for a regional and extra - regional model to estimate highway traffic movement between provinces within Atlantic Canada, to and from the central Canadian provinces of Quebec and Ontario, and to and from each of the New England states. Such a model would help to evaluate various pertinent and key policy, planning and operating issues facing transportation engineers and planners today including: energy shortages, environmental concerns (vehicle emissions and climate changes), sustainable transportation, capacity and level-of-service, and safety. Most model development requires origin-destination information; however, regional origin-destination surveys are prohibitively expensive to complete. The last comprehensive roadside survey within the Atlantic Region was completed in 1979. A review of the origin and destination tables produced from this survey was completed in this research to recap the activity in the region from an historical perspective. The relative distribution of traffic was also considered to be potentially helpful in verifying the effectiveness of any traffic model developed from the present research.

In the present study a preliminary aggregate - based modelling exercise was completed to determine the feasibility of developing a regional highway transportation model based upon border traffic counts

(essentially cordon counts) in conjunction with basic demographic characteristics associated with each of the relevant provinces and states, and using travel time as the measure of impedance. An aggregate, gravity-based model was developed in this case rather than concentrating on a more detailed data-intensive dis-aggregate modelling approach. The intent was to determine the practical feasibility of developing a regional traffic model, to evaluate the relative effectiveness in estimating the distribution of the highway traffic throughout the study region and to identify various means of verifying the results generated from the model.

Historical Review of Traffic Activity

The 1979 origin-destination survey represents the last comprehensive roadside survey of all the highway traffic occurring in the Atlantic Region. It encompassed all four Atlantic Provinces, and it was intended to capture activity related to both passenger and goods movements. The present research examines the traffic in aggregate, combining both traffic types. The intent therefore is to review the aggregate activity that occurred in 1979, and try to relate it to what is presently happening in the Atlantic Region.

It is important to note that each survey is completed to capture particular segments of the highway traffic. In the 1979 survey particular emphasis was on capturing longer distance traffic; thus short-distance, local traffic was not necessarily captured. This approach was taken to satisfy the major purpose for the survey: to evaluate road user benefits to the travelling public resulting from major upgrading or rehabilitative projects on the primary highway system in the Atlantic Region which services longer - distance inter- and intra-provincial traffic. This included benefits accruing to the trucking industry from strengthened major sections and resulting efficiencies through more uniform vehicle size and weight regulations and standards. Efficiency and effectiveness

of the primary highway system was a concern in 1979 and continued efficiency and effectiveness remains a concern today.

Table 1 shows the traffic distribution in the Atlantic Region based upon the 1979 origin destination survey, particularly the results of the surveys completed in New Brunswick and Prince Edward Island. The origin-destination tables from the Nova Scotia and Newfoundland surveys were not readily available. Therefore, there are no estimates available for the 1979 traffic between Nova Scotia and Newfoundland.

As expected the major long-distance activity in the region is between New Brunswick and Nova Scotia with an annual average daily traffic (AADT) of 2884. The survey station capturing this activity was located at the intersection of routes 2 and 15 near Moncton; thus a significant amount of local activity between New Brunswick and Nova Scotia was not captured. One can correct for this. To quote from the New Brunswick Department of Transportation (1980) report:

> "A permanent counter at the border indicated an average annual daily traffic figure of 6830. The origin-destination table indicated a value of approximately two-thirds of the 6830 figure. It appeared the local traffic represented one-third of the average daily traffic figure".

Given the above, local traffic would represent approximately 2276 AADT. Therefore, the total traffic between New Brunswick and Nova Scotia in 1979 was approximately 5160 AADT.

This example serves to indicate the relative importance of so-called local traffic. This is also important when looking at the traffic estimates for New Brunswick-Quebec and New Brunswick-Maine, both of which were significantly underestimated because none of the survey stations were located at the borders. They could not, as a result, be relevant when evaluating the effectiveness any regional highway traffic model,

other than to expect considerably higher AADT's than presented in Table 1.

Table 1 Distribution of Traffic in 1979

Origin-Destination Pair	AADT 2-Way Trips
New Brunswick - Nova Scotia	2884*
New Brunswick - Prince Edward Island	1286
New Brunswick - Newfoundland	18
Newfoundland - Prince Edward Island	9
Nova Scotia - Prince Edward Island	834
New Brunswick - Quebec	1407*
New Brunswick - Ontario	332
New Brunswick - Maine	1268*
New Brunswick - New Hampshire	23
New Brunswick - Vermont	12
New Brunswick - Massachusetts	121
New Brunswick - Rhode Island	15
New Brunswick - Connecticut	8
New Brunswick - New York	18
Prince Edward Island - Quebec	76
Prince Edward Island - Ontario	32
Prince Edward Island - Maine	60
Prince Edward Island - New Hampshire	3
Prince Edward Island - Vermont	1
Prince Edward Island - Massachusetts	24
Prince Edward Island - Rhode Island	1
Prince Edward Island - Connecticut	1
Prince Edward Island - New York	2
Nova Scotia - Quebec	195
Nova Scotia - Ontario	118
Nova Scotia - Maine	195
Nova Scotia - New Hampshire	9

Cont'd Table 1 Distribution of Traffic in 1979

Origin-Destination Pair	AADT 2-Way Trips
Nova Scotia - Vermont	2
Nova Scotia - Massachusetts	36
Nova Scotia - Rhode Island	0
Nova Scotia - Connecticut	6
Nova Scotia - New York	5
Newfoundland - Quebec	3
Newfoundland - Ontario	3
Newfoundland - Maine	1
Newfoundland - New Hampshire	0
Newfoundland - Vermont	0
Newfoundland - Massachusetts	0
Newfoundland - Rhode Island	0
Newfoundland - Connecticut	0
Newfoundland - New York	0

Source: 1979 Atlantic Provinces Highway Origin - Destination Survey

* No survey station located at the border; therefore AADT excludes the local traffic between provinces/states.

Traffic between New Brunswick - Prince Edward Island, 1286 AADT, and Nova Scotia - Prince Edward Island, 834 AADT, was captured at the ferries to Prince Edward Island. Therefore, all traffic was included in these estimates. The AADT of 332 between New Brunswick and Ontario should be all inclusive as well. Extra - regional traffic between each of the Maritime Provinces of Nova Scotia and Prince Edward Island and Central Canada was fairly substantial also, and should be all inclusive. This addresses the major traffic activity within the Atlantic Region and to/from Central Canada.

Other than for the state of Maine, extra - regional activity related to the New England states appears to be substantially lower, particularly when the relative population sizes and displacement (as measured in travel time) are compared. The majority of activity occurs between the Maritime Provinces and Massachusetts with a 1998 population of 6,147,132 (US Government Census, 1999). New York with three times the population of Massachusetts generates considerably less activity. This could be explained to some extent by the additional travel time of almost three hours. But an additional point to note is the relative difference in traffic activity generated in Ontario as compared to New York. New York, with a population of about 18 million and an approximate travel time of 10.5 hours to New Brunswick, generated an AADT of 18 while Ontario, with a population of only about 11 million and a corresponding travel time of 14 hours, generated an AADT of 332. This indicates that two separate models may be appropriate; one for trips to/from the New England states and another for trips within Canada.

Preliminary Highway Traffic Model

Various efforts have been made to develop a transportation model based on traffic counts. One of the more recent models in the Canadian context was developed by Leore (1996) based on an intervening opportunity model and various traffic counts throughout Canada and the United States. Major urban centres (approximately 148) in Canada and an additional 60 in the United States) were considered to be the generator of the majority of inter-provincial and provincial-state traffic; minimum traffic counts along routes between the urban centres were considered to be representative of the measure of this traffic activity. Independent explanatory variables included various demographic characteristics in conjunction with travel time as the measure of impedance. Reasonable success was noted with this approach, but not considered as appropriate in the present study where cordon counts at provincial and state borders are being used to account for all traffic activity between provincial-provincial and provincial-state pairs. In this

case, both the local activity as well as long distance travel is captured.

The approach taken in the present study is to incorporate basic demographics (population) at coarse grained zonal levels, and therefore consideration is given to all the population, not just the major urban centres. County level zones are used within the Atlantic Provinces, within Quebec east of Quebec City and within the state of Maine. Because of the greater distance from the Atlantic Region, the remainder of Quebec is considered a single traffic zone with the city of Montreal as the zonal centroid. Similarly, Ontario is divided into only two zones; one centroid is Toronto, and the other is Ottawa. For the states other than Maine the whole state is considered to be a traffic zone.

Based on the observations noted in the historical review of activity observed from the 1979 origin-destination survey, a preliminary aggregate, gravity-based model was calibrated for Canadian based activity, and a model of similar structure was calibrated for United States related activity. The effective model form is:

$$T_{ij} = \left[C_{ij}\right]\left[a_0 \frac{\left(P_i \times P_j\right)^{a1}}{I_{ij}^{a2}}\right] + \left[C_{ij}+1\right]\left[a_3 \frac{\left(P_i + P_j\right)^{a4}}{I_{ij}^{a5}}\right]$$

where, C_{ij} = country activity code; 1 = inter-Canadian activity, 0 = Canadian-United States activity for each pair of zones i and j

P_i and P_j = population of zone i and j, respectively

I_{ij} = travel impedance between zones i and j as measured in travel time between zonal centroids

a0, a1, a2, a3, a4 and a5 = non-linear regression coefficients to be solved for using an optimization routine

The Quattro Pro spreadsheet package was used for data compilation and analysis. The spreadsheet optimization solver was used to determine the values of the regression coefficients by minimizing the sum of the squares of the error in the cordon counts. These results are summarized in Table 2 and are discussed in the following section.

Model Verification

The initial model verification is based upon a comparison of observed and estimated cordon counts shown in Table 2. As a point of clarification the individual cordon counts presented are not border point counts, but rather the sum of the average annual daily traffic determined at each of the various points along the whole border defining a particular province or sub-region area. For example, the cordon count relating to traffic activity to and from Prince Edward Island is the sum of the AADT using the Confederation Bridge at the Prince Edward Island - New Brunswick border plus the AADT using the ferry service at the Prince Edward Island - Nova Scotia border. From Table 2 it can be seen that the relative errors in estimating the cordon counts is quite small, ranging between zero percent for trips between the United States and the Atlantic Provinces to the highest of 13 percent (or 465/3625) for trips to/from Prince Edward Island. The generalized coefficient of determination, R-squared has a value of 0.995. This indicates that, for the optimization, 99.5 percent of the variation in the observed cordon counts has been explained.

However, the model results should also be evaluated in terms of the estimated AADT activity between provincial O-D pairs and between provincial and state O-D pairs. Table 3 presents the AADT estimates for trips to and from each of the Atlantic Provinces. Two primary sources of data can assist in this evaluation: the Canadian Travel Survey (Statistics Canada, 1997) and the report Trade and Traffic Across the Eastern US - Canada Border (Taylor, 1997).

Table 2 RESULTS OF THE NON-LINEAR REGRESSION ANALYSIS

Cordon Count Locations	Cordon Counts at the Borders			
	ESTAADT	OBSAADT	ERROR	SQERROR
To/From PEI+NS+Nfld	14819	14346	473	224138
To/From NS+Nfld	12203	11721	482	231929
To/From PEI	3160	3625	-465	215885
To/From NS	12719	12245	474	224679
To/From Nfld	516	540	-24	556
Que/Ont To/From Atlantic Provinces	16888	17830	-942	887069
USA To/From Atlantic Provinces	23572	23572	-0	0
MINIMIZED SUM SQERROR			SUM=	**1796707**
		GENERALIZED R-SQR =		**0.9952089**
Model Coefficients:	a0 =	**1.79E-07**		
	a1 =	**1**		
	a2 =	**-2.5**		
	a3 =	**8.47E-07**		
	a4 =	**1**		
	a5 =	**-4**		

Table 3 EXTRA- & INTRA-REGIONAL TRAFFIC (ATLANTIC REGION)
(Travel time, hrs / Estimated AADT)

1998 Population	Population	753000	136500	934200	543800
Population	Prov./State(Activity centroid)	N B	P E I	N S	Nfld
543800	Nfld (ST. JOHN'S)	22.43 / **42**	21.6 / **8**	19.95 / **81**	
934200	N S (HALIFAX)	4.73 / **6154**	3.9 / **979**		19.95 / **81**
136500	P E I (CHARLOTTETOWN)	3.93 / **1296**		3.9 / **979**	21.6 / **8**
753000	N B (FREDERICTON)		3.93 / **1296**	4.73 / **6155**	22.43 / **42**
7334500	Que (MONTREAL)	8.02 / **9740**	11.83 / **458**	12.68 / **2401**	30.47 / **186**
11413700	Ont (TORONTO)	14 / **2298**	17.8 / **243**	18.65 / **1386**	36.47 / **178**
1244250	Me (AUGUSTA)	4.37 / **20295**	8.22 / **38**	9.02 / **163**	26.8 / **2**
1185048	N H (CONCORD)	6.93 / **197**	10.8 / **10**	11.6 / **49**	29.38 / **1**
590883	Vt (MONTPELIER)	8.7 / **48**	12.55 / **3**	13.35 / **14**	31.13 / **1**
6147132	Mass (BOSTON)	7.02 / **983**	10.87 / **53**	11.68 / **251**	29.47 / **5**
988480	R I (PROVIDENCE)	7.88 / **102**	11.73 / **6**	12.55 / **30**	30.33 / **1**
3274069	Conn (HARTFORD)	8.47 / **259**	12.32 / **17**	13.13 / **83**	30.92 / **2**
18175301	N Y (NEW YORK)	10.52 / **643**	14.37 / **50**	15.18 / **258**	32.97 / **10**

The Canadian Travel Survey is representative of only passenger traffic by all modes in the domestic travel market. As such it cannot be used directly. Air traffic can be subtracted using information from Air Passenger Origin and Destination, Domestic Report (Statistics Canada, 1997). This results in only highway passenger traffic in the Atlantic Region. This then has to be converted to vehicle trips by dividing by an estimate of the vehicle occupancy rate (available from Atlantic Region ferry statistics and border crossing statistics). This number has to be further adjusted to account for the percentage truck traffic (available from ferry statistics, border crossing statistics and various department of transportation statistics). As such traffic flows based upon the Canadian Travel Survey are really estimates themselves. Table 4 presents the comparison of the AADT based upon the Canadian Travel Survey to both the modelled traffic flows and the 1979 O-D traffic flows.

A review of the results presented in Table 4 indicate that the preliminary traffic model has estimated some of the traffic activity reasonably well, particularly within the Atlantic Region itself. The activity for Nova Scotia appears a little high; on the other hand the AADT at the New Brunswick-Nova Scotia border has increased from 6830 in 1979 to 10800 in 1997 which tends to support the model estimate. But there appears to be substantial error in estimating traffic to and from Quebec and Ontario. The report Trade and Traffic Across the Eastern US-Canada Border (Taylor, 1997) only provided enough information to adequately estimate traffic of about 20,000 AADT between New Brunswick and Maine. The model estimate is 20295. The overall evaluation indicates that other explanatory variables should be included in the model, perhaps some of those identified by Leore (1996) such as a language factor. There should also be a separate model developed for each of the classes of traffic, one for passenger traffic and one for truck traffic. Perhaps a multi-objective optimization procedure should be incorporated to minimize, not only the error in the cordon counts, but also the error in available O-D activity.

Table 4
Comparison of the 1997 Canadian Travel Survey AADT, the Modelled AADT and 1979 O-D AADT
(for selected O-D pairs where sufficient data was available)

O-D Pair	1997 Canadian Travel Survey AADT	Modelled AADT	1979 O-D AADT
Nfld-NB	42	42	18
PEI-NB	1295	1296	1286
NS-NB	3947	6155	2884 (5160*)
Ont-NB	372	2298	332
PEI-NS	1122	979	834
Que-NS	82	2400	195
Ont-NS	235	1386	118
Que-PEI	105	458	76
Ont-PEI	279	243	32

* The long distance activity is adjusted to include short distance local activity

Conclusions and Future Research

The optimization procedure itself was successful, validating the feasibility of the basic approach of using cordon traffic counts in conjunction with demographic statistics and travel time data. The verification of the estimated AADT for various O-D pairs indicates that the model performed reasonably well within the Atlantic Region itself, but not quite as well for estimating activity to and from central Canada. There was good agreement between the model estimate of activity between New Brunswick and the state of Maine and the estimate of activity indicated in the Taylor (1997) report; however, there was not enough information available to make a reliable comparison for the other New England States.

Future research is required to improve the performance of the model. Additional demographics, such as language, will have to be examined. A finer grained zonal structure, at the parish level, might also help. Separating the traffic into two homogenous groups, passenger traffic and truck traffic, would probably improve the model performance as well. An effort is also required to improve the information available from on-going surveys such as the Canadian Travel Survey microdata, which is now being produced on an annual basis by Statistics Canada. A multi-objective optimization procedure could then be employed which would simultaneously minimize both the error in the cordon traffic counts and the error in O-D pair traffic.

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Travel Management on an Arterial Roadway

Richard A. Raub

1. Travel on Congested Arterial Roadways

1.1 The study

The effects of congestion and incidents on arterial roadways has received significantly less attention in the literature than similar effects on freeways. However, arterial roadways are carrying an ever increasing share of traffic. As suburban areas expand, and freeways become more congested and without additional lanes being built, increasing traffic pressures are placed on the arterial roadway. Travel times are increasing significantly; incidents only exacerbate the problems.

The effect of incidents on the management of traffic is being studied along with means to reduce these effects and to incorporate Intelligence Transportation Systems (ITS) elements into improving travel. This is part of a larger project which is identifying impediments to travel on one major, four-lane arterial roadway in the Chicago metropolitan area. Data related to incidents, travel times, traffic volumes on the arterial and its cross streets, and traffic signal operation data have been obtained for a 20 kilometer (km) segment of this arterial. With the assistance of a microscopic modeling program NETSIM, typical delays have been estimated. To this work is added what is known about incidents and how they can affect traffic, and the effects on this arterial are being examined. The value of using alternate routing also is considered. This process allows a better understanding of how recurrent and non-recurrent congestion affect travel and provides a basis for examining potential methods of reducing the effects.

1.2 Delays and Modeling of Networks

Although the literature has paid significant attention to freeways in regard to travel times and delays, fewer works address the arterial

roadways. Some examples of more recent efforts are provided by Jha, *et al.* (1999) and Jayakrishman, *et al.* (1997). Many of these works treat the arterial as an alternate to the freeway during situations which significantly reduce capacity on the latter (Chen and Ivan 1997, and Sisiopiku, *et al.* 1994). Some works have attempted to identify issues, e.g., Coombe, *et al.* (1998) for London. Others provide an attempt to model arterial network operation, such as by Laird, *et al.* (1999) for Edinburgh city center and Tremblay (1993) for Montréal. Even these works tend to be more concerned with travel time and arterial signal coordination than the overall affects of congested conditions on travel and delays.

Two efforts were found that have examined the effects of incidents on travel. The first is a theoretical approach by Maher, *et al.* (1993). The other was an examination of capacity restrictions on four-lane arterial roads (Pfefer and Raub 1998).

The limited theory applied to network travel generally has evolved from the microscopic models such as that which drives NETSIM. The most thorough addressing of the theoretical concepts can be found in the text by Ahuja, *et al.* (1994) on network flows, and earlier by Rathi and Santiago (1990) in their description of the NETSIM model.

Given this background, this paper attempts to examine estimated effects of incidents on already congested roadways from an empirical rather than theoretical approach. This is not to say that the theory is not valid and needs to be put in place, but rather, that efforts to enhance travel along the roadway (and ultimately in a larger 500 km^2 area served by arterial roadways) will benefit from the efforts presented here.

2. Lake Cook Road and the Corridor

Separating Cook and Lake Counties in Illinois is Lake Cook Road, mostly a four-lane arterial extending east-west for approximately 35 km. A four-lane, 20 km segment is the basis for the larger travel study. This roadway approximately bisects a much larger corridor of 510 km^2 into which has moved a number of well-known, large international and United States corporate headquarters. The area which contains all or parts of 18 communities has more than 300,000 residents and 150,000

employees. Some of the trips to work originate and terminate within this area, but a larger percentage pass through, or enter or leave.

The corridor is served by three limited-access roadways. Two bring traffic to and take traffic from Lake Cook Road. Only one passes through, but because it is a toll road it discourages local travel. The remainder of the corridor is served by approximately 200 km of major, 2-lane and 4-lane arterial roadways. There are 5 principal east-west (including Lake Cook Road) and 5 north-south roadways with several shorter connecting ones. Most of these roads exceed capacity during peak four to six hours daily. Lake Cook handles a peak hour volume of 1200 vehicles per hour per lane (vphpl) in several locations.

Because of the large number of intersecting arterial roadways crossing Lake Cook, there are 38 traffic signals. Even with cycle times exceeding 120 seconds, the large crossing volumes preclude giving more than 60% effective green time to Lake Cook Road. A few sets are interconnected, but many operate independently. Because of the traffic signals, significant recurrent delays exist, even in those locations with interconnected operation. Westbound travel time on one five-kilometer section averages 17 minutes with a queue exceeding one km at the first of the nine traffic signals encountered. When an incident occurs during peak travel periods, delays increase rapidly.

Traffic volumes easily justify three lanes in both directions. However, increases in capacity by adding lanes is actively resisted in the communities bordering all the arterial roadways, including Lake Cook Road. Some enhancements in capacity will derive from turn-lane improvements at intersections, by better coordination of travel along the roadway, and by introducing ITS elements where appropriate. The remaining efforts on reducing delays will have to derive from travel demand management (TDM).

The remainder of this paper examines travel times and delays calculated through simulation, the effect of incidents on delays, costs, and remedial possibilities. For the discussion, a four-kilometer section in the Village of Deerfield, Illinois was selected. Speed limit is 70 kilometers per hour (kph). This shorter segment is served by two major arterial roadways, two minor arterials, and an Illinois Tollway entrance and exit. Although only six signalized locations are used in the discus-

sion (each Tollway entrance and exit is separately signalized and separated by approximately 300 meters), there are entering streets, some of which also are signalized. However, the signals on these other streets provide minimal added delay. For this reason, they were not included in the simulation. Traffic volumes in the peak period are similar to those found elsewhere along the entire segment.

3. Travel and Incidents

3.1 Travel time

The traffic volumes are at their lowest between 2100 and 0500 hours, rapidly rising starting at 0600. There are two peak periods representing the morning and afternoon commute. Volume in the peak hour is approximately double that of the shoulder period. Eastbound average hourly volume doubles from 450 vehicles per hour per lane (vphpl) to 895 vphpl. For westbound traffic, the increase is from 405 vphpl to 885 vphpl. The result of these increases is to generate significant increases in travel time. A series of 15-minute simulations were run using NETSIM for both off-peak (defined as the hours outside the two morning and afternoon peak hours, e.g., 0900) and peak-hour travel. As shown in Table 1, off-peak travel time eastbound normally averages 334 seconds with a delay of 130 seconds (an average speed of 43 kph). Westbound travel is slightly faster with less delay, reflecting the lower westbound volume.

At the peak period, eastbound travel time increases by 33 seconds per vehicle and delay by 54 seconds per vehicle.[1] Even though volumes have increased significantly, delays do not because most of the signals are coordinated in this direction. Lack of westbound signal coordination is evident when examining the differences in travel times. Here, delay adds 224 seconds to the trip. Travel speeds fall from an average of 44 kph to 27 kph. As a result of the increased delay and accompanying volumes, eastbound drivers face an additional 24 hours of delay and

[1] Because these times are derived from a simulation, the increase in delay exceeds the increase in travel time; if measured directly, the travel time would increase at least as much as the delay time increase.

Table 1
Lake Cook Road - 4 km Segment
One Hour Operation

Off-Peak				
	Eastbound			
Link	Hourly Volume	Seconds Per Vehicle Travel	Seconds Per Vehicle Delay	Minutes Total Delay
Sanders-Tollway (W)	888	56.3	24.7	91.6
Tollway (W) - Tollway (E)	756	19.1	3.8	12.1
Tollway (E) - Wilmot	956	46.8	27.2	108.5
Wilmot - Pfingsten	992	113.7	33.5	138.0
Pfingsten - Waukegan	888	98.2	40.5	150.0
Total	896	334.1	129.7	500.2
Peak				
Sanders-Tollway (W)	1748	61.4	29.8	216.9
Tollway (W) - Tollway (E)	1532	22.4	7.2	45.7
Tollway (E) - Wilmot	1940	52.3	32.7	264.6
Wilmot - Pfingsten	1984	162.0	70.4	943.2
Pfingsten - Waukegan	1720	69.4	43.6	497.2
Total	1785	367.5	183.7	1967.6
Difference	889	33.4	54.0	1467.4
Off-Peak				
	Westbound			
Sanders-Tollway (W)	956	52.4	20.7	126.2
Tollway (W) - Tollway (E)	800	23.6	5.8	31.4
Tollway (E) - Wilmot	840	24.9	5.3	18.7
Wilmot - Pfingsten	776	111.8	31.6	102.3
Pfingsten - Waukegan	688	93.3	35.7	165.0
Total	812	306.0	99.1	443.6
Peak				
Sanders-Tollway (W)	1468	201.5	169.8	1038.7
Tollway (W) - Tollway (E)	2096	27.6	12.4	108.3
Tollway (E) - Wilmot	1880	27.8	8.2	64.0
Wilmot - Pfingsten	1744	137.8	57.6	393.6
Pfingsten - Waukegan	1660	132.6	75.1	519.3
Total	1770	527.3	323.1	2123.9
Difference	958	221.3	224.0	1680.3

westbound drivers an additional 28 hours. In both directions, travel at the peak period generates 68 hours of recurrent delay daily.

The simulation also yielded delays for cross-street traffic. Peak-hour traffic increases substantially because of the number of business served by these cross streets. An almost threefold increase in traffic increases crossing delay from an average of 24 hours to 155 hours. The average vehicle delay increases from 35 seconds to 82 seconds. Increasing the amount of green time for the cross streets would reduce the delay, but it would significantly increase delay on Lake Cook Road. Planned fiber optic cable installation and signal interconnection should help reduce the recurrent delay from traffic signals.

Under these congested conditions, even during non-peak hours, an incident which reduces the flow increases delays, especially during the peak periods. The next section addresses what is known about incidents that are occurring in this 4 km segment and then discusses the potential delay resulting from them.

3.2 Incidents

The Village of Deerfield provided data on incidents occurring from 1 January, 1999 through 30 June. Given that the six hours from 1200 to 1800 had higher average volumes than any other hour (excluding 700 to 0800), this period was chosen to examine how incidents might affect travel and delays. As shown in Table 2, 129 incidents were recorded for a rate of 0.72 per day. For the four kilometers, crashes occurred at a rate of 16.2 per km, motorist assists at 11.8, and all events at 32.2 per km. The 0.7 incidents per day was equivalent to 0.18 per km. Crashes were most likely to occur at 1200, a time quickly becoming a third peak travel period. However, the traditional peak period from 1500 to 1800 also had a high rate.

Table 3 shows a more complete breakdown by classification. Additionally, it provides an estimate of time taken to handle the incident. As was evident in Table 2, crashes account for 50% of the incidents with injury producing collisions representing 20% of all crashes. This latter value is typical for an urban roadway.

Time estimates which have been used elsewhere for duration of incidents affecting travel (Raub, *et al.* 1996), were applied to the values

Table 2
Traffic Incidents Along Lake Cook Road
1200 to 1800 Hours

Hour of Day	Incident Classification				Incidents per Day
	Crash	Motorist Assist	Other	Total	
12	12	7	4	23	0.13
13	5	2	3	10	0.06
14	13	4	3	20	0.11
15	6	8	0	14	0.08
16	6	11	5	22	0.12
17	15	5	0	20	0.11
18	8	10	2	20	0.11
Total	65	47	17	129	0.72
Per Km	16.2	11.8	4.2	32.2	0.18

Table 3
Traffic Incidents Along Lake Cook Road
1200 to 1800 Hours

Incident Classification	Number	Percent	Average Time (Minutes)	Minutes per Day
Crash				
PDO	52	40.3%	30	8.7
Injury	13	10.1%	60	4.3
Motorist Assist	47	36.4%	20	5.2
Traffic Stop	15	11.6%	40	3.3
Other	2	1.6%	90	1.0
Total	129		31	22.6

for this segment. Given the distribution of incidents by type and time to handle, incidents were determined to affect traffic flow on average of 23 minutes per day.

Not all these events close a lane for the entire duration. For example, while a lane often remains blocked in a property-damage-only (PDO) crash, when the police arrive at the scene, they direct the drivers off the roadway (most of the time all vehicles can still be driven). However, with an injury crash or a traffic stop for driving under the influence of alcohol, the vehicle will remain blocking one or more lanes of travel. Even though Table 3 shows that the average time to handle an incident, adjustment had to be made for those vehicles which could be removed immediately. Using these adjustments, the revised estimated time that an incident affects travel is 20 minutes. This value will be used for further analysis.

4. Effect of Incidents on Delay

4.1 Saturation flows

Effective green time for signals facing Lake Cook Road is between 53% and 68%. This provides a potential throughput of between 1900 and 2450 vph on two lanes (ignoring startup delay). The traffic signal at Sanders Road on the west end has the least capacity followed closely by Waukegan Road. As was seen in Table 1, volumes along several segments exceed the capacity at Sanders Road. This paper will assume a saturation flow of 2200 vehicles per hour.

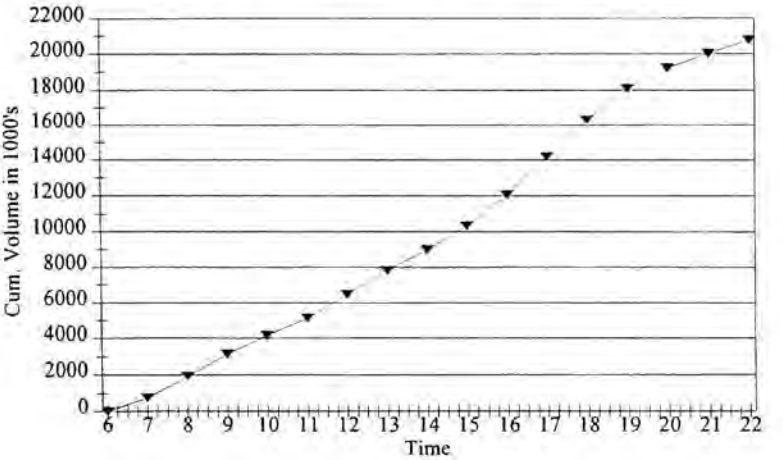
Under conditions where lane closure occurs, the saturation flow drops significantly. On four-lane roadways such as Lake Cook, Pfefer and Raub (1998) found that a flow of 1500 vph could occur with one lane of travel blocked. However, where there was significant activity at the scene, e.g., police vehicles, ambulance, and fire personnel, this flow rapidly decreased to under 1100 vph. Given the distribution of incidents that was shown in Table 3, a saturation flow under lane closure of 1300 vph will be used for delay calculations.

Figure 1 displays the actual flow on Lake Cook Road during a 16-hour period from 0600 through 2100. The flow over time is relatively constant until 1600 hours when it increases and stays at an elevated rate until 2000. From 1600 through 1700 the rate of flow per minute

approximately equals saturation. Because this is an unstable condition, delays frequently occur as was demonstrated earlier in the simulation.

Figure 1

Lake Cook Road
16-Hr Count 0600 to 2200



4.2 Added Delay from an Incident

Given that flow resulting from lane blockage is below demand for all hours of the selected period, except between 1300 and 1359, any lane blockage will generate queuing and delay. Using the demand curve shown in Figure 1 and applying an assumption that a 20-minute incident occurs at the beginning of each hour, the effects of delay were computed for each hour. The results of these calculations appear in Table 4. The table shows the demand, average flow per minute for each one-hour period, the time taken for a resulting queue to dissipate, and the hours of recurrent delay experienced by the motorists.

At 1500 hours, for example, the queue resulting from a lane being closed for a 20-minute incident will require 14 minutes to dissipate.

Table 4
Effect of Incident On Lake Cook Road
(20 vs 15-Minute Duration)

Time	Demand	Flow per Minute	Queue Dis. Time (mins.)	Recurrent Delay (hours)	Reduced Delay (hours)
1200	7801	22.2	0.5	1.7	0.9
1300	8991	19.8	0.0	0.0	0.0
1400	10336	22.4	0.8	2.7	1.5
1500	12072	28.9	14.1	46.9	26.4
1600	14178	35.1	114.9	403.1	255.9
1700	16316	35.6	68.3	221.9	161.6
1800	18096	29.7	17.1	57.0	32.1
Average				104.7	68.3
Percent Decrease					34.8%

Duration - 20 minutes		Saturation Flow	2200 vph
Revised Duration - 15 minutes		Incident Flow	1300 vph

During this time, because of the 1700 vph demand, approximately 985 vehicles will be affected. The drivers will experience a combined total of 47 hours of delay, an average of 2.9 minutes per driver. When traffic volumes equal saturation flow, such as occurs at 1600 and 1700, the effect of an incident will last for more than one hour after the incident has been cleared. An incident starting at 1600 and lasting 20 minutes will affect traffic for more than two hours (20 minutes plus queue dissipation). It will result in more than 400 hours of delay affecting 4,780 vehicles (an average of five minutes per driver).

If the peak hour is assumed to be 1700 to 1759, and using the distribution of incidents from Table 2 and the hours of delay shown in Table 4, the average daily delay can be estimated. Recurrent delay from Table 1 was 68 hours. From 1700 to 1759, daily average of 0.11 incidents occur. Given that each incident has a potential delay of 400 hours, this adds an additional 44 hours daily. The daily total delay is

112 hours. Of this delay, 60% comes from recurrent congestion and the remaining 40% from incidents.

4.3 Options to Reducing Delay

4.3.1 Recurrent delays. Given that capacity increases through addition of lanes is not an acceptable solution, then reduction in recurrent delays must occur from two other sources. The first is better coordination of the traffic signals. Cook County, who operates Lake Cook Road, is moving toward placing all signals under fiber optic. When that is done, and through the use of real-time travel data, it should be possible to adjust timing to maximize the flow. However, as noted in Table 1, traffic volumes are reasonably balanced during the peak period. This suggests that signal coordination will add minimal improvement. Additionally, some increases in the length of turning bays can help reduce some of the occasional spill back from turning queues.

The most significant improvement for reducing recurrent delays is going to come from TDM. The project underway is seeking funding to plan the implementation of ITS applications which can be used to help spread demand over a longer period. Fortunately, the many businesses that are served by Lake Cook Road already understand the detrimental effects congested travel has on their employees. They are active supporters of efforts to reduce demand through both transportation mode and time shifting. The ITS applications will stress both forms of demand management.

4.3.2 Incident delays. Reducing incident delays also will benefit from demand management. Fewer vehicles on the roadway during the peak hours should also result in fewer incidents. More important is the reduction in delays by better management of incidents. Potential approaches to incident management were covered thoroughly in the report by Raub *et al.* (1996) and have appeared elsewhere in the literature. ITS applications also can be of value with reducing incident delay, through faster detection and response. Additional efforts will be undertaken by a travel enhancement committee being formed for Lake Cook Road in developing policies and procedures to help reduce the effects of incidents.

Returning to Table 4, the last column showed what would occur if the average time for handling an incident was reduced by 5 minutes from 20 to 15 minutes. This would result in a 35% decrease in the average delay. At the peak periods, the reductions could exceed 50%. Achieving a 5-minute decrease is not as difficult as it might appear. For example, more prompt removal of damaged but driveable vehicles (through legislation requiring their removal except where injuries are present or they are not driveable) could reduce the time PDO crashes block travel from the current estimated six minutes to one minute. This contribution alone could gain two of the needed five minutes.

A final action is the use of rerouting traffic when lane blockage is severe. If the network has closely spaced roadways and the alternate streets have relatively light traffic, rerouting is possible. However, in the Lake Cook corridor major arterial roadways often are 1.6 km apart. They also have heavy traffic. A simulation of using such a network of roads that is available for this segment of Lake Cook Road showed that if a 20-minute closure of the roadway required rerouting of 400 vehicles, only 50% could be handled during that 20 minutes. The remainder would be waiting to make their turns onto or off from the alternate routes. Total delays to the rerouted vehicles would exceed the delays if the vehicles remain in queue waiting to be served. This does not mean that rerouting should not be attempted; however, it should be attempted only when travel times over the alternate will approximate the travel times through the delayed segment.

5. Concluding Comments

This paper has attempted to provide some answers to the questions of travel and delay on a congested arterial. In addition, it has examined how incidents can affect that travel. While an incident occurring at certain periods can create extensive delays, such as the example of one occurring at 1700 hours, the more important approach is to examine how incidents affect travel over a longer period. The importance of this approach is underscored when discussion centers on travel demand management through time shifting. Even increasing demand slightly during off-peak hours will help reduce both recurrent and incident-induced delays.

Overall, this work has shown that on a congested arterial roadway such as Lake Cook Road, that recurrent congestion plays a greater role in creating delays than do incidents. However, because the time at which incidents occur is critical, in terms of delay, efforts to control how long an incident disrupts traffic remains important. Therefore, actions, even on arterial roadways designed to reduce time for detection and response, and to work more swiftly to remove an incident need to be undertaken. However, an option often discussed, traffic rerouting, does not appear as feasible as might be believed.

A further request for funds is being made to allow the researchers to extend their examination of travel to the entire segment of Lake Cook Road. The data will be important to provide Cook County with sufficient information to help them best optimize the traffic signals. Having better information on where travel times and delays are most critical and where incidents are most likely to cause the greatest problems will allow better allocation of resources to respond and manage the incidents that occur. Also, the data can be used as part of a dynamic traffic assignment model which can then accept real-time data supplied by the signal network and predict travel times. The latter times then can be provided to the travelers on Lake Cook Road allowing them to make better judgments regarding when they should travel. As a result, this further work also remains an important element in achieving travel demand management.

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ANGUS L. MACDONALD BRIDGE - THIRD LANE PROJECT

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by O'Halloran Campbell Consultants Limited, Halifax

1. Introduction

The Angus L. Macdonald and A. Murray MacKay Suspension Bridges spanning Halifax Harbour are owned and operated by the Halifax-Dartmouth Bridge Commission.

The Macdonald Bridge was opened to traffic in 1955 and consists of suspended main and side spans totalling 762 m, plus approach spans of 437 m in Dartmouth and 148 m in Halifax. It experienced a very high rate of growth in traffic volumes through the later 1950's and beyond. In 1970, the four lane MacKay Bridge was open across the Narrows, and this with a network of expressway type approaches played a major role in the development and expansion of the nearby Burnside Industrial Park in Dartmouth. Annual traffic volumes for the Macdonald and MacKay Bridge are shown in Figure 1.

By the early 1990's it had became clear that the concrete deck on the approach spans of the Macdonald Bridge had deteriorated and would require replacement.

2. Primary Objectives

With the concrete deck on the Macdonald approaches at the end of its useful life, it was concurrently recognized that with further Metro area growth, some measure to increase cross-harbour capacity would be beneficial to the Halifax-Dartmouth Metro area. Given that the MacKay

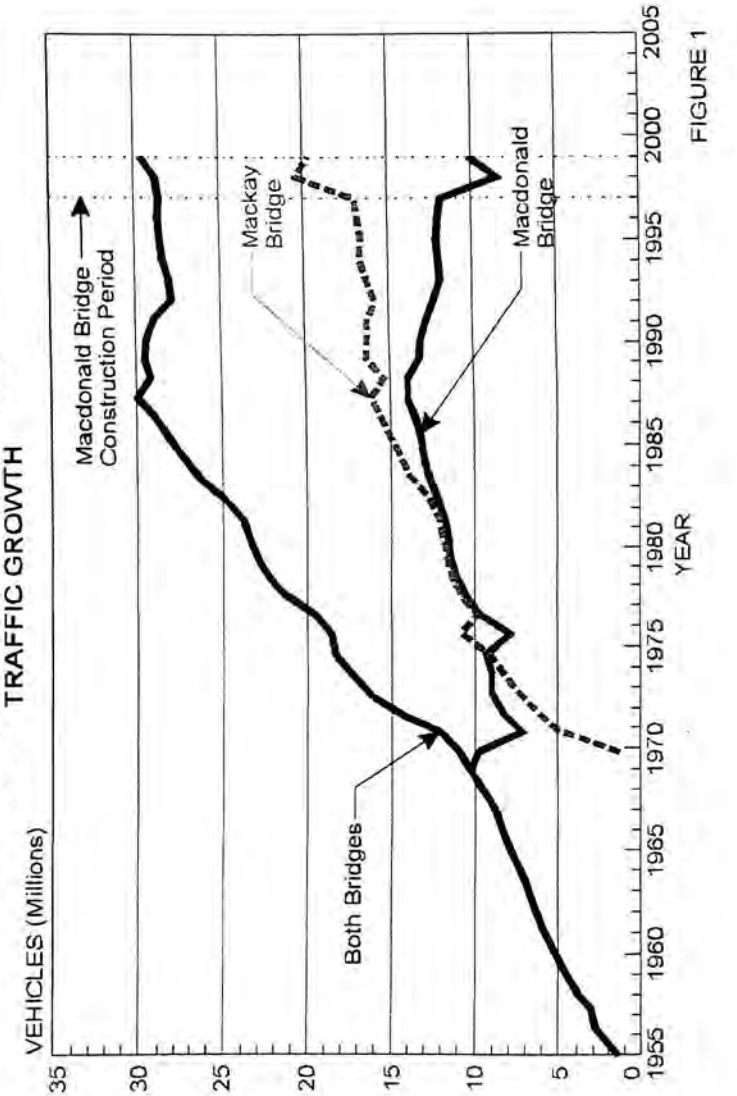

HALIFAX-DARTMOUTH BRIDGES
TRAFFIC GROWTH
VEHICLES (Millions)
35
30
25
20
15
10
5
0
1955
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005
YEAR
Macdonald Bridge
Construction Period
Mackay
Bridge
Macdonald
Bridge
Both Bridges

FIGURE 1

Bridge could not be expanded physically to increase the capacity, a solution lay in developing a third lane on the Macdonald Bridge.

While design work for the concrete deck replacement was proceeding, simultaneously investigations were conducted on the feasibility of adding a third lane of traffic. Two factors assisted with this possibility - the fact that the bridge was originally designed to accommodate a 30 in. dia. watermain, whereas a 24 in. dia. line had been installed; and secondly, the fact that the Macdonald Bridge was no longer on truck routes in Dartmouth and Halifax meant that its actual lane loading was reduced from the original design values which included heavy trucks. Through the design process a third significant factor was determined, i.e. the use of recently developed epoxy urethane lightweight surfacing would reduce the deadweight, compared to conventional asphalt.

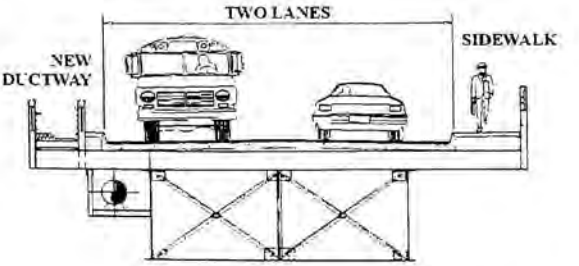
The Halifax-Dartmouth Bridge Commission determined, based on predesign cost estimates and other factors, that it would be beneficial to expand the "deck reconstruction" into the "Third Lane" project.

Testing by The University of Western Ontario/Boundary Layer Wind Tunnel Laboratory on several cross-section options found that there was very little change in torsional flutter wind speed between the original cross section and the proposed symmetrical section with sidewalk and bikeway added.

3. Structural Solutions

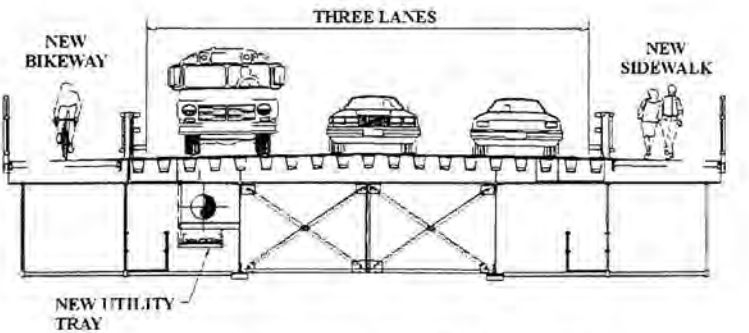
The design solution for the concrete deck replacement lay in the use of relatively lightweight orthotropic steel plate deck (OSPD). This is a steel plate which spans simultaneously in two principal directions, laterally between the webs of stiffening ribs, and longitudinally as the top flange of the beam system formed by the deck plate and underlying longitudinally stiffening ribs.

To achieve the width for three lanes, the south sidewalk and north ductway were removed (Figure 2). A new sidewalk was constructed, cantilevered outside the main stiffening truss on the south side, and a mirror image



EXISTING DECK SYSTEM ON APPROACH SPANS

FIGURE 2



THREE LANES ON APPROACH SPANS

FIGURE 3

bikeway was constructed on the north side, again by cantilevering outside the main truss (Figure 3).

On the suspended spans, the existing grid deck was widened over the areas which were previously occupied by the north ductway and the sidewalk (Figures 4 and 5). New guardrails were added to the inside face of the stiffening trusses. When completed there was about 10.5 m between the guardrails for three 3.5 m wide lanes of traffic. This is not ideal, but will provide an important capacity increase at affordable cost.

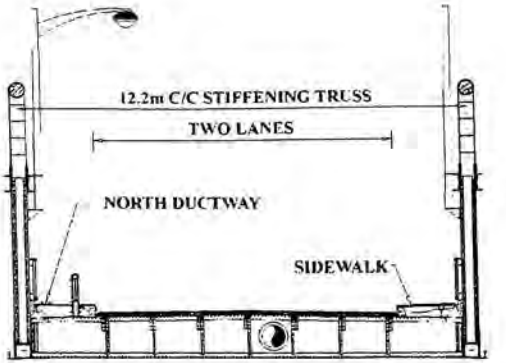
4. Implementation

A significant challenge to the project lay in the fact that it was not practical to close the Macdonald Bridge during the weekdays. Diverting approximately 40,000 vehicles/day to the MacKay Bridge was known to be unacceptable because it would cause major congestion in Halifax, and to a lesser extent in Dartmouth. Also, the MacKay Bridge was approaching its capacity under its normal traffic load.

The solution lay in the prefabrication of the OSPD panels, and nighttime operations. The bridge was closed from approximately 7:00 pm to 5:30 am each weekday night. During this time the full two lane width of the existing concrete deck was removed, over approximately 5 m length of bridge, and the replacement OSPD panel was placed (Figure 6). Connections were made to the underlying support girders and trusses, and a complete penetration transverse weld was made to the deck panel placed on the previous night. One hundred and twenty eight deck panels were installed over a seven month period.

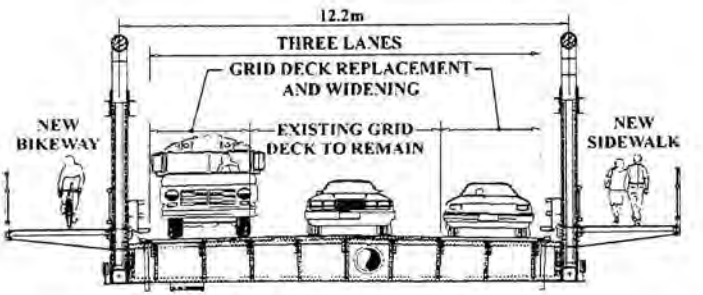
Due to the constraints imposed by daytime traffic, the construction phasing became a challenge. Elements of the deck replacement construction phasing in the approach spans included:

- relocation of services from the north ductway to the underside of the bridge deck
- placement of new orthotropic deck panels on the approach spans at night



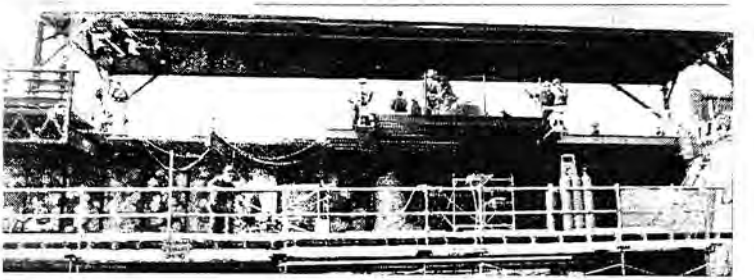
EXISTING DECK SYSTEM ON SUSPENDED SPANS

FIGURE 4



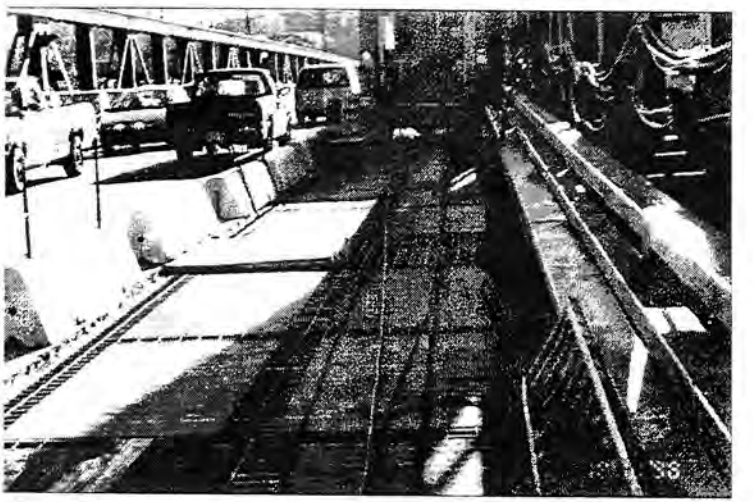
THREE LANES ON SUSPENDED SPANS

FIGURE 5



INSTALLING ORTHOTROPIC DECK - APPROACH SPANS

FIGURE 6



INSTALLING GRID DECK - SUSPENDED SPANS

FIGURE 7

- strengthening the main carrying members with the new deck acting compositely
- adding the cantilevered sidewalk and bikeway
- installing new roadway lights and wiring

Work on the suspended spans was carried out concurrently with work on the approach spans, and the sequence was as follows:

- addition of plate stiffeners at sidewalk and bikeway connections to the existing stiffening trusses
- installation of cantilevered sidewalk and bikeway panels on the suspended spans starting at mid-span and moving toward the main towers to balance loads. On the side spans installation of the sidewalk and bikeway panels progressing towards the main towers.
- pedestrians transferred to the new cantilevered sidewalk
- removal of existing north ductway and installation of grid deck on the north side (Figure 7)
- traffic shifted to the north and the grid deck widened on the south side
- installation of new expansion joints and adjustment of breather joints (for reduced thickness of wearing surface)
- application of 10 mm wearing surface (Sternflex)

5. Improvements to Approaches

With significant commuter traffic using the bridge to go to downtown Halifax plus universities, hospitals and other cross-harbour destinations, and with the normal return trips in the afternoon/evening, the Halifax approach roads in particular experienced am and pm peak congestion on streets which had (for the most part) not been built as bridge approaches. Following intersection analyses on both sides of the bridge, these major improvements were included in the project:

- reconstruction of the bridgehead/Wyse Road/Nantucket intersection in Dartmouth, with new traffic signals (Figure 8)
- modifying the Dartmouth Toll Plaza, and using six eastbound toll lanes and four westbound lanes, with a dedicated electronic toll collection lane (MacPass) in each direction.



UPGRADED INTERSECTION IN DARTMOUTH

FIGURE 8



NEW RAMP OVER BARRINGTON STREET

FIGURE 9

- widening Barrington Street to five lanes south of the Macdonald Bridge, incorporating a merge lane for southbound traffic exiting the bridge
- a new single lane ramp and overpass northbound on Barrington Street to access the bridge. This eliminated the former left turn to Artz and Brunswick Streets, easing northbound flow on Barrington Street and eliminating Brunswick Street as a bridge approach, much to the satisfaction of residents on that street (Figure 9 and 10).
- widening North Street from Gottingen Street to the bridge

In the end, construction proceeded with minimal disruption to traffic. With the exception of periodic weekend closures, two lanes of traffic were maintained.

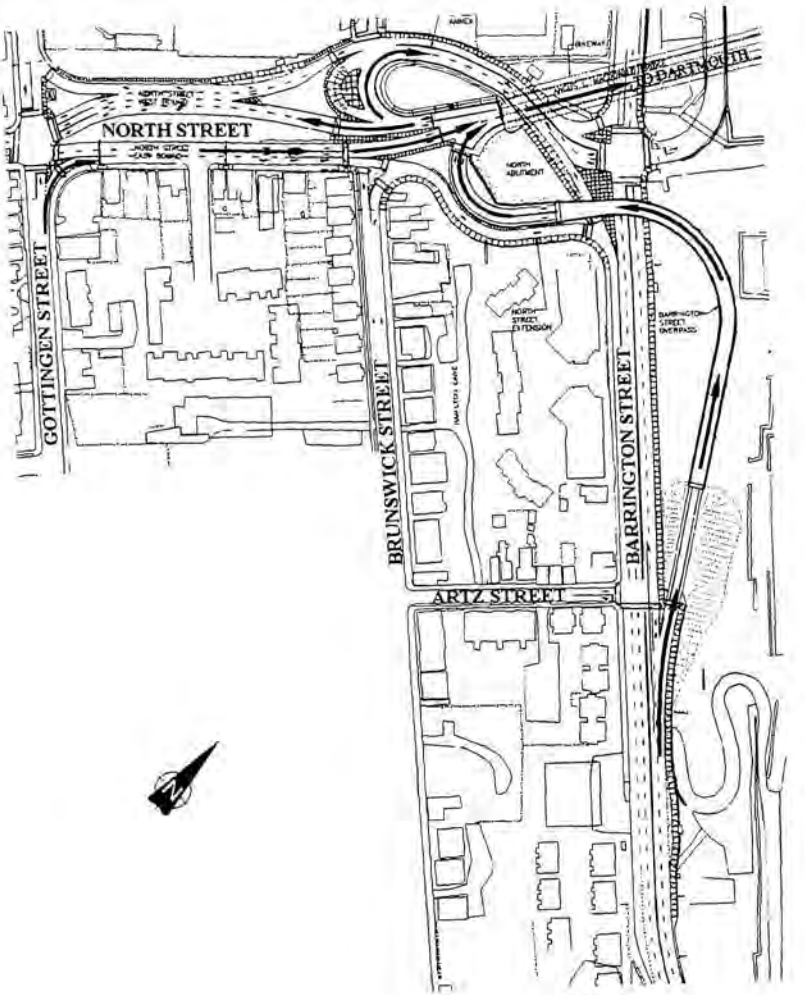
6. Public Relations During Construction

The Commission has a good longstanding relationship with its neighbours and patrons. In the interest of keeping people well informed the Commission held public information forums, open houses, media sessions, issued paid advertisements, public service announcements, information bulletins, hand-delivered notices and erected signs during the construction period.

A public relations team consisting of the Commission, a PR Consultant, the Contractor and O'Halloran Campbell informed the public and addressed complaints, which were minimal. Special attention was given to sound abatement measures for nighttime work.

The Commission established and advised its neighbours of a formal complaint protocol. The intent was that if the public was being exposed to excessive nighttime noise, or other bothersome construction activity, they would have a single point of contact, the Commission's Duty Sergeant. He would complete an incident report and issue it to the Consultant/Contractor for immediate action.

The end result was well informed and generally satisfied bridge neighbours and patrons. Public feedback was overwhelmingly positive.



HALIFAX APPROACHES

FIGURE 10

O'Halloran, Deveau
Eppell, Eisan

7. Traffic Management

The centre lane is reversible to accommodate peak hour traffic flows. The lane directions are controlled by overhead, fibre optic lane indicator signs, variable message signs and lane control gates.

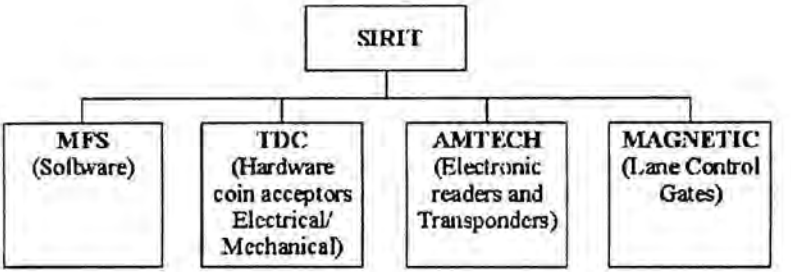
The completed project incorporates the following traffic management tools:

- electronic toll collection (ETC)
- overhead variable message signs
- lane control gates
- central computer system
- surveillance cameras
- computerized ice dection system

For over 30 years the Commission had used automatic coin machines (ACM's) for the collection of tolls. The ACM's had become obsolete mechanical devices subject to wear and tear. After monitoring the development of ETC systems in the US and elsewhere, the Commission decided that it would be advantageous to replace the outdated toll equipment with a system capable of accepting cash, tokens and electronic payment (i.e. ETC).

ETC is achieved with a transponder on a vehicle's windshield, and reading the unique code in the transponder with a scanner in a toll lane. The appropriate fare is then deducted from the ETC user's account.

The general contractor for the ETC system was Sirit who coordinated the components, as shown below.



The ETC user purchases a transponder ("MacPass") for $30, which is fully refundable if returned within 12 months, and a depreciated value is refunded after one year. An account is established according to the user's needs and must be replenished when it reaches a set level, such as $10. As the user makes bridge crossings, the vehicle is identified and the cost of each crossing is deducted from the user's account.

When a minimum balance is reached, a flashing amber light indicating "Low Account" is shown to the driver on three successive trips. At this time, through the authorized payment system, the individual account is topped up in accordance with the user's wishes.

The ETC is operating well, with over 20,000 subscribers so far. It saves time for the vehicle at the booth, reduces emissions and the need for serviced lanes, and delays caused by missed coins and tokens. Drivers find the ETC very convenient, avoiding the need to use cash or purchase tokens.

The lane control signs, which are visible from both directions, are located at eight key points on the bridge, the Barrington Street Ramp and on the North Street approach to the bridge. The signs communicate with their respective controllers and a central computer system (CCS) via fibre optic cables. The system is controlled from the Commission's Administration Building using CCS. The system operates automatically on preset traffic management plans, where two lanes of traffic flow from Dartmouth to Halifax between midnight and noon, and two lanes from Halifax to Dartmouth between noon and midnight. This system incorporates a

number of other user controlled traffic management plans for special circumstances, i.e. lane closures.

Four variable message signs are located at three points on the bridge. Westbound signs are visible at the Dartmouth Abutment and Centre Span, eastbound signs are visible at the Halifax Abutment and Centre Span. The messages displayed on these signs are controlled by the operator at the CCS. The variable message signs provide the Commission with the opportunity and flexibility to advise motorists of special circumstances on the bridge, i.e. partial lane closures for maintenance work, etc.

Lane control gates are integral to the traffic control system. Gates are located at both ends of the bridge. Four horizontal swing gates are located at the north end of the Barrington Street Ramp, near the bridge access. They are open when the bridge traffic in the centre lane is flowing eastbound and closed to deflect traffic to the south lane when the centre lane is flowing westbound. Similarly, four horizontal swing gates are located along the north edge of the North Street bridge approach. They function in the same manner as the gates on the ramp.

A vertical lift gate is located on a traffic island on the Dartmouth Plaza. It controls westbound traffic access to the centre lane. When the gate is open (up) two lanes of traffic flow westbound. When the centre lane is flowing eastbound the gate is closed (down), forcing westbound traffic into the north lane.

The CCS (hardware and software) forms the brain of the traffic management system. The lane control signs, variable message signs and lane control gates are all controlled by it, and they are configured to work in a coordinated manner.

The signs and control software were prepared and supplied by Mark IV Industries, and the gates were supplied by Magnetic. Electrical/communication infrastructure was supplied and installed, and signs and gates were erected by, Black and McDonald.

A computerized ice detection system was installed on the bridge deck. It consists of six road sensors and remote processing units, two sub-surface

temperature sensors (abutments), a weather station (temperature, relative humidity and barometric pressure sensors, anemometer and wind vane) on the south side, at centre span, and a remote processing computer in the Commission's Administration Building.

This system is used as a tool for determining deck freezing so that the Commission can begin deicing before the deck becomes slippery. The computer monitoring system is configured to provide an audible warning alarm for potential ice conditions.

The surveillance camera system (approximately 16 cameras in total) consists of a combination of fixed and rotating colour cameras on the roadway, bikeway and sidewalk.

The closed circuit TV (CCTV) control equipment includes a data multiplexer, camera keyboard, controller and digital video recorder. The cameras are used to monitor traffic flow and for general security on the bridge.

As part of the overall enhancement of the Macdonald Bridge, the Commission installed "Bridge Highlighting". Lamps are positioned at the main towers and along the top chords of the stiffening trusses to provide accent lighting for the towers, suspender ropes and main suspension cables.

8. Results

The 45 year old bridge has been upgraded and now provides about 100% more capacity in the principal travel direction. The additional lane adds 17% to the cross-harbour capacity of both bridges combined, and adds 33% to the capacity in the principal direction of travel. The duration's of cross-harbour trips during peak traffic times have been reduced by 15 to 20 minutes. The Commission is now well served by a range of modern traffic management installations. The project, for which Walter SCI/Cherubini Joint Venture was the principal contractor, and for which O'Halloran Campbell provided all design and project management services, was completed within schedule and under budget.

OPEN SKIES FOR PASSENGERS, BUT WHAT ABOUT CARGO? RE-EVALUATING CANADA-U.S. AIR CARGO REGULATIONS

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Michael A. Crockatt, Research Affiliate
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ABSTRACT: *Air cargo co-terminalization and pre-clearance restrictions impede the efficiency with which international air cargo can be moved. Removal of restrictions may allow for a more efficient system, but some industry stakeholders indicate that there will be winners and losers. This paper summarizes those perspectives of a more liberalized air cargo environment.*

1.0 INTRODUCTION

The 1995 Canada-US Open Skies Agreement had a significant impact on passenger air transportation and now, a similar agreement for air cargo traffic between the two countries is being debated. Currently, a co-terminalization (CO-T) restriction prohibits the right to co-terminalize points (combine the gateway with one or more additional points beyond) on any scheduled all-cargo or courier service with aircraft having a takeoff weight greater than 35,000 lbs. This type of trade restriction is unique to the Canada-US agreement

Under current regulations, carriers originating in the US and destined to Canada are restricted from extending their reach beyond a single city pair. In other words, CO-T is not permitted. US integrated carriers – Federal Express (FedEx) and United Parcel Service (UPS) in particular – routinely use their own aircraft fleet to make multiple outbound stops from their central sorting hubs to drop off packages at

US cities. Once they reach their final outbound destination, courier aircraft and crews turn around and head back to their hubs, picking up packages at each stop along the way. CO-T rights would permit US carriers to add multiple stops in Canada as tag ends to their existing US and transborder routes.

However, CO-T is not the only air cargo regulation impacting the industry's efficiency. Cargo pre-clearance would allow shippers and freight forwarders better, quicker, and more seamless access to US and international markets. Cargo pre-clearance would operate in a similar manner to passenger pre-clearance, which is in effect at most major Canadian airports with transborder routes. After clearing US Customs and Immigration at the Canadian airport of origin, passengers are mixed with US domestic passengers upon arrival at the US airport. By pre-clearing cargo in the same manner at Canadian airports, cargo can be handled more efficiently through the US system, avoiding delays that are out of the control of the shippers or forwarders.

This paper assesses how CO-T and cargo pre-clearance restrictions might effect the North American air cargo industry. Specifically, this paper examines:

i. a case study of air cargo routing patterns under a regulated and relaxed operating environment;
ii. stakeholder perspectives of removing current CO-T restrictions on Canada-US all-cargo operators;
iii. a potential trade-off to CO-T restriction involving the two regulatory issues; and,
iv. potential winners and losers in allowing for CO-T rights.

2.0 Case Study Of A US Integrator: FedEx

The CO-T restriction has different ramifications for all-cargo carriers in Canada and the United States. Currently, US-based carriers, such FedEx, UPS, Emery Worldwide and Burlington Air Express (BAX) Global, contract with Canadian all-cargo carriers, such as Purolator Courier, Knighthawk Air Express (KAX) and Morningstar Air Express (MAE), to fly cargo between "tag-end points" in Canada.

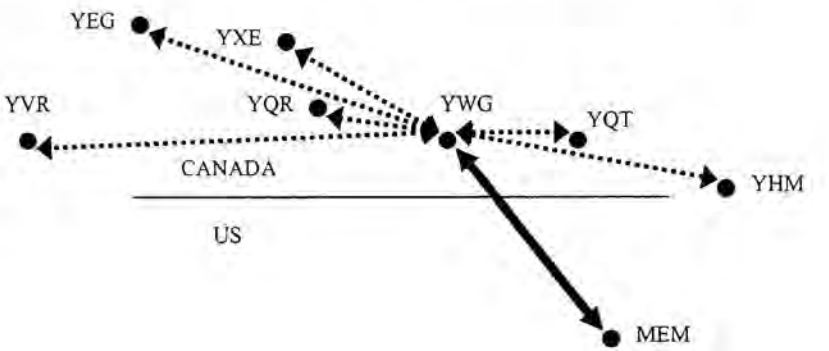
This paper considers the example of how FedEx might operate between airports in Memphis, Winnipeg and Edmonton.

2.1 Current Air Cargo Scenario

Currently, FedEx serves several Canadian cities on transborder routes from its major sorting and regional hub network in the US. However, when the US-based integrator reaches the airports in those cities, it can not simply exchange cargo and continue on to another Canadian point. It must return to the US carrying only US-bound or international cargo.

Figure 1 illustrates the current transborder O-D integrated air cargo route pattern for FedEx. Under the current scenario, FedEx flies a 727-100 from its Memphis sorting hub to Winnipeg. Upon arrival in Winnipeg, some of the transborder cargo destined for Winnipeg is unloaded, transferred to truck in the early morning and sent to its final destination. The remaining cargo is sorted and transferred to several MAE 727-100s and metroliner aircraft to be distributed to other Canadian points such as Edmonton (YEG), Regina (YQR), Saskatoon (YXE) and Thunder Bay (YQT). The US-based FedEx aircraft can not serve those cities from Winnipeg because the CO-T restriction prohibits them from doing so. Once unloaded, the US-based aircraft is reloaded with Winnipeg cargo destined for the US, including Canadian cargo flown to Winnipeg from other parts of Canada by MAE.

Figure 1 Current Transborder O-D Air Cargo Route Pattern

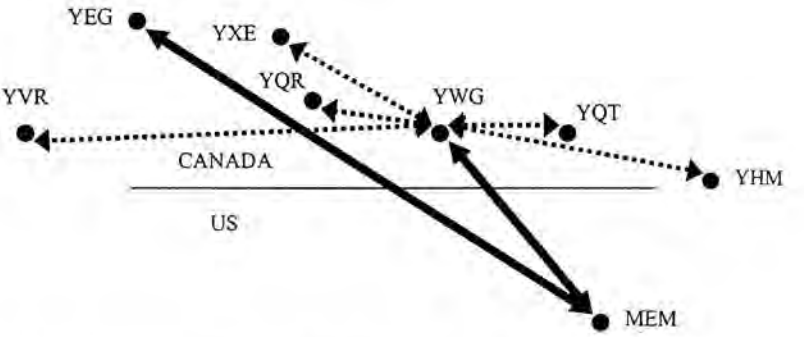


MAE aircraft are identical to FedEx aircraft in appearance; both carriers are painted with the familiar "blue & orange" flag colours. Differences exist only in aircraft ownership and the routes they serve. MAE flies all routes for FedEx that serve Canadian cities only, while Federal Express Canada manages the movement of cargo. Similar relationships exist between many other all-cargo companies. For example, All Canada Express (ACE) flies Canadian routes for UPS.

2.2 Economies Under CO-T Restriction

If cargo volumes were substantial enough, US integrators could serve more Canadian cities directly from their US sorting hubs, even under the current CO-T restriction. Rather than flying Edmonton-bound cargo to Winnipeg, unloading and reloading it onto another aircraft, a US carrier could serve both cities directly from its US hub, utilizing two aircraft and two routes from Memphis. For instance, FedEx could expand its operational network directly by serving both YWG and YEG from its primary sorting hub in Memphis by flying aircraft such as a B727 for each city pair (i.e. MEM-YWG and MEM-YEG). This is illustrated in **Figure 2**.

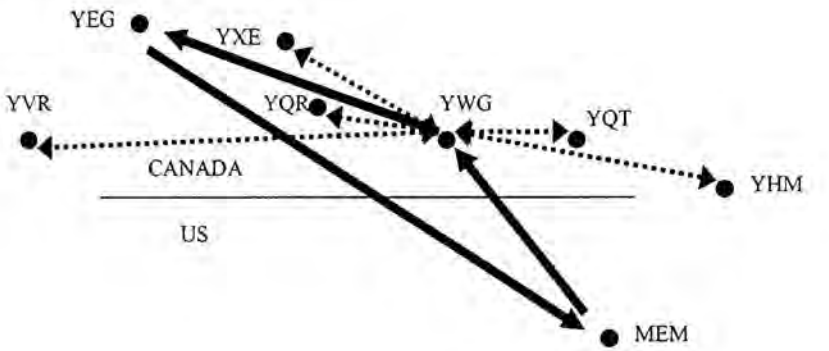
Figure 2 Network Economies Under CO-T Restriction



2.3 Co-Terminalization Rights

Serving multiple Canadian cities (i.e., Winnipeg-Edmonton) with a single wide-body aircraft would improve efficiency for FedEx. Allowing for CO-T rights is illustrated in **Figure 3**. With the CO-T restriction relaxed, FedEx could fly a wide-body DC-10 from Memphis to Winnipeg, unload cargo, and reload with US-bound cargo. The aircraft could extend its route to Edmonton and unload the remainder of the cargo that had originated in the US and load any cargo returning to the US from Edmonton. The aircraft could return directly to Memphis, bypassing Winnipeg since it had already exchanged cargo there. Efficiency gains from reducing the fuel burn for an additional takeoff and the landing fee charge would result in cost savings to FedEx. Furthermore, utilizing fewer aircraft to move the same volume of cargo would result in labour cost savings (i.e., fewer pilots, cargo ground handlers, etc.) along the MEM-YWG-YEG triangular cargo route segment. Efficiency gains in aircraft utilization and labour productivity could be achieved by serving both Canadian destinations with a wide-body extended route. Since the marginal cost of adding additional Canadian points to their existing network is relatively low, the cost savings could be passed on to shippers through lower freight rates.

Figure 3 Air Cargo CO-T Rights



There are three aspects of the air freight industry's economic structure – economies of density, scale and size. CO-T rights would provide for *economies of density*, where unit costs would decline as Fedex either adds flights or increases the capacity of existing flights (e.g., through larger aircraft), with no change in the number of points served or network configuration.[1] *Economies of scale* would be present where unit costs decline when additional co-terminal points are added to the network. *Economies of size* combine economies of density and scale. It is the proportional increase in output (i.e., total revenue-tonne-kilometres (RTK) of freight), co-terminal points served and density resulting from a declining proportion in all inputs (e.g., fuel, labour, materials and service, flight capital), with average stage length and input prices fixed.

Under CO-T rights FedEx might exhibit economies of size, especially where its Canadian network is less mature. When its freight network is growing, additional traffic generated by increasing the number of

[1] Additional output should have little effect on system costs, since additional traffic is normally accommodated on existing flights rather than through adding additional flights, and since ground distribution costs decrease with traffic density.

co-terminal points served more than compensates for the additional costs of adding points.[2] In a mature network, these effects largely counteract each other.

Cabotage regulations restrict US-based aircraft from moving domestic cargo between Winnipeg and Edmonton, or between any co-terminal points. The restriction prevents foreign carriers' equipment and personnel from engaging in domestic point-to-point movements within Canada. Cabotage regulations are separate from CO-T restriction, and would not be altered even with changes to the restriction. There are proponents of free trade who believe that cabotage rights would bring even more efficiency to the industry. While, it is unlikely that either Canada or the US would relax those regulations, some reform has taken place. A 1997 Customs Act Memorandum of Understanding specified that international goods dropped off in a country of destination but not the final destination according to the goods' bill of lading are still considered international. Therefore, the transport of those goods by a foreign carrier would be legal and would not be considered a cabotage move.

3.0 Consolidation Efficiencies: Not Hub-and-Spoke

US integrators currently consolidating cargo at Canadian airports may consider flying fewer aircraft to more points in Canada to be more efficient than using the current "hub-and-spoke" system. The current system relies on one carrier flying to a Canadian airport from the US to connect with several carriers destined to various locations across Canada. A new system might see one carrier from the US serving more than one Canadian city, eliminating the need to consolidate at a Canadian centre. Not only could a single aircraft serve Winnipeg and Edmonton, but a similar routing could be created for:

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[2] The marginal benefit of adding another co-terminal point exceeds the marginal cost of adding that point, hence MB>MC. In a mature network, MB=MC.

- Memphis-Wpg-Thunder Bay (MEM-YWG-YQT);
- Memphis-Wpg-Regina-Saskatoon (MEM-YWG-YQR-YXE)[3]; or,
- Other combinations that increase the operational efficiency of a carrier's operations.

Currently, Canadian all-cargo operators contract with the US couriers to operate between those "tag end" Canadian destinations, picking up and dropping off transborder packages on behalf of US integrators. While relaxing the restriction would ultimately change the air cargo industry in Canada, the resulting impacts are uncertain.

4.0 Potential Impacts

Potential impacts of removing the CO-T restriction must be weighed for all stakeholders in the air cargo industry. Clearly, stakeholder support for removal of the restriction is not unanimous. US-based integrators are firmly in favour of eliminating the restriction, and would further advocate the removal of cabotage regulations, enabling them to have full access to the Canadian market. The Canadian Airports Council (CAC), which represents airports that have been transferred to local and Canadian airport authorities, also supports removal. Conversely, the Air Transportation Association of Canada (ATAC), which represents the interests of Canadian cargo carriers that contract with US carriers, is in favour of retaining the current CO-T restriction. ATAC foresees no opportunities for Canadian cargo operators and no identifiable benefits for the Canadian public. Sections 4.1-4.3 identify stakeholder positions regarding CO-T.

[3] As mentioned, Regina, Saskatoon and Thunder Bay are served by smaller Metroliner aircraft flown by MAE from YWG.

4.1 ATAC Position[4]

Canadian all-cargo carriers fear diminishing opportunities to move transborder cargo between Canadian cities – a cornerstone of their business. These carriers strongly support the retention of the current regulation.

ATAC claims that US couriers wish to co-terminalize Canadian destinations on transborder routes. The integration of their domestic US hub and spoke operations with co-terminal services in Canada could be achieved more efficiently and at lower cost. The inability to co-terminalize Canadian points has created the requirement to contract Canadian all-cargo charter operations to pick up and drop off transborder packages at points within Canada.

The following points list some of ATAC's claims regarding CO-T.

i. Little reason for US carriers to contract Canadian all-cargo carriers to carry transborder cargo within Canada except possibly on a limited scale to small and remote communities, where carrier costs and airport limitations dictate the use of smaller aircraft.

ii. Maintenance and space lease contracts, and Canadian pilot and mechanic jobs could be lost at Canadian airports if the majority of aircraft return to the US each day and were no longer stationed at Canadian airports.

iii. In the absence of CO-T rights, more US courier business will not be diverted from Canadian carriers and airports to truck. US carriers already use inter-city trucking where trucks are the most timely and cost-effective mode of transport.

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[4] Air Transport Association of Canada (ATAC), "Co-terminalization: All-Cargo Route Rights Under Canada/US Open Skies" – *Position Paper*, 1999.

iv. Lower transborder courier prices through greater efficiencies to be passed on to consumers is unsubstantiated: (1) Canadian carrier unit costs are likely to be less than the US on operations between Canadian points (primarily due to lower overhead costs), and (2) Canadian all-cargo charter operators utilize smaller equipment that is more appropriate to the tag-end segments of the hub-and-spoke systems of major US carriers.

4.2 AIRPORT POSITION

Some Canadian airport authorities agree that the current CO-T restriction hinders trade development, and that relaxing the regulation would have significant benefits similar to those experienced after the 1995 Open Skies Agreement for passenger aircraft. The Edmonton Regional Airports Authority (ERAA) lists the following three benefits to Canadian airports:

i. Additional frequencies of heavier aircraft with resultant airport revenue increases from landing, parking and fuel fees;

ii. Improved service levels for the shipping public in the beyond (co-terminal) points with earlier flight arrivals in the morning and later cut-off times for receipt of shipments at the end of the day; and,

iii. Increased demand for handling space at Canadian airports due to the recovery of some shipment volume presently diverted to trucking.

While new co-terminal airports could increase revenue from heavier aircraft, there is also the distinct possibility that current gateway airports could double their revenues by handling 2 landings per day by heavier aircraft (routing to/from the co-terminal point) instead of just one. In such cases, aircraft would return to the gateway airport (i.e. Winnipeg) on its return to the US. However, this cargo routing does not follow the network efficiencies of triangulation described in Figure 3.

Airports view risks associated with the loss of jobs and investment in operating/maintenance bases with scepticism. Since Canadian all cargo carriers operate on the basis of short-term contracts (which can be withdrawn or cancelled in 30 days for lack of performance), they rarely undertake the risks of investing in large capital projects such as new facilities for larger aircraft. In fact, airports claim that there is no evidence of significant investment in hangar and maintenance facilities made possible by the current restriction. While additional jobs (crew, maintenance, office, etc.) may be added with a contract, these jobs are most likely to be added in constant or diminishing proportion to the number of aircraft operated. The threat of job losses is just as real under the current scenario, with CO-T. As Figure 2 shows, US cargo carriers could already reduce the number of aircraft and jobs based in Canada. As cargo volumes continue to increase, this possibility becomes more likely.

Airports view the threat of increased trucking as very real. US integrators already use trucking services to a significant degree and could increase the practice. Overnight delivery in the short-haul market and second-day expedited trucking delivery over medium distances are becoming increasingly more competitive.[5] In 1997, ERAA estimated that approximately 40 percent of its air cargo market was diverted to trucking, and that over 28 percent of its courier traffic was trucked between airports. In 1999, Winnipeg Airports Authority found that 25 percent of freight forwarders total inbound and outbound air cargo was diverted by truck.[6,7] The largest airport leakage from YWG by truck was destined to Toronto (YYZ) and Calgary (YYC) Airports.[8]

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[5] Trucking companies can offer various time-deferred services with similar reliability at considerably less cost than traditional air express carriers.

[6] Thompson, W., Crockatt, M.A. and Shurvell, S.J., Winnipeg Airports Authority Air Cargo Marketing Plan, 1999.

[7] Crockatt, M.A., and Shurvell, S.J., *"Air Cargo Leakage: Assessing Opportunities For The Local Air Cargo Market"*, CTRF, 2000.

[8] Reasons driving forwarder routing decisions at YWG stem from the lack of O-D air cargo service, the inability to accommodate large shipments due to

Air cargo leakage is a substantial loss to both cargo aircraft operators and airports. Leakage is bound to increase if CO-T restrictions are not relaxed. Canadian couriers must realize that their competition is an increasingly efficient trucking industry, not the heavier US integrator aircraft.

The airport perspective on lower prices is that while CO-T rights may not bring about price reductions to consumers, the lower operating costs incurred by couriers and integrators may allow them to withhold rate increases. This would improve cargo service levels.

A suggested strategy of the CAC would be to negotiate a phase-in period of CO-T for US carriers. In the short-term, US carriers are unlikely to make immediate changes to their cargo service plans. Therefore, a phase-in period that would designate specific routes for US carriers and the number of points a carrier can co-terminalize on a single route could be implemented in the interim.

4.3 US INTEGRATOR POSITION

US integrators are proponents of loosening the CO-T restriction. FedEx and UPS have submitted a joint position paper to the US government outlining the benefits they believe will accrue to themselves, Canadian airports and Canadian cargo carriers. At present, CO-T is being reviewed by the US DOT.[9]

Under the current system, UPS Canada President Scott Corrigan indicated that "service offerings and market opportunities are restricted, leading to sub-optimal trading patterns".[10] CO-T directly results in increased costs and complexity of cargo routing to the carriers. These costs are ultimately passed on to shippers.

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the lack of wide-body aircraft serving YWG and insufficient frequency levels of scheduled passenger (belly capacity) and all-cargo service.

[9] The Fedex/UPS joint paper was unavailable for public distribution at the time this paper was completed.

[10] Corrigan, S., *National Post, June, 1999.*

US carriers also point out new opportunities for air cargo operators in identifying and serving market niches. These consist of markets that cannot be tapped with the CO-T restriction in place.

Even though CO-T restrictions are perceived as necessary to protect Canadian carriers, integrators state that liberalization would not have a significant impact on their domestic partnership arrangements now in place. The ability to co-terminalize would not reduce US integrator partnership arrangements with Canadian carriers – ACE and MAE – serving the Canadian air cargo market.

5.0 Trade-Off: Cargo Pre-Clearance

The inability to pre-clear cargo is another policy that restricts the efficiency of transborder air cargo movement. It adds additional transaction costs (i.e., time, service) that impair the cargo system preventing optimal competitiveness for cargo shippers, forwarders and airlines. The ability to pre-clear cargo would help to reduce transaction costs in the system by reducing the dwell time cargo shipments would be held in bond in the US. Canada has the opportunity to negotiate a concession from the US as a possible trade-off for CO-T. ATAC alludes to the possibility that it might give up its opposition to CO-T for a counter benefit(s). While there has been no indication as to what the offsets might be, cargo pre-clearance as a counter benefit to CO-T rights might be seen as a compromise to all stakeholders.

The CO-T discussion mentioned the issue of air cargo leakage from Winnipeg, indicating that a portion of that leakage is trucked to Minneapolis-St. Paul (MSP) before being flown to its destination. If cargo could be pre-cleared at YWG, and flown by Northwest Airlines to MSP, it could then enter the domestic cargo market immediately, rather than having to clear customs on arrival. This could cut total transit time by hours, or even days for some cargo.

Advantages of cargo pre-clearance can be illustrated even more clearly when considering international air cargo originating in Winnipeg, destined for Europe via MSP. Cargo from Winnipeg could be timed to reach MSP to connect with a flight to Europe, something made much more difficult given the current dwell time cargo must endure in US airports, waiting to clear customs.

Pre-clearance would also give Canadian airports the opportunity to pursue *same-plane service* to international markets. For example, if a shipper in Winnipeg wanted to send freight from Winnipeg to Amsterdam via Minneapolis, the freight would have to be unloaded at MSP to clear US customs, even if, hypothetically, the same aircraft were flying directly to Amsterdam. If cargo could be pre-cleared at YWG, it could stay on the plane at MSP and fly on to Europe. This minimizes the handling of the cargo and reduces the total time it spends in transit. Furthermore, pre-clearance could be set-up at Canadian airports with relative ease, particularly where there are already US government facilities in place.

If any negative impacts would be felt from cargo pre-clearance, it would not likely occur at Canadian airports, where employment would increase with the addition of US customs officials on-site to clear cargo. Cargo volumes could be stimulated at Canadian airports due to improved service levels and the anticipated capture of some air cargo leakage that is diverted to truck. Minimal employment loss may occur at US airports due to lower cargo volumes requiring customs clearance. Lost jobs would be relocated from US to Canadian airports. US Customs officials at Canadian airports would still be US citizens.

6.0 Co-Terminalization: Winners & Losers

Not all Canadian airports would experience the benefits of CO-T rights. There will be winners and losers. For example, FedEx could choose to serve Regina and Saskatoon directly from Memphis, bypassing Winnipeg. In such a case, YQR and YXE would benefit from increased frequencies of heavier aircraft, while Winnipeg would

lose out. Similarly, while co-terminal points may receive better service, cut-off times may negatively impact "first-stop" airports, particularly if the US-bound aircraft are not returning to that city. For instance, Winnipeg would be at a disadvantage if FedEx required all boardings of transborder cargo on the Winnipeg-Edmonton segment to depart earlier than current cut-off times dictate for cargo returning to Memphis from Winnipeg. Currently, US bound cargo carriers must wait for connecting cargo from other Western Canadian points.

Before committing to a position on new CO-T regulations, Canadian regulators should consider all of the ramifications. Some airports will likely experience negative impacts. Therefore, airport officials have adopted a conservative "show-me" approach. One cargo manager for an Eastern Canadian airport, as it relates to that airport, wishes to have the overall benefits of CO-T demonstrated before supporting or opposing any changes. Each party claims benefits and/or costs to support their own opinion, but there is no way of knowing which opinion – and therefore which position on the issue – is correct.

For Winnipeg International, it would have to weigh the costs and benefits of new CO-T regulations. By maintaining the current situation, cargo operations at YWG will continue to develop slowly but steadily. However, YWG could be well positioned to benefit from CO-T rights by receiving increased landing fees if US carriers expand their use of YWG as a gateway.

YWG would benefit more if cabotage rights were also included with CO-T rights. YWG is ideally situated to be a western hub for Canadian air cargo.[11] Flights could meet in Winnipeg from Hamilton, Vancouver, Calgary, Edmonton, Memphis, and numerous other US and Canadian cities. There would be no limitations on the type of cargo carried (i.e., domestic or international) or the nationality of the aircraft equipment or of the pilots used to fly the aircraft. The system

[11] In all likelihood, Hamilton would remain the hub for Eastern Canada, but would complement Winnipeg well. There are already several flights nightly between YHM and YWG.

would be extremely efficient, mirroring the systems set up by FedEx and UPS in the US already.

7.0 Conclusions

The 1995 Canada-US Open Skies Agreement allowed for more liberalized movement of passengers throughout North America. Open Skies has been beneficial to passengers and airlines. However, cargo activity was deliberately omitted from the agreement and is still subject to regulations restricting the efficiency with which international air cargo can be moved. There is no argument that CO-T and pre-clearance would increase overall efficiency, but there is concern over whether net benefits exist for stakeholders. Regulators face the decision either to support a more liberalized air cargo system, or support industry constraints at the expense of efficiency.

Notes

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The authors take full responsibility for any errors or omissions.

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AIR CARGO LEAKAGE: ASSESSING OPPORTUNITIES FOR THE LOCAL AIR CARGO MARKET

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ABSTRACT: *Air cargo planning and development are becoming increasingly important to the strategic direction of airports. To adequately plan for air cargo facilities and infrastructure means that airports must understand their local air cargo market. Strategic marketing plans that assess air cargo leakage can arm airport authorities with the information necessary to improve their competitiveness. Airports that ignore leakage will have more difficulty in effectively planning for air cargo growth.*

1.0 INTRODUCTION

Worldwide air cargo growth exceeds the growth in passenger traffic. For airports, the development of cargo facilities and infrastructure is a component of air cargo growth. Planning for the right types of cargo facilities, buildings, apron space and service means that airports must understand their local air cargo market. They must understand not only the volumes of air cargo flows, but the underlying characteristics of those flows.

Air cargo volumes – even those collected directly by airports – do not address the issue of diverted air cargo, or air cargo leakage. In 1999, a Leakage Study was undertaken by the Winnipeg Airports Authority (WAA) to assess air cargo traffic flows that bypass Winnipeg International Airport (YWG).

[1] The authors were a part of Winnipeg Airports Authority's Air Cargo Development Team and co-authored its 1999 Air Cargo Marketing Plan.

This paper identifies air cargo being moved via other airports to and from Winnipeg. Specifically, it outlines the methodology of the study and presents diverted air cargo by: volumes, commodities, regions of origin-destination and airports used. Reasons that drive freight forwarder air cargo routing decisions are also discussed. The paper examines WAA's route development strategies aimed at enhancing Winnipeg's local air cargo market and service opportunities that link airports along the Mid-Continent International Trade Corridor (MCITC).

2.0 The World Air Cargo Industry

Air cargo is expected to grow at a faster rate than the world economy. Boeing forecasts an average annual growth rate of 6.4 percent for air cargo over the next twenty years, while predicting an annual growth rate of 2.9 percent for global GDP through 2017.[2] Similarly, MergeGlobal predicts a 6.2 percent average annual growth rate for air cargo and a 3 percent growth rate for world GDP over the next five years.[3] The most significant factors that drive the continued growth of air cargo are:

- economic growth
- global economic integration
- re-engineering of supply chains
- time-based competition
- declining real air freight rates

Air cargo demand is growing because expanding logistics systems emphasize higher processing speeds, greater efficiency, enhanced customer service, and activity-based costing. Individual firms are focused on reducing order-cycle times including all of their integrated logistics strategies — just-in-time (JIT), make-to-order, quick response, etc. — as a source of competitive advantage. On the supply side, increased competition has forced carriers to become more efficient. Holding fuel prices constant, efficiency gains could translate into declining freight rates that induce shippers to use more air freight. The air cargo industry is offering more complete services

[2] See Boeing Forecasts, www.boeing.com.
[3] See Mergelobal Forecasts, www.mergeglobal.com

and the lines between freight forwarders and integrators continue to blur. Freight forwarders and consolidators are following the example of the integrators by providing comprehensive door-to-door logistics services. Through mergers and acquisitions, freight-forwarding companies are expected to continue to decrease in number but increase in size and market share. The integrators, meanwhile, are expected to continue to be the fastest growing sector of the industry. In addition, integrators are showing an increased interest in acquiring freight forwarders to expand their own business.[4]

3.0. Air Cargo Research

3.1 Air Cargo Data Gaps At YWG

Data gaps prohibit an accurate measure of cargo volumes moving through YWG. Statistics Canada data is incomplete since it reports information only for major scheduled and charter carriers at Canadian airports. No cargo data are collected from the integrators, regional/local carriers and smaller airlines at YWG. Publication of Statistics Canada data is also untimely. Passenger and cargo data generally are unavailable until several months after the end of each year. Cargo information that is incomplete and dated is of little use for airport planning.

As part of a new air cargo research initiative, WAA has begun the process of collecting timely cargo volumes from all carriers moving freight via Winnipeg International Airport.

3.2 Air Cargo Volumes

The WAA Air Cargo Development Team was established in January 1999 in conjunction with the Transport Institute (TI) at the University of Manitoba. TI commenced data collection of cargo volumes from firms moving air cargo through YWG. Carriers report monthly cargo volumes directly to WAA. Data can be updated within two weeks at the end of each reporting month.

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[4] For example, at the time of this writing, FDX, the parent company of Federal Express, was in negotiations to purchase GeoLogistics.

Initial data collection reveals that published statistics of inbound and outbound cargo under-estimate the true volumes at Winnipeg. Statistics Canada figures appear to represent less than 15 percent of the total cargo moving through YWG, including in-transit and connecting cargo. The 1999 estimated total air cargo throughput for YWG is between 90,000-100,000 metric tonnes, while Statistics Canada will likely report volumes in the neighborhood of 15,000 metric tonnes.

4.0 Air Cargo Leakage Study

A "leakage" study was undertaken to assess air cargo traffic flows that bypass the airport. The leakage study identifies air cargo being moved via other airports to and from Winnipeg. For example, a significant amount of air cargo that originates in Winnipeg is carried by truck to other airports before subsequent airlift. Similarly, air cargo destined for Winnipeg lands at other airports, before being trucked to Winnipeg.

4.1 Leakage In Other Airport Jurisdictions:

- **Case Of Minneapolis-St.Paul (MSP)**

Minneapolis-St.Paul is often referred to as America's "North Coast Gateway", a gateway that exists in the shadow of Chicago. While the production of airborne exports in the region has experienced growth, what remains unclear, is the how much leakage from Minneapolis-St.Paul's catchment area occurs due to insufficient international cargo service at MSP. Although there is widespread agreement among local airport officials, shippers and forwarders that a high percentage of local products are trucked to Chicago or other substantial cargo gateways for export, leakage flows from MSP have not been documented in a manner that is likely to help the airport draw additional cargo service into the area. Local leaders must convince prospective carriers that the Twin Cities can generate sufficient demand for inbound international air cargo traffic to fill flights returning from much needed outbound trips.

Transport companies need either to make enough money on one-way traffic so that they can afford to operate return trips without additional revenue, or to have enough traffic in both directions to support the outbound and inbound service. This backhaul issue is one reason why the supply of air cargo service does not seem to keep up with the demand for service at Minneapolis.[5] A growing share of air cargo traffic in the Minneapolis region is trucked out of state and airlines are reluctant to launch new all-cargo service. However, *Air Cargo World* noted that there is not much competition at MSP on a cargo basis, not because of Northwest's control of the market, but because forwarders control the market and the vast majority are trucking it out.[6]

- **CASE OF EDMONTON (YEG)**

The Edmonton Regional Airports Authority conducted a study similar to the WAA Leakage Study. Although the full findings of the study were never made public, ERAA has disclosed that approximately 40 percent of its air cargo is diverted by truck to other airports.

For Edmonton, the vast majority of this cargo utilizes Calgary International Airport, just three hours away by truck. Calgary's airport has more wide-body service than Edmonton, and also has more transborder and international routes. To the shippers and forwarders, trucking cargo between Calgary and Edmonton allowed for more efficient air routing.

Some of these same routing issues apply to Winnipeg in Section 5.0.

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[5] An equally important factor in cargo service's constrained growth at MSP is Northwest Airline's dominance within the local market. The dominant hub operations of Northwest make it a difficult market for new entrants on both the passenger and cargo sides. The lack of competition has given Northwest little reason to improve its service at its captive home market.

[6] See B. Sobie "Squeezing the Heartland", *Air Cargo World*, August, 1999.

4.2 Why Conduct A Leakage Study?

In 1998, WAA learned that a significant volume of air cargo – approximately 2 truckloads per week – was being trucked from Winnipeg to Ottawa and then flown to Iqaluit, Nunavut (then Northwest Territories) by First Air. WAA encouraged First Air to expand its northern passenger and re-supply routes out of YWG. In doing so, First Air has captured a portion of the local cargo leakage by flying a 727-combi aircraft between Winnipeg and Iqaluit. WAA's instincts were that there was likely a significant volume of air cargo still being diverted that could be captured.

The leakage study was undertaken to assess both existing and potential air cargo service levels at YWG. Understanding the diversion of air cargo from YWG's catchment area assists future cargo marketing and planning requirements. It also assists the airport in supplementing passenger route development, as carriers are becoming more aware of the incremental revenue flow opportunities represented by air cargo. As part of WAA's passenger route development activity with scheduled carriers, the leakage information could be used to assess the viability of attracting wide-body service capacity to Winnipeg. Leakage information also identified better opportunities to meet the needs of Winnipeg's freight forwarding community. Freight forwarders are key players in the air cargo industry because they consolidate freight and arrange for it to move in the bellies of passenger aircraft.

Leakage information for 1998 was obtained through a survey of freight forwarders who focused on factors that influence their routing decisions. These factors include:

- Availability of Air Service
- Compatibility of Aircraft Capacity
- Economies of Consolidation
- Time, Cost and Efficiency
- Service Market Information

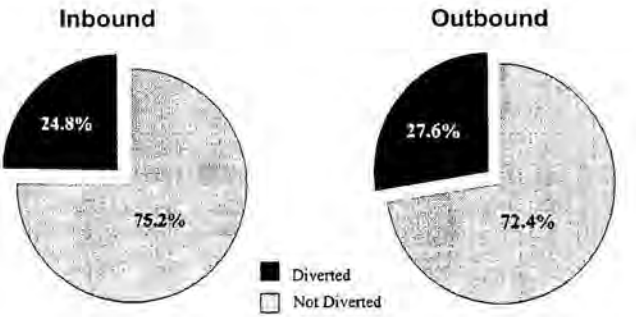
Information was requested on total cargo volumes, the percentage of cargo diverted via other airports, air-eligible commodity types and by regional origins/destinations.

The study appealed to the freight forwarders because it represented an opportunity to improve the cargo service level at YWG, and make Winnipeg more of an air cargo gateway. Increased and improved cargo services translates into higher volumes and better margins for freight forwarders.

5.0 Study Results

The results of the Leakage Study could convey to forwarders the competitive advantages of utilizing YWG for air cargo services, while at the same time addressing key issues driving forwarder routing decisions. Figure 1, Tables 1-2 and Leakage Maps 1-4 illustrate the results of the study by tonnage, commodity, airport and region. **Figure 1** shows that a significant amount of inbound and outbound air cargo is diverted via other airports. For 1998, participating freight forwarders diverted approximately one-quarter of the total inbound/outbound volume.

Figure 1 Total Air Cargo to/from YWG, 1998



Winnipeg's total air cargo market includes the actual air cargo that moves through YWG *plus* all diverted air cargo that is trucked between Winnipeg and other airports. If 25 percent of the total air cargo market is diverted, then the actual volumes moving through YWG account for the remaining 75 percent. The estimated total cargo flow through YWG in 1999 is in the range of 90-100,000 metric tonnes. An estimate of the total diverted cargo would equal one-third of the actual recorded volumes, or 30-33,000 metric tonnes. The true size of the local air cargo market – or the actual volumes *plus* the diverted volumes – is between 120-133,000 metric tonnes. This includes diverted air cargo of freight forwarders, integrated carriers and passenger carriers, assuming each diverts approximately one-quarter of their cargo. In terms of belly space, this estimate may support new service of 3-4 flights per day using a 767 wide-body aircraft.

While the percentages of diverted inbound and outbound volumes were roughly equal, the types of commodities diverted differed. **Table 1** presents total diverted inbound and outbound commodities. Inbound, the two largest proportions of diverted inbound commodities were textiles (37.1 percent), and furniture and collectibles (12.4 percent). Other notable diverted inbound commodities were industrial/machinery products, construction machinery and electronic components.

Outbound, the most significant of diverted commodities from Winnipeg consisted of aircraft engines and parts (27.2 percent) and printed matter (20.9 percent).[7] Electronic components, general cargo (eg., building supplies), agricultural product and industrial machinery also have sizeable volumes of diverted outbound commodities.

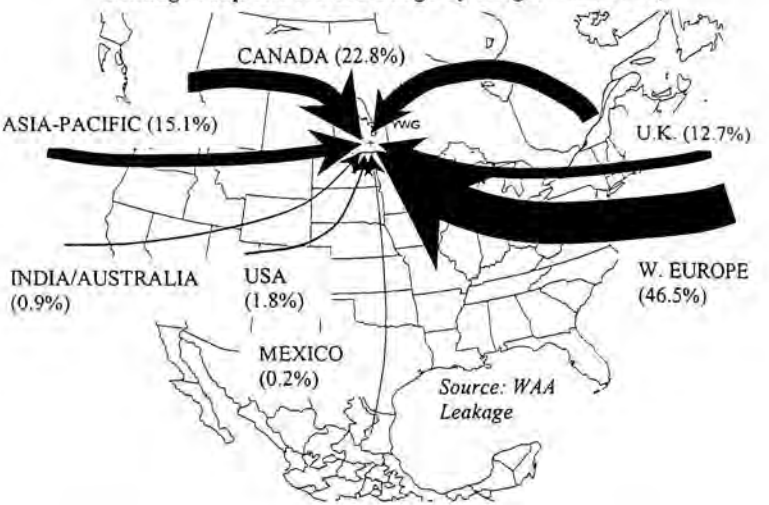
[7] Winnipeg has a very healthy aircraft manufacturing and aerospace sector (i.e., Boeing, Bristol Aerospace and Standard Aero). The majority of this sector's manufactured goods are transported via truck.

Table 1 Diverted Commodities			
Inbound		Outbound	
Commodity Type	% diverted	Commodity Type	% diverted
textiles	**37.1**	aircraft engines & parts	**27.2**
collectibles/furniture	12.4	printed matter/artwork	**20.9**
industrial machinery	11.5	electronics	11.2
construction machinery	11.4	general cargo	10.9
electronics	6.2	agri-product	6.5
aircraft engines & parts	5.4	industrial machinery	6.1
motor vehicle parts	4.5	construction machinery	3.9
communications equip.	3.7	other	3.1
live animals	3.4	computers/office equip.	2.9
computers/office equip.	3.0	motor vehicle parts	2.7
other	1.4	textiles	2.4
		food & beverages	2.2
Source: WAA Air Cargo marketing Plan, 1999.			

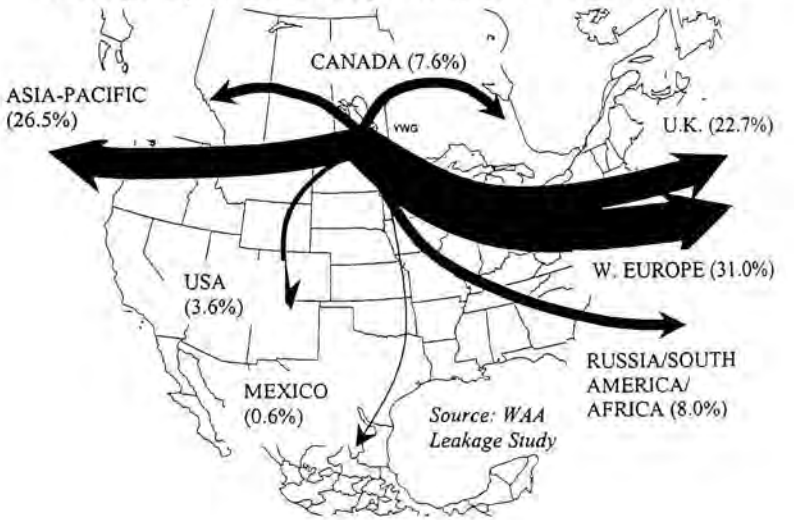
Leakage Maps 1 and 2 present a regional perspective of air cargo leakage. The majority of the leakage originates in Western Europe. Inbound, the United Kingdom (UK) accounted for 12.7 percent of diverted cargo, while other Western European countries accounted for 46.5 percent. Nearly one-quarter of the diverted inbound cargo originated within Canada. The Asia-Pacific region accounted for 15.1 percent. Outbound, the most significant cargo lanes are Western Europe, Asia-Pacific and the U.K. Outbound diverted cargo destined to Western European countries – excluding the UK – accounted for 31 percent of the total. Asia-Pacific and the UK accounted for 26.5 percent and 22.7 percent respectively.

Leakage Maps 3 and 4 depict leakage by airport. The majority of cargo leakage was diverted via Toronto (YYZ) or Calgary (YYC) International Airports. Combined, these airports accounted for approximately three-quarters of both the inbound and the outbound totals. Vancouver International Airport (YVR) accounted for 14.4 percent inbound and 9.3 percent outbound. Air cargo leakage via Minneapolis-St. Paul (MSP) accounted for 13.3 percent of the total outbound share from YWG, while the inbound leakage was negligible.

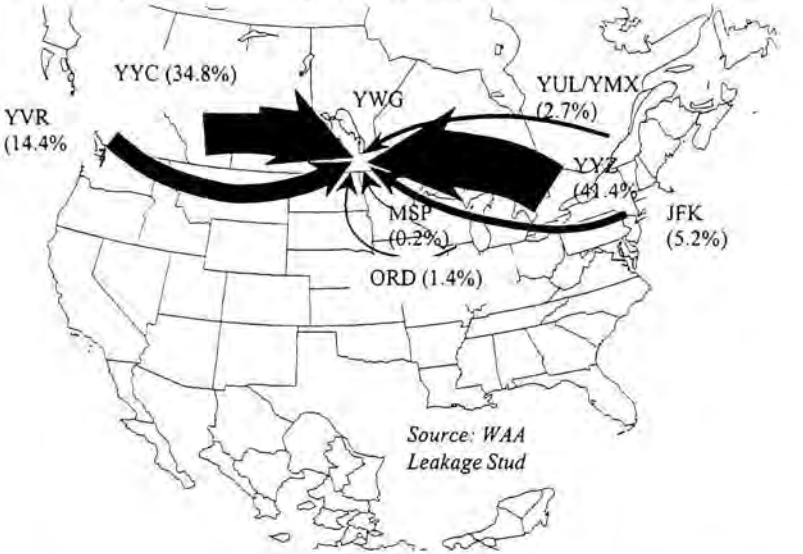
Leakage Map 1: Diverted Cargo by Origin – Inbound,



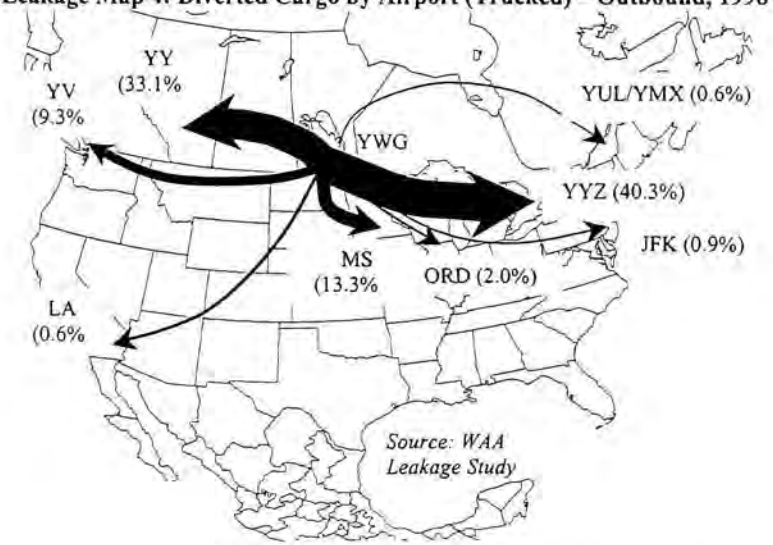
Leakage Map 2: Diverted Cargo to Destination – Outbound, 1998



Leakage Map 3: Diverted Cargo by Airport (Trucked) – Inbound, 1998



Leakage Map 4: Diverted Cargo by Airport (Trucked) – Outbound, 1998



5.1 Air Cargo Routing Decisions

As part of the survey, forwarders were requested to identify reasons that drive air cargo routing decisions. Figures 3 and 4 illustrate forwarder issues by level of importance. The evaluation factors allow for presentation of mean scores and rankings based on those mean scores. The level of importance ranged from "1" (not important) to "5" (most important). On both inbound and outbound sides, the lack of air cargo service (i.e., Origin-YWG; YWG-Destination) and the inability to accommodate large shipments were the two most important problems facing forwarders.[8] Winnipeg's freight forwarding community indicated that the lack of wide-body aircraft serving YWG has resulted in a significant amount of oversize cargo – too large to load on narrow-body aircraft – to be shipped via other locations.[9] Insufficient frequency levels of scheduled passenger (belly capacity) and the lack of all-cargo service were also important reasons for diverting air-eligible commodities, both inbound and outbound. Considering that there is no all-cargo service – a part from integrated express carriers – it was not surprising forwarders would indicate the lack of all-cargo service as a reason for routing traffic via other airports. Forwarders indicated that issues related to inadequate storage facilities, loading/unloading equipment, poor arrival/departure times, cargo loss/damage and transport costs through Winnipeg were of relatively lower importance, but still areas to be addressed.

6.0 Passenger Route Development

Now that we gathered all of this leakage information, we had to ask ourselves: "What are we going to do with the information?", and "What opportunities can be explored?" The results of the study indicated the freight forwarding community's specific set of needs: *"improved wide-body service to key markets"*.

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[8] The lack of air cargo service reflects limited international connections possible from YWG.

[9] The largest aircraft serving YWG are B757s, operated by charter airlines. The largest aircraft used by main line scheduled passenger airlines are A319s, A320s, B737s, B727s and DC9s. All of these are narrow-body aircraft.

Figure 2 Freight Forwarder Issues - Inbound

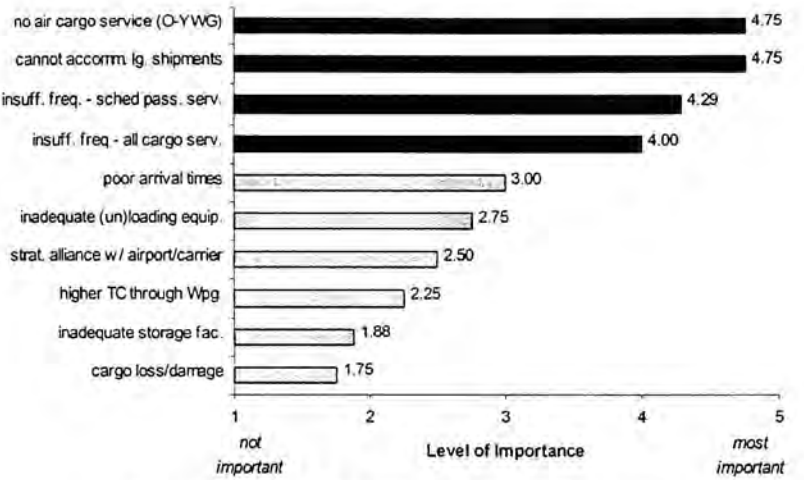
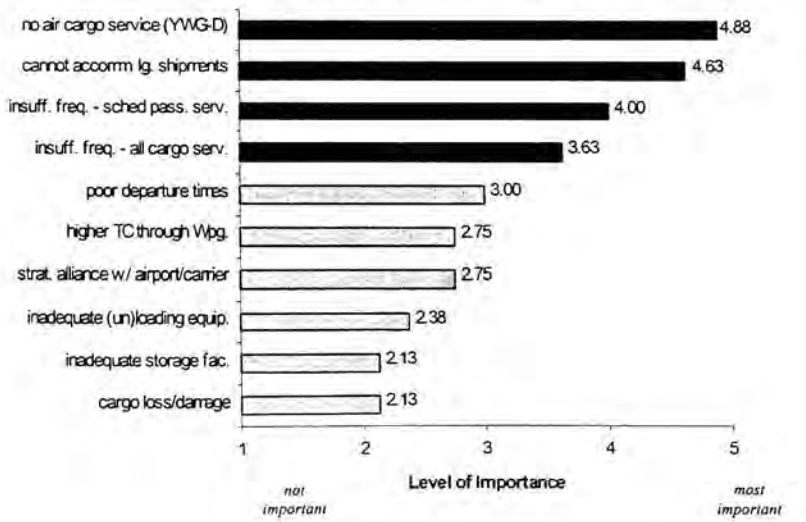


Figure 3 Freight Forwarder Issues - Outbound



Freight forwarders expressed the opinion that air freight volumes could increase if direct service were available. Knowledge of diverted volumes combined with the identification of Western Europe and the UK as key markets should encourage WAA to market passenger service between Winnipeg and London or Frankfurt using larger gauge aircraft – such as a Boeing 767. Filling aircraft serving such routes with belly cargo, which is presently being diverted, would improve the viability of Winnipeg-Europe service.

Winnipeg's air cargo market can not support regular all-cargo flights, with the notable exception of the integrators. To improve air cargo service offered through Winnipeg, WAA should regularly address cargo in its passenger marketing efforts to attract wide-body service. Large shippers and freight forwarders would be better served by four or five wide-body passenger flights per week than a single weekly all-cargo flight.

6.1 Wide-Body Service To Key Markets

- **Winnipeg–Toronto (YWG/YYZ)**
- **Winnipeg–Calgary (YWG/YYC)**

A Canadian passenger carrier would be a natural fit for improved passenger service at YWG. Increasing the gauge of aircraft on YWG-YYZ or YWG-YYC or YWG-YVR flights would provide forwarders with the belly capacity required to send palletized air cargo. However, Air Canada, Canadian Airlines and Canada 3000 have to date been unwilling or unable to make such a commitment. Therefore WAA's attention must also include other international airlines, two of which have expressed an interest in increasing belly capacity at YWG through improved passenger service.

- **Winnipeg–Minneapolis (YWG/MSP)**

One-stop wide-body service could be provided from Winnipeg to Europe by Northwest Airlines through its Minneapolis-St. Paul (MSP) hub. By converting one of its current flights between YWG and MSP (five flights per week) from a DC-9 to a DC-10, and routing the same plane service to a European destination (i.e., Amsterdam,

London-Gatwick, Oslo), Northwest could resolve the three most important issues identified by Winnipeg's freight forwarders in the Leakage Study. Furthermore, passengers flying Northwest would also benefit from increased aircraft size serving this busy route. Northwest also offers direct flights serving Asia (i.e, Tokyo, Osaka, and Singapore) from MSP that could accommodate some of the diverted cargo between YWG and the Pacific Rim.[10]

However, *cargo pre-clearance*[11] would be a necessity as cargo would be originating in Canada, stopping in the United States and destined for Europe or Asia. If cargo pre-clearance could be negotiated in upcoming bilateral discussions between Canada and the United States, the possibility of Northwest capturing YWG's air cargo leakage would increase. Without cargo pre-clearance, the economic advantages of shipping international cargo through MSP would be diminished.

- **WINNIPEG – REYKJAVIK (KEF)**

Alternatively, Icelandair could provide service between YWG and Keflavik International Airport (KEF) in Reykjavik, Iceland utilizing Boeing 757s. Currently, the airline flies directly between KEF and Halifax (YHZ), but could add YWG to its route network during upcoming bilateral discussions between Canada and Iceland. Most major European markets are served non-stop from KEF so Winnipeg shippers and forwarders would have one-stop service to almost anywhere in Europe. However, the majority of Icelandair's flights are on 757s, which are narrow-body aircraft. The current problems associated with shipping palletized cargo would not be resolved.

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[10] In fact, Northwest added several weekly frequencies –and an additional B747-freighter – after the latest US-China bilateral agreement, though not exclusively from MSP (Putzger 1999).

[11] The inability to pre-clear cargo adds further transaction costs (time, service), which impairs the cargo system and reduces the competitiveness of cargo shippers, forwarders and airlines. Allowing for cargo pre-clearance would reduce the dwell time cargo shipments would be held in bond. See Shurvell, S.J. Crockatt, M.A., "Open Skies For Passengers, But What About Cargo? Re-Evaluating Canada-U.S. Air Cargo Regulations", CTRF, 2000.

Also, flying to KEF still necessitates changing aircraft before continuing on to other European destinations. Shippers and forwarders prefer to have same plane service rather than having to change aircraft.

- **OTHER CHARTER/START-UP CARRIERS**

WAA should be prepared to accommodate new cargo charter operations or the expansion of existing operations that may utilize wide-body aircraft in Winnipeg. This could include airlines such as Winnport, Evergreen, HeavyLift-VolgaDnepr, or other possible start-up carriers. WAA should be ready to take advantage of any new cargo opportunities that arise.

7.0 TRI-LATERAL AIR CARGO WORKING GROUP

Another opportunity for increased level of air cargo service is through the work of a recently formed Tri-Lateral Air Cargo Working Group. In the summer of 1999, the Working Group was established to examine the feasibility of air cargo service opportunities along the MCITC. The Working Group consists of two key airports along the corridor – Winnipeg Airports Authority (WAA) and the Kansas City Aviation Department (KCAD) – and a number of organizations in Winnipeg, the mid-continent US, and Mexico. The first meeting of the Working Group took place in July 1999 in Kansas City, MO. At that time, preliminary data was presented and a further work plan was discussed. WAA's 1999 Air Cargo Marketing Plan encouraged the continued development of cargo partnership opportunities with Kansas City International Airport and the exploration of new alliance opportunities as they present themselves along the MCITC.

In recent years, there has been a shift in transportation and trade patterns in North America. The rate of growth of north-south trade is greater than that of traditional east-west trade. There is a need to facilitate these changing trade patterns. Conventional wisdom dictates that cargo moving through the U.S. travels east or west. But, the Working Group hopes to send traffic in other directions. While truck and rail traffic head up and down the Interstate 29 corridor and

eventually into Mexico, the members of the Working Group believe a similar north-south air service could be well received.

While truck and rail modal service opportunities have greatly increased along the MCITC, the level of air cargo service has not. Shippers in Kansas City must send air freight to either Chicago, or Dallas for transshipment to Mexico. Similarly, no direct air cargo service exists between Winnipeg and Kansas City, even in the belly of passenger aircraft. Important first steps in attracting air cargo service involves assessing the local cargo market, including the value and weight of commodities already moving along the corridor and identifying transferable commodities that could be moved by air from alternative modes (i.e. by truck) along the same route.

The Air Cargo Working Group is proceeding with quantifying trade-flow potentials via dedicated resources in both Kansas City and Winnipeg. The primary objective of the Working Group's efforts is to present a compelling business case to an air cargo carrier to begin the provision of air cargo service along the corridor. The separate leakage studies conducted for Winnipeg and Kansas City help to pinpoint the demand for a charter service linking the two cities and destinations in Mexico. The service would be combined to complement north-south services offered by the Kansas City Southern Railway through its intermodal hub in Kansas City.

The Working Group is also endeavouring to identify air cargo leakage between the Winnipeg International Airport catchment area, the eight-state catchment area for Kansas City International Airport (these include Arkansas, Colorado, Iowa, Kansas, Minnesota, Missouri, Nebraska and Oklahoma) and three key Mexican regions: Monterrey, Guadalajara and Mexico City.

7.1 Methodological Issues

More information could have been derived from the Leakage Study if freight forwarder information was supplemented with direct information from passenger airlines and integrators. A longer, more detailed survey was also considered. The longer version would have enabled further disaggregation of the leakage data to analyze the

connections between commodities, airports used, and origin or destination region. For instance, results from a longer survey could have indicated the proportion of cargo trucked to Toronto that goes to each destination region.

7.2 "Walk-Before-You-Run" Strategy

WAA's "walk-before-you-run" air cargo development plan establishes an on-going framework for the collection of cargo data and provides for an understanding of cargo leakage. The information gathered is necessary if WAA is to make informed investment and development decisions that could encourage continued air cargo growth at YWG.

8.0 Conclusion

The continued growth of air cargo worldwide means that air cargo can no longer be dismissed as a side issue at airports. In Canada, cargo information is hard to address because of significant data gaps. Although airport authorities have recently begun to fill those gaps, they still do not address air cargo leakage. At Winnipeg, ¼ of total air cargo volume was diverted. If cargo service levels improved, leakage could be reduced.

Leakage Studies not only arm airports with information pertaining to diverted air cargo flow characteristics, but also identify underlying issues and impediments that force forwarders to consider alternative cargo routings. Resolving issues and impediments raised by forwarders could enable airports to improve their competitiveness with other airports and recover leakage. Every tonne of diverted cargo are lost revenue opportunities for an airport. Other airports subsequently gain this revenue loss. For this reason, every airport should consider a leakage study to improve its competitive position. While the leakage study for Winnipeg (YWG) found that improved air cargo service should be blended in its passenger route development and marketing, this need not be the case for every airport. If airports can successfully address issues that restrict their air cargo growth, the benefits extend not only to airports, but also to freight forwarders, carriers and shippers.

Airports do not have to fight the leakage battle single-handed. Strategic partnerships and alliances (i.e., Air Cargo Working Group) enable airports to address specific leakage components and stimulate trade between each market's catchment area.

NOTES

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The authors take full responsibility for any errors or omissions.

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The Transportation of Dangerous Goods in Canada: Risky Business

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Introduction

Dangerous goods come in a variety of forms. They may be radioactive, explosive, combustible, corrosive, poisonous, infectious, or magnetic (which would affect the operation of navigational equipment on airplanes and marine vessels). Though not a good *per se*, hazardous waste (i.e., certain products or substances intended for disposal or recycle) also falls under the regulatory guidelines that deal with dangerous goods. [1]

On January 14, 2000 a shipment of weapons-grade plutonium, obtained from dismantled U.S. nuclear warheads, was transported from Los Alamos, New Mexico, through the Sault Ste. Marie border crossing, to the Atomic Energy Research Lab in Chalk River, Ontario. The purpose of this experiment was to see if this "waste" could be effectively burned

as fuel in CANDU reactors.[2] Atomic Energy Canada, Ltd. (AECL), the Crown corporation that builds and sells CANDU reactors, originally planned to make the shipment exclusively by truck but the threat of protests and disruptions by various Canadian interests made the federal government decide to switch the cargo to a helicopter on the Canadian side on the border for the rest of the trip. The air flight served two purposes: (1) it avoided any confrontation; and (2) it allowed the AECL to answer the concerns of some critics that felt if the transport was so safe, why not do it by air.[3] Community concern is always an issue when it comes to such transportation.

In Brandon, Manitoba Provincial Trunk Highway 10 and Highway 1A, both of which run through the city, are closed to the through-traffic transportation of dangerous goods. Dangerous goods shipments destined for Brandon may only enter if a permit is first obtained. This pilot project which began in January, 2000 involves a 25.5 km detour around the city. The Manitoba Minister of Highways claims that the detour will actually save time presumably because of the avoidance of traffic congestion, traffic lights and lower municipal speed limits. Such a result may be a win-win situation in that the city is spared the risk of exposure in case of an accident and the cargo may be delivered in less time. Of course, the actual probability of an accident in the detour area and the question of response time are factors that are not a part of that calculation; and they may indeed be critical. Furthermore, there is the question of a longer in-transit time at a greater average speed.

This paper will examine the interface between transportation and risk. After a brief discussion of some of the latest data covering transportation of dangerous goods, an overview of Canada's regulatory structure is provided. Finally, the paper discusses theoretical and practical problems involved in the measurement of risk.

Some Data

The average annual number of dangerous goods shipments taking place

in Canada in recent years has been about 27 million. Between 1988 and 1998 the number of annual reportable accidents has ranged from a low 242 in 1993 to a high of 561 in 1989 (**Transportation in Canada 1998; p. 49-50**) thus representing a negligibly small percentage of total shipments.[4] The 11-year average is 408. It should also be noted that reportable accidents may occur either in-transit or not in-transit. For the 1988 to 1998 time period 46% was the average proportion of annual reportable accidents that occurred in-transit. About 80-90% of these in-transit accidents occurred on the roads while most of the balance occurred on rail. The annual number of air and marine reportable accidents during the time period were each below 10.

The average annual number of deaths resulting from the dangerous goods themselves at the reportable accidents between 1988 and 1998 has been 3 (**table 4-16**).[5] Given the amount of such transport taking place, this is a very low number. The average annual number of injuries was 43.5 with the occurrences, as averages in descending order, being classified as: 21 moderate (emergency hospital treatment), 14.2 minor (on-sight, first-aid) and 6.4 major (over-night hospitalization). However, the average annual number of deaths (injuries) resulting from vehicle mishaps alone, and not the dangerous goods themselves, over the same period was 11.6 (48) (**calculated from tables 4-16 and 4-17**). In this case, the ranking of injuries were: 20.5 moderate, 18.8 major, and 8.9 minor. It may be concluded that the transport act itself is a more likely cause of death or injury than exposure to the dangerous goods contained therein.

Transportation Safety and Dangerous Goods

Transportation of any cargo in Canada is governed by particular modal safety regulations in place by the various levels of government. Marine and air transportation safety are governed exclusively by the federal government. Marine transport safety is governed by the Canada Shipping Act and is monitored in part by Transport Canada. The Department of Fisheries and Oceans oversees the marine environment

as well as the handling of any marine rescues and emergencies. The *Aeronautics Act* as administered by Transport Canada lays out, among other things, the guidelines for air worthiness, flight rules, and personnel training. Rail safety is governed through the *Railway Safety Act* and compliance is monitored by Transport Canada. Provinces are responsible for the safety of intra-provincial short-line rail and they, along with local government, are responsible for the roadways approaching any rail crossings. Roadway safety itself is governed at the federal level through the *Motor Vehicle Safety Act* which establishes national standards for manufacturers regarding vehicle safety and emissions while extra-provincial road transport is governed by the *Motor Vehicle Transport Act* (MVTA) which is implemented by the provinces/territories as agents of the federal government. The MVTA deals with the operational aspects of commercial transportation along the roads. Intra-provincial/territorial road transport as well as road provision/maintenance is handled by the respective government.

The Transport of Dangerous Goods (TDG) Directorate is the federal body, under the auspices of Transport Canada, that governs the special case of dangerous goods transport. The TDG Program (**q.v., supra-note 4**) is jointly administered by Transport Canada and all provincial/territorial governments and is concerned with mitigating risk through the activities of: prevention, avoidance and response (control, clean-up and monitoring).[6] Road transport of such goods is under the jurisdiction of the particular provincial/territorial government. While there appear to be 10 different provincial and 3 different territorial requirements, all of these were harmonized through the all-government National Task Force on the Transportation of Dangerous Goods. The Task Force meets three times per year to insure that a common set of regulations are being issued and enforced.

The consignor, carrier, and consignee all work within a chain of responsibility when dangerous goods transportation occurs. While the consignor alone classifies the shipment, all three are responsible for: documenting their activities regarding the shipment; insuring only fully certified personnel work with the shipment; inspecting the packaging

and reporting any violations; preparing a pre-shipment Emergency Response Plan as well as reporting any emergencies or dangerous occurrences.[7] Each party is liable for any accident or infraction that occurs while the shipment is his care.[8] As an incentive to insure proper personnel training, each of the three employers is liable for any accidents caused by one of his employees not found to have taken reasonable precautions. And the carrier and consignee are each required to refuse the shipment if an infraction is detected.

Before the shipment can take place the consignor must inform the TDG Directorate and Environment Canada (if the shipment is a waste dangerous good) at least 60 days in advance of any transborder shipment and 30 days in advance of any extra-provincial shipment (if the shipment is the industrial waste known as polychlorinated biphenyl (PCB)). PCB transportation is also unique in that the carrier must identify the specific route to be travelled.[9]

Risk and Transportation of Dangerous Goods

What is meant by risk? Risk is the term applied to a decision that is made in an environment where a range of possible outcomes may occur as a result of that decision; and each outcome is weighted by its objective probability.[10] The monetary risk of dangerous goods transport is quantified to be the product of the magnitude of an accident (in dollars) and the probability of its occurrence. Accidents can have adverse effects on people, property and the environment which suggests a whole series of probabilities may need to be established in order to fully appreciate the total effect an accident may have. This broader calculation is at the heart of risk assessment analysis. It should be noted at the outset that this measure of risk is the statistical mean or expected cost of the transport. Variance is not often known and yet, to some, out of two shipments bearing the same expected cost (risk) the one with the lower variance in outcomes may be considered the more risky of the two.[11]

Regarding dangerous goods transportation, what constitutes an acceptable level of risk? **Burton (1982)** suggests five criteria: (1) the degree to which those bearing the risk are informed about the risk and the benefits; (2) the distribution of risks and benefits (inclusive of compensation); (3) the existence of alternatives with either, *ceteris paribus*, lesser risk or greater benefits; (4) all risk-bearers play a role in the decision-making process; and (5) value judgments are avoided wherever possible. While point (2), itself, involves a value judgment, it should be noted that some of these criteria are best satisfied politically as opposed to the marketplace. Of course, most often the process is handled by a regulator in the role of decision-maker but who is subject to political pressure. This makes point (5) institutionally difficult to achieve.

What would be an acceptable measure of transportation risk (R)? A common measure used in simplified risk-indicator-analyis (SRIA) is the specification of risk as a function of the product of accident frequency (F), the transport distance (D), and the exposed population (N); that is, R=R(F x D x N).[12] Complete probabilistic-risk-indicator-analysis (CPRIA), on the other hand, extends SRIA by including the expected magnitude of the accident and its related probabilities. Spatial, temporal and geographical factors are more explicitly included. In this case:

$$R=R(F_{1a} \times D_a \times P_{2ab} \times P_{3abc} \times P_{4ad} \times P_{5ae} \times A_{abc} \times X_{ace} \times N_{ad}) \qquad (1)$$

where,

F_{1a} = accident frequency per unit of transport corridor along potential accident area (a) ;[13]
D_a = length of accident area (a);
P_{2ab} = probability that an accident in (a) results in accident-force (b) (i.e., mechanical or thermal);
P_{3abc} = probability that a release-type (c) of dangerous goods occurs given that accident-force (b) has occurred in (a); [14]
P_{4ad} = probability that a population distribution (d) occurs in (a);
P_{5ae} = probability that weather condition (e) occurs in (a);

A_{abc} = release amount occurring as a result of release-type (c) given accident-force (b) in (a);
X_{ace} = physical area impacted by release-type (c) and weather condition (e) in (a);
N_{ad} = number of people in population distribution (d) in (a).

If the decision-maker's problem is to choose between transport routes x and y that make use of the same mode and container for transport, then the minimization of (FxDxN) as part of the simple risk function within SRIA would be acceptable (**Rhyne 1990**). However, it is worth noting the assumptions that were implicitly made. There would be only one release-type, one population distribution, and one weather condition along the two potential accident areas (i.e., P_4 and P_5 both equal 1). And since the mode and containers are the same for the two routes it may also be assumed that P_2, P_3, A, and X are equal for x and y; that is, there is no difference in (b) and (c) between x and y. In the real world, topographical differences in surface area and wind pattern differences in air space work against this assumption. Furthermore, the equality of A and X between x and y also assumes equal effectiveness in emergency preparation and response.

Thus, if the decision-maker decides *ex ante* to use SRIA because of time or data constraints, he is assuming the risk equation to be a reduced-form of CPRIA. Such a decision appears reasonable for the Brandon case study noted above since the choice was between the same trucks on two different roads; however, the Chalk River case study involves three different transport modes. In terms of CPRIA the quick decision to fly the radioactive material rather than truck it straight-through may have been the most expedient for the decision-maker but, if society is risk-averse, it may not have been socially optimal.

Of course, risk is only a part of the routing decision. Origin to destination routes are comprised of nodes and links within a transportation network. The optimal route according to **Zografos and Warkov (1990)** would be the one that minimizes a criteria-set

composed of, for example: (1) monetary cost (transportation, emergency preparedness and response); (2) risk (total and/or per capita); and like **Burton (1982)** (3) the distribution of risk. The decision-maker's problem is to find the Pareto-optimal route in the sense that no other route can enhance one criterion without degrading another. Point (3) is subjective and the different possibilities suggested by different routes be can ordinally ranked only on the basis of the decision-maker's personal valuation.[15]

Conclusions

The transportation of dangerous goods in Canada occurs under an umbrella of specific regulations affecting the entire chain of the shipping process. While administered within each province and territory, the regulations are harmonized across Canada and have recently been rewritten in order to make them easy to understand and comply with. Accidents and fatalities resulting from the specific shipments or the transport act itself have been remarkably low given the total amount of such shipments taking place.

The politics of risk and the calculation of risk are at the heart of the decision-making process when dealing with the transportation of dangerous goods. Politically, it is ideal when all potentially affected parties are able to calculate their risk and feel that their share of the risk among the population at large is equitable. However, such ideals to not exist in the real world. The decision-maker is often a regulator acting on behalf of the population at large and his decision may not be socially optimal. Time or data constraints may limit the ability of the decision-maker to calculate the risk function for the shipment in question. Any approximations are the subject of a value judgment that is often inescapable. At best, the regulatory regime and the practices of shippers and carriers ought to be such that risk is managed as part of an accepted combination of accident prevention and response. The TDG Program is Canada's current template for this.

Endnotes

1 Under the *Transportation of Dangerous Goods Act* "hazardous wastes" are classified by the oxymoron, "waste dangerous goods". Specifically, waste dangerous goods are "those wastes which, due to their nature and quantity, are potentially hazardous to human health or the environment and which require special handling and disposal techniques to eliminate or reduce the hazard" (**Transport of Hazardous Wastes 1989; p. A-2**). The following products or substances are not classified as waste dangerous goods and therefore need not comply with their specific transportation regulations: those that are household in origin; those that are non-infectious and low concentration from hospitals or laboratories; and those that are to be returned to the supplier. Interestingly, neither are explosives, radioactive material or Department of National Defense shipments occurring as part of national security. As waste, explosives are regulated by Energy, Mines and Resources and radioactive material is regulated by the Atomic Energy Control Board. The Act itself covers about 3,500 different products.

2 CANDU stands for Canada Deuterium-Uranium which indicates the particular chemical process used for nuclear fission. The design is unique to Canada. The plutonium shipment in this case was a radioactive pellet inside a fuel cylinder which was about the size of a large suitcase.

3 The helicopter flight was a secret operation known only to the federal government, AECL officials, and the police and fire departments in Sault Ste. Marie, Ontario. No civic government officials were informed. A second shipment of weapons-grade plutonium will arrive in the spring of 2000 from Russia using an ocean vessel travelling via the St. Lawrence Seaway.

4 All references in this section refer to the cited report. The Transport of Dangerous Goods (TDG) Program defines what is a "reportable" accident. Out of the 436 reportable accidents occurring in 1998 only 1 was attributable to the dangerous goods themselves as

opposed to the handling and transportation; however, no fatalities, injuries or environmental damage occurred as a result of that accident. Note that the TDG Program does not regulate dangerous goods transportation by bulk on ocean vessels or by pipeline.

5 Most of these were isolated incidents, and no deaths at all occurred in 1990, '92, '94, and '95. The average was raised due to 18 deaths occurring in 1993 as a result of a bus-truck collision in Lac Bouchette, Quebec. If that year were removed from the series the average for the remaining years would be only 1.5 deaths.

6 In terms of prevention, TDG regulations were rewritten in plainer language in 1998 in order for shippers and carriers to better understand and comply. Avoidance means measures to prevent a transport accident from leading to the release of the dangerous goods. And in terms of response, the TDG Directorate operates the Canadian Transport Emergency Centre (CANUTEC) which provides, on a 24-hour basis, chemical and regulatory information and advice for both emergency and non-emergency situations. The monitoring function, itself, is under the jurisdiction of Environment Canada. A complete breakdown of these activities is found in **Martin, Matthews, and Rucker (1986).**

7 Trained personnel are required to possess a Certificate of Training that conforms to TDG regulations. Re-training occurs every 36 months; 12 months for air-related transportation. Summaries of the Emergency Response Plan and all reports are submitted to the TDG Directorate. The Plan must review and certify the response capabilities of the organization and describe how the Plan is to be implemented. The TDG regulations differentiate between a dangerous occurrence and an emergency. An emergency is the more serious of the two since it involves an immediate threat to human life, property or the environment. A dangerous occurrence involves a non-immediate threat; for example, a dented container or a tipped-over tanker car.

8 If the carrier were held strictly liable for any in-transit accidents as a result of litigation, the carrier would in effect take on the role of

insurer *vis a vis* the litigant. The issue of carrier negligence is complicated if it were determined that the cause was due to a mistake made by the consignor that the carrier claims was easy to miss. For an overview of key U.S. cases, see **Singer (1994).**

9 In general, all waste dangerous goods transportation requires the consignor to prepare a waste manifest to accompany the shipment. The consignor, carrier and consignee all document their activities on the manifest. In the case of multiple carriers, the consignor is required to prepare an individual manifest for each. Copies are sent to the TDG Directorate and all three parties must retain their's for two years.

10 Note that "risk" and "uncertainty" are two different terms. The latter applies to a range of outcomes for which the magnitude of each is known but the objective probabilities for each are not, or cannot, be known. In terms of dangerous goods, transportation of a toxic solvent by tanker-truck would be an activity subject to risk if quality-assurance data can allow one to calculate the probability of, for example, the tank shell or solvent-release valves failing. On the other hand, establishing a probability of the tanker-truck sliding off of an icy road is not objectively possible because the relationship between weather and driver error cannot be known objectively. In that regard, transportation is an activity subject to uncertainty.

11 As an example, suppose one dangerous good transport will cause 1,000 deaths once every 100 years while another will cause 10 deaths every year. Over a 100 year planning horizon, both transports would have identical expected deaths per 100 year-period while the year-to-year variance of the former is much greater than the latter (which has none at all). Thus, such people would "gamble" in the hope that the 1,000 deaths occur in a year beyond their life span. However, the first case is a low-frequency/high-consequence shipment that is likely not to be accurately reflected in historical traffic data. And yet an accident involving that good would be more "newsworthy" and likely subject to stricter regulation as a result. As an example of special interest group influence, note that the U.S. Environmental Protection

Agency (EPA) measures hazardous waste clean-up targets on the basis of a reduction in individual risk as opposed to population risk **(Hamilton and Viscusi 1999; p. 134-35)**. In this way, small numbers of people can have a disproportionate influence on policy.

12 Risk is a *function* of the product of these measures. These physical amounts, weighted by the accident frequency, which may be called the expected exposure (in person-kms), must be converted into risk-disutility. Only with risk neutrality on the part of the decision-maker would R=FDN. More likely the risk function is either concave (risk-loving) or convex (risk-averting); which, it should be noted, are the opposite shapes as compared to a von Neumann-Morgenstern expected utility curve since, in this case, exposure and risks are two bads.

13 This variable may include the corridor's surface quality, vehicle type to be used, and traffic conditions (which captures the different vehicle usages that take place along many roads for example). For an overview of studies that have been able to generate frequencies using truck-only data as opposed to general traffic data, see **Harwood, Viner, and Russell (1990).**

14 This is a conditional probability that could be re-specified in a more familiar fashion as: $P(c|b)_a = P(c|b)_k \times P(k)_a$ where (k) comprises all variables in equation (1) that indicate the accident type.

15 Thus, the polity would be assumed to allow the decision-maker's subjective valuations to form the social welfare function. If that is not socially acceptable then a political decision must be made (which, itself, is no guarantee of efficiency; **q.v., supra-note 11**).

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Political Influences on National Transportation Policy

By Javier Caceres and Darrell Richards
AgriTrade and Transport

Each generation is tempted to believe it has the solution to Canada's transportation problems and that we are evolving to a more logical, rational and less ideological transportation policy.

The purpose of this paper is to analyze and describe the political influences on transportation policy in Canada, from the early trade with Europe through the transformation from colonial to continental to domestic economy, and from domestic to continental and global economy.

Trade has always been important, starting with colonial trade in fish and fur. As colonial preference and trade declined, the provinces adopted reciprocity and free trade with the U.S. in 1854. But the economic failure of continentalist policies by 1864 led to the nationalist policies of the latter 19th century.

The Federal Government became extensively involved in the domestic economy during much of the 20th century. Results of the interventionist ideology include subsidies for railway construction, nationalization of bankrupt railways, creation of the Canadian Wheat Board and various social programs.

Political objectives shifted in 1985 with the adoption of a continentalist market driven policy, cemented by free trade agreements with the U.S. and Mexico. The new ideology of globalization embraces deregulation, privatization and free trade.

There are counter pressures to the apparent triumph of the new globalization ideology. Some legislators are proposing regulatory scrutiny of mergers and pricing practices in both transportation and petroleum markets. The Government may no longer be able to regulate domestic activities of transborder corporations effectively because they control investment. However, there are signs of a global populist challenge to globalization.

Introduction

Each generation is tempted to believe it has the solution to Canada's transportation problems and that we are progressing in a linear fashion to a more logical, rational and less ideological transportation policy.

The purpose of this paper is to analyze and describe the political influences on transportation policy in Canada, from the early trade with Europe through the transformation from colonial to continental to domestic economy, and from domestic to the global and continental economy.

Colonial Trade

Globalization and trade are popular buzz words today in discussions about transportation and the economy. However, Europeans in what we know as Canada in the 16th and 17th centuries and the early part of the 18th century were probably just as focused on trade as Canada as a nation is today.

Vessels from ports in Europe fished along the coasts of Newfoundland and Nova Scotia and the Gulf of St. Lawrence and the Gulf of Maine. Settlers followed. France started a trade in furs following contact with natives along the St. Lawrence River. England took over the French and Dutch territories in America. The increasing burdens of colonial trade on Britain, as well as the

development of a domestic New England market, led to the American Revolution and creation of a new country independent of Britain.[1]

The downsizing of the fur trade involved consolidations and mergers of the trading companies. Trade in timber took over from trade in fur. Vessels used to export material from BNA were used as cheap reciprocal transportation to import settlers and goods.

Following the War of 1812 with the United States, the provinces pursued a strategy of constructing canals and further developing water transportation. The Act of Union of Upper and Lower Canada provided funds to construct canals on the upper St. Lawrence and to improve the Welland canal. In 1849, there was a political movement to annex the provinces to the U.S. As colonial preference and trade declined, the provinces achieved free trade with the U.S. in the 1854 reciprocity treaty.[2]

From Continental to National Economy[3]

Early railways in British North America (BNA) prior to 1861 were continental projects built at great expense to compete with railways south of Lake Erie in the context of relatively free trade and reciprocity with the U.S. The political desire to create a single country in BNA coincided with the economic failure of the continental railway projects and the cancellation of the free trade agreement by the U.S. in 1864. The solution to the problem involved political union of the provinces and tariffs to construct east-west railways to unite them.[4]

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[1] Harold Innis, Introduction to A History of Transportation in Canada. Toronto: The Ryerson Press, 1938, p.vii-x

[2] ibid, p.x,xi

[3] G.P. de T. Glazebrook. Toronto: Ryerson Press, A History of Transportation in Canada, 1938, Chapter VI

[4] ibid

The new Dominion helped pay for constructing the Canadian Pacific Railway as part of a bargain with British Columbia. It also financed the construction of railways to the Maritimes. "In short, Confederation was first concluded, and then extended, based on the possibilities, hopes and financial demands of railway transportation."[5]

The tariffs helped develop a branch plant economy in Ontario and Quebec involving U.S. technology, for example in the automobile industry. At the same time, the tariffs fostered ill will in the West which had to pay higher prices for inputs. They also frustrated trade between the Maritimes and New England, and the Maritimes suffered with the decline of the wooden shipping industry.

Government Intervention

Government played a major role in the Canadian economy during the first half of the 20th century. Having already subsidized the construction of the Canadian Pacific Railway, it then subsidized the expansion of the Grand Trunk to Prince Rupert via the Grand Trunk Pacific. The Government built the National Transcontinental across Northern Ontario for use by Grand Trunk. The Government helped the Canadian Northern Railway extend its line to Vancouver.

The Federal Governnment also began to regulate the rates and service of the railways with the Railway Act of 1903. This trend actually started south of the border in the 1870's when groups of farmers lodged complaints against the railways and grain elevator companies, resulting in the Granger laws. A populist backlash against concentration of wealth and power led to the "trust busters" and the 1890 U.S. Sherman Antitrust Act. Early in the 20th Century, the U.S. Supreme Court ordered Union Pacific to relinquish its stake in Southern Pacific (which it now owns and has unified with UP).

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[5] H.J. Darling, "Transport Policy in Canada: The Struggle of Ideologies versus Realities," Issues in Canadian Transport Policy. Toronto: Macmillan, 1972, edited by K.W. Stucknicki-Gizbert

Canada followed the U.S. trend by passing the Railway Act of 1903 and setting up a Board of Railway Commissioners to regulate the railways. Railways were considered a public utility and different from other types of business.

In 1917, the U.S. Government nationalized its railroads for 26 months during the First World War. In Canada, the over-expansion of transcontinental railways left them vulnerable to economic recession during the First World War. By 1920, the Federal Government had nationalized the Canadian Northern and Grand Trunk and unified them with government railways as the Canadian National Railways.

Government intervention in the industrial economy continued, with support to construction of grain elevators, bailing out the wheat pool accounts in the early 1930's, making the Crow rate on grain statutory in 1925, and implementing a 20 per cent subsidy on Maritime rail freight rates in 1927. During the 1930's, it created the Canadian Broadcasting Corporation and Trans-Canada Airlines as public enterprises. In 1935, it created the Canadian Wheat Board in order to deal with government control of grain purchases in many importing countries.

The Provinces were also intervening in the economy. The 1931 Royal Commission on Transportation reports that the Conservative Government of Ontario was pleased that its new system of granting exclusive (i.e. monopoly) licenses to inter-city bus operators had greatly improved the service and reduced complaints about safety.

Agrarian reformers drove much of the pressure for Federal Government intervention in the period 1910 to 1940. Government investment in grain terminals and support for pooling of the crop was seen as a way to limit the control by private grain companies. Prime Minister King made the Crow rate on grain statutory in 1925 in order to lure the support of the Progressives. Government expenditure and involvement in the 1930's responded to the economic depression which was most severe in the West.

Government involvement in the economy and transportation peaked during World War II. Government restricted road transport to save gasoline and tires. It regulated wages and prices. On August 13, 1941, the Munitions Minister C.D. Howe appointed a "transportation czar" with widespread powers over all forms of transportation. He had complete control of the use and operation of transportation facilities and companies, as well as fares and rates. He had the power to stagger work hours to relieve transportation congestion.[6]

At the end of the War, the government lifted wage and price controls, and this set the stage for the final showdown over regulation of railway rates. In 1946, the railways applied for a 30 per cent rate increase to cover increased costs in relation to rates that had changed little since 1929. The Government created the Turgeon Commission to look into the matter. Its report recommended some rate regulations to deal with the most annoying regional grievances and a subsidy to the railways for maintaining long stretches of isolated track north of Lake Superior [7](the latter was recommended by the leader of the Saskatchewan Liberal Party[8]).

During the Post World War period, the farm community, the three Prairie Provinces and general public opinion on the prairies was united in its anti-railway sentiment and support for government subsidies and regulation. The Prairie Wheat Pools were not just elevator companies. They also engineered and orchestrated a powerful political machine that heavily influenced Federal Government transportation, agriculture and economic policies.

The Turgeon Commission did not solve the disputes about freight rates. The railways continued to face wage and cost increases and filed for rate increases through the 1950's, accumulating to 46 per cent by 1957. A further 15 per cent was to be implemented on

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[6] Globe and Mail, August 14, 1941, p. 1
[7] Darling, p.20-21
[8] Harold Innis, memorandum to Royal Commission on Transportation, 1951

January 15, 1958. Prime Minister Diefenbaker, a prairie populist, chose instead to subsidize the railways and appoint another Commission. Much to Dief's dismay, rather than respond to regional grievances about freight rates the MacPherson Commission dealt with the sacred Crow rate issue. The resulting report, which was implemented in the 1967 National Transportation Act, reduced government regulation of railway rates and put in place temporary subsidies until unprofitable passenger trains and branch lines could be discontinued. However, the Government's 1967 legislation did not implement the MacPherson report recommendation to subsidize the railways for grain movement.[9]

The Government also started to open up competition to Trans Canada Airlines on its transcontinental routes. By 1959, Canadian Pacific Airlines was allowed to operate a daily service between Vancouver and Montreal via Winnipeg and Toronto. The 1965 Wheatcroft report found that introducing competition had not improved efficiency, but had improved public satisfaction and choice. The Government increased CPA's share of the market to 25 per cent by 1970.

Public support for government intervention did not go away in the 1970's, but the prairie community was becoming divided on the issue. Prosperity suggested that private markets were working. The political influence of the Pools and the National Farmers Union declined and was offset by the growing influence of commodity groups that wanted open marketing.

Transport Minister Otto Lang, a triumph of logic over politics, tried to get the Government out of subsidies, but was unsuccessful. He appointed Justice Emmett Hall (a Conservative who in a previous Royal Commission had recommended a national medicare system) to head up a Royal Commission to sort out what to do with the prairie branch lines. The Crow Rate was not part of the terms of reference.

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[9] Darling, p.30-34

Just as MacPherson had turned on Diefenbaker, Hall turned on Lang. The 1977 Commission report recommended not only that the Crow rate be retained, but that it be extended to cover meat, rapeseed (now called canola) oil and other products processed in the West. It also said that any subsidy should be paid to the railways rather than farmers. "The very idea of sending out cheques to 160 thousand farmers is appalling."[10] No one was more appalled at this report than Minister Lang who had been championing the idea of paying a subsidy directly to farmers.

From National to Continental Economy

The Hall report's nationalist philosophy of government intervention was quickly forgotten and swept aside by the deregulation revolution occurring south of the border. In the late 1970's, the United States deregulated its airline industry, following shortly thereafter by trucking. The 1981 Staggers Act deregulated U.S. railways in order to prevent another Penn Central type bankruptcy.

Meanwhile, the nationalist political forces in both the Liberal and Conservative Parties were declining. The Liberal Government of 1980-84 canceled the Crow rate and further opened up the transcontinental air market to competition. The supremacy of continentalist ideology was evident in the 1985 Freedom to Move policy by the Mulroney Conservative Government, which borrowed heavily from the U.S. deregulation trend. The Canada U.S. Free Trade Agreement, and later the North American Free Trade Agreement, cemented the continental market.

The National Transportation Act of 1987 instituted the process of deregulation, but did not complete it. The 1993 NTA Review Commission, prepared by the outgoing Conservative Government,

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[10] Report of the Grain Handling and Transportation Commission (Hall report), 1977, p.337

recommended further deregulation and privatization of Canadian National.

In 1994, the newly elected Liberal Government moved quickly to implement the NTA Review Commission report. It also said it was prepared to accept market outcomes "even when these may vary somewhat from pre-conceptions or traditional policy positions." Any failures would be considered isolated *commercial* failures, not system failures.[11]

Starting in 1995, Liberal Transport Minister Doug Young was able in short months to privatize Canadian National and pass the Canada Transportation Act. The new Act eliminated unnecessary economic regulation, placed greater reliance in the market, and reduced the role of the National Transportation Agency. By the turn of the century, the Federal Government had eliminated or reduced funding support for grain transportation, Atlantic region freight movement, airports, air navigation services, ports, maritime navigation, ferries, icebreaking, dredging, flood control, and passenger rail.

This was an amazing transformation of the Liberal Party, which once was home to C.D. Howe and Mackenzie King. Part of the explanation could be that the balance of marginal political power and momentum had over 60 years shifted from the CCF to Reform.

Trucking

Darling writes that the period of 1897 to 1967 was dominated by the Railway Age Ideology (RAI) in which railways were the focus of national transportation policy in practice and in theory. For example, the 1951 Turgeon Commission report of 351 pages dealt almost entirely with rail. The air section was four pages and motor vehicles comprised just two pages.

[11] Transport Canada, working document, undated but probably June 1994.

In 1967, truck accounted for 40 per cent of inter-city surface freight revenues and rail 60 per cent. By 1997, truck had 60 per cent and rail 40 per cent. Although rail still accounts for the majority of tonne-kilometres, government policy makers are increasingly interested in the truck mode. Today, trucking appears to be the primary focus of government policy work on NAFTA trade corridors.

Federal Government regulation has not kept pace with the transformation of inter-city trucking from a purely local concern to a long-haul component of the continental logistics system. The Federal Government twice (1937 and 1940) introduced legislation to regulate inter-provincial trucking, but withdrew the legislation in face of strong opposition because trucking was only three to five per cent interprovincial. Today, however, 78 per cent of for-hire truck traffic tonne-kilometres are international or interprovincial.[12]

Globalization

The new ideology of globalization (free trade, deregulation and privatization) has replaced the old ideology of government intervention as the best way to develop the economic interests of Canada. Globalization has broken down borders and undermined national policies and nation states. In the 17th century, the Empires of England, France and Spain managed international trade. Today, transnational corporations and international bureaucratic bodies manage trade.

The Role of Government

The role of Government has changed over the past 130 years as Canada applied different models of capitalism. In the first stage, the State led the creation of the nation with a nationalist policy of tariffs,

[12] Transport Canada, Transportation in Canada 1998, p.250

settlement and railway building. Transportation was structured to meet political-economic objectives.

After the Second Word War, Canada began building the welfare state. In this Social Democratic culture, transportation was a way to improve the well being of the Canadian people. Economic integration with the U.S. coincided with government investment in the St. Lawrence Seaway, the trans-Canada highway, ports, airports and air navigation systems.

In the 1980's, Canada entered into market driven continental rationalization. The private sector took a more prominent role as the government downsized and reduced its role. The Government deregulated transportation operations and privatized transportation assets. It also decoupled regional economic development from federal transportation policy.

One writer argues that Canadian transportation policy, past and present, is driven by political objectives. Ed Abbot writes: "In sum, the politicians created the east-west Canadian transportation system and again, one hundred and twenty three years later, politicians have decided to change the transportation system to a north-south market driven transportation network. In both cases motivated by political objectives rather than the transportation needs and the economic interest of Canada."[13]

The Future

Are we progressing in a linear fashion to the ultimate logic of free markets that have finally triumphed so successfully over government intervention in transportation? Or have we replaced one ideology and its language with another? What is in store for the 21st century?

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[13] Ed Abbot, Canadian Railway Labour Association, "Canada's – Rail – Trucking - Grain Future in a Deregulated – Free Trade – Market Driven North American Transportation Market Place., 1991

Desire for government intervention is by no means dead. Anti-railway sentiments in the West have coalesced around the proposal of open access for any operator to the rail infrastructure as a way to stimulate railway competition. This would involve some type of government intervention in ensuring fair dispatch and in setting the rates for using another company's tracks.

The recent announcement that CN and BN intend to unify their railways takes a big sting out of the effectiveness of proposed open access in Canada. Burlington Northern was the most likely entity to use running rights to access Canadian grain and potash in competition with CN and CPR. With unification, BN would not compete with CN.

The BN CN unification proposal has stimulated a legislator proposal to have the Canadian Transportation Agency review and rule on rail acquisitions and mergers. The previous National Transportation Agency had this power, but the Government removed it in 1996 as suggested by the NTA Review Commission. Parliamentarians appear to be going in circles.

After the Government deregulated airlines in 1984, there was an initial burst of transcontinental competition with three major carriers. Soon, Canadian Airlines absorbed Wardair, and now Air Canada has absorbed Canadian. The government has responded with legislation to prevent potential abuses by Air Canada.

Another response to the airline merger is the call to relax restrictions on foreign ownership of airlines. It is not clear where this would lead because the domestic U.S. market is having the same problems with corporate concentration, as evidenced by the hoarding of important slots at major airports.

Requests for government intervention are also evident in the U.S. Some shippers and railroads are calling on the Surface transportation Board to place a moratorium on railway mergers. This type of

intervention is the antithesis of deregulation. Economies of density and scale appear to be in conflict with competition. The related response by some shippers to regulate competitive access to tracks would also require bureaucratic intervention.

There is still a strong desire for government spending in transportation, for example the push for a $17 billion upgrade to the National Highway System. Proposals for government spending on intelligent highway systems and other electronic traffic systems would cost $2.3 billion. User-pay does not seem to be a politically acceptable option because roads are considered too important for regional development and trade. For example, New Brunswick recently cancelled tolls on a new highway. The lost revenue will have to be picked up by taxpayers. This is a contradiction to free markets and getting government out of the economy.

The recent increase in gasoline and diesel prices has resulted in political, consumer and industry request for government scrutiny or regulation of retail fuel prices, which are largely influenced by global forces.

Internet commerce threatens the ultimate break down of national borders and loss of tax collection to pay for common local services. As consumers switch to buying on-line, the local economic activity and tax collection from retailing will decline. Presumably, the Federal Government will collect some GST at the border, but it is reducing its share of transfers and cost-shared programs.

There may also be a populist backlash against international trade and the borderless economy. Recent examples of this trend include the demonstrations at and collapse of the Seattle World Trade Organization talks. The Montreal protocol on bio-diversity appears to assert the right of nations to know the biological nature of imports.

Conclusion

Trade has always been important to the settlers living in what is now known as Canada, beginning with colonial trade in fish, fur and timber. As colonial preference and trade declined, the provinces adopted reciprocity and free trade with the U.S. The desire for political unification of the provinces, and the economic failure of continentalist policies by 1864, led to the nationalist policies of the latter 19th century, exemplified by tariffs and railway construction.

The Federal Government became extensively involved in developing the domestic Canadian economy during much of the 20th century. Results of the interventionist ideology include subsidies for railway construction, nationalization of bankrupt railways, creation of the Canadian Wheat Board and various social programs.

Political objectives shifted in 1985 with the adoption of a continentalist market driven government policy, cemented overall by free trade agreements with the U.S. and Mexico by 1994. The new ideology of globalization embraces deregulation, privatization and free trade.

There are some counter pressures to the apparent triumph of the new globalization ideology. Some legislators are proposing increased regulatory scrutiny of mergers, acquisitions as well as pricing policies in both transportation and petroleum markets. However, the Government may no longer have the ability to regulate domestic activities of transborder companies effectively because they control investment. There are signs of a potential populist backlash against globalization.

INTERNATIONAL REGULATORY REFORM OF RAILWAYS AND OTHER NETWORK INDUSTRIES

Lessons for Canadian Freight Railways

There is considerable controversy in the US and Canada concerning the degree of competition among freight railways. Shippers complain that intra-modal competition is inadequate – especially shippers in "bottleneck" situations in the US, and western grain interests in Canada – while railways counter that significantly declining rail freight rates, loss of overall surface freight market share, and inadequate financial returns to railways demonstrate the opposite. Politicians and regulators caught in the middle of this debate tend either to pick sides or try to steer a tenuous middle course.

In the search for insights, interested parties have examined regulatory reform of railways in other countries, and also examined regulatory reform of other network industries such as electricity, gas and telecommunications. Those who support the view that intra-modal rail competition in North America is inadequate cite mandated access and vertical separation adopted in some of these industries and sectors as a model for rail reform in the US and Canada.

This paper[1] will provide a brief survey of international regulatory reform of railways, as reviewed in a number of published sources, and the lessons to be learned. Competition in other network industries will also be examined briefly to determine points of comparison and contrast with rail and to assess whether these industries offer a valid model for rail reform.

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[1] The information contained in this paper was previously presented by the author at a C.D. Howe Policy Meeting on Canada's Rail Industry, December 2 1999.

I RATIONALE FOR ECONOMIC REGULATION OF CANADIAN RAIL

As a preliminary, it is worthwhile to summarize the rationale for continuing economic regulation of Canadian integrated freight railways. Historic public utility regulation of the rail industry was inefficient, is now obsolete, and has been correctly replaced by regulatory principles more in line with modern economic analysis. Such analysis recognizes that the rail industry is characterized by economies of scale, density and scope. These have important economic implications:

- Economies of scale imply that marginal cost pricing will not permit a railway to recover total costs;
- Economies of scope imply that cost savings may be achieved by the simultaneous provision of a variety of different rail services by a single carrier. The shared, common or joint costs that are a concomitant to economies of scope cannot be unambiguously identified with individual services, and any rule or regulation associating shared costs with individual services will be arbitrary and yield economically inefficient prices.

In the presence of pricing freedom, railways resort to an approximation to efficient demand-based differential prices or Ramsey prices. Ramsey prices apportion shared costs among services on the basis of their demand characteristics – each service is priced at a mark-up over marginal cost that is inversely related to the elasticity of demand for that service.

In the rail industry, significant capital sums must be sunk in way and structures and in a variety of ancillary facilities in order to create new rail lines, and these high costs of entry are suggestive of protective barriers to entry, which in turn suggest an ability to exercise market power. Market power is the ability to maintain prices above competitive levels for a substantial period of time and/or the ability

to exercise predatory or unfair practices against existing or potential competitors.

In the combined presence of pricing freedom, demand-based differential pricing, and the potential for the exercise of market power, regulatory oversight of rail carrier conduct is warranted in the public interest:

- To protect captive shippers from excessive pricing; and
- To ensure that an integrated carrier does not prevent competitive access through the foreclosure of more efficient carriers.

These concerns coalesce in Canada to the limited situations at origin and/or destination where a shipper has no effective competitive alternative to a single rail carrier. Regulatory remedies already exist in the Canada Transportation Act 1996 to address these concerns, namely running rights, interswitching, competitive line rates and final offer arbitration[2].

Before embarking on the review of international regulatory reform of railways, it is worthwhile emphasizing that government intervention in the Canadian rail industry is not currently warranted for any of the following reasons:

- Privatization of a nationalized industry or firm;
- Reduction or elimination of government subsidies;
- Reversal of failing financial performance of a firm or industry;
- Provision of freight services in the public interest;
- Incentives for increased investment; or
- Deregulation of pricing – with the exception of western grain.

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[2] Note that in the US running rights and interswitching – referred to as reciprocal switching – are voluntary and generally not subject to regulatory intervention, while competitive line rates and final offer arbitration do not exist. However, rates are subject to a rate reasonableness test if they exceed 180% of variable costs, and there is a maximum rate ceiling equivalent to a stand-alone cost test.

Legitimate concerns may still exist however regarding incentives for the ongoing quality of rail service, and the degree of innovation in the rail industry in support of broader government goals such as Canadian competitiveness.

II INTERNATIONAL REGULATORY REFORM OF RAILWAYS

In Exhibit 1 is presented a summary of the rail industries in a range of selected other countries prior to reform during the past 15 years[3]. In all cases the railways were publically owned and government subsidized. Those in South America and Australasia were predominantly freight railways, while those in Japan and Europe were predominantly passenger railways. The railway's share of the total freight market never exceeded 30% in any country and was sometimes much lower – in contrast the railway's share of the total surface freight market in Canada and the US in 1997 was 50% and 40% respectively by volume.

The explicit and implicit goals of reform were varied and complex, depending upon specific circumstances, and included increasing rail efficiency, reducing government subsidies, attracting private investment and increasing rail market share. What is noteworthy here is that little, if any, mention was made of increasing intra-modal rail competition – which is the principal source of contention in North America.

The international reform process had to address a number of structural elements and options including:

- The degree, if any, of retained public ownership;
- The extent and focus of any remaining government subsidies;

[3] Much of the information contained in this section is taken from "Assessing the Track Record of Open Access", Mercer Management Consulting, February 1999 and "Competition and Railroads", OECD Journal of Competition Law and Policy, 1998.

EXHIBIT 1 : RAIL IN OTHER COUNTRIES PRIOR TO REFORM

	Ownership	Subsidies	Dominant Service	Freight Market Share	Years of Reform	Goals of Reform
Argentina	Public	1% of GDP	Freight	less than 10%	1989-1994	Subsidy reduction; attract private-sector investment
Mexico	Public	US$460m	Freight	in decline	1995	Eliminate freight subsidies; attract private investment; increased efficiency
Australia	Public	US$1,400m	Freight	near 30%	1990s	Improve global competitiveness
New Zealand	Public	Yes	Freight	near 30%	1995	Increased efficiency and eliminate subsidies
Japan	Public	Enormous	Passenger	very low	1987	Replace "improve the welfare of the general public" with "respond to market needs and establish effective management"
Sweden	Public	US$300m	Passenger	near 30%	1988	Modal equity; full cost recovery including externalities
United Kingdom	Public	US$1,240m	Passenger	less than 10%	1993-1996	Subsidy reduction; improved service; increased rail market share; attract investment
Germany	Public	Yes	Passenger	23%	1991-1994	Subsidy reduction
Netherlands	Public	Yes	Passenger		early 1990s	Increased rail market share; separate the commercial and social aspects of rail service

- The means to introduce commercial incentives;
- The extent and type of rate regulation;
- The need to separate freight and passenger services into distinct lines of business with different post-reform structures; and
- Whether to vertically separate rail infrastructure from train operations

On the last point, it is worthwhile to distinguish the characteristics of a vertically-integrated railway:

- Rail infrastructure, train operations and marketing conducted by a single entity;
- Ownership may be private or public;
- Access to rail lines by other rail operators generally by commercial negotiation, and only mandated under restricted circumstances;

from the characteristics of vertical separation of rail infrastructure and train operations:

- Goes beyond mere accounting separation – which was the intention of a 1991 EU Directive 91/440;
- Can provide for access by competing train operators over an entire network;
- More usually intra-modal rail competition arises at the time of bidding for franchises, rather than arising from multiple operators over the same rail lines.

In Exhibit 2 is presented a summary of the current status of rail reform in the selected countries – Australia is presented separately in Exhibit 3 since its federal system has supported different structures by State and Commonwealth. The following broad points may be noted from examination of Exhibit 2:

- South America, New Zealand and Japan opted for vertically-integrated railways while Europe opted for vertical separation;

EXHIBIT 2 : CURRENT STATUS OF RAIL REFORM IN OTHER COUNTRIES

	Ownership	Operations			Model	Access	Investment	Subsidy	Pricing
		Freight	Passenger	Infrastructure					to shippers
Argentina	Public infrastructure	Six regional 30 year franchises	Largely discontinued	Leased to freight franchisees	Vertical integration	Regulated for passenger operations only	Private franchisee	Implicit in low lease rates	Maximum freight rates indexed over time
Mexico	Privatized	Three regional 50 year concessions		Part of freight concessions	Vertical integration	Limited trackage and haulage rights	Private concessionaires	Eliminated	Broadly unregulated
Australia	Mixed structure by State and Commonwealth - see Exhibit 3								
New Zealand	Privatized	Single operation by Tranz Rail			Vertical integration	Minimal and discouraged	Private	Eliminated	Unregulated
Japan	Limited privatization	One freight company	Six regional companies	Operated by the passenger companies	Vertical integration	Regulated for freight operations	Public and private	Continues	
Sweden	Public	Separate company SJ providing freight and passenger services; competition from private operators possible but minimal		Separate company BV	Vertical separation	Minimal access fee	Public	Increased for infrastructure	
United Kingdom	Privatized	Single freight operator EWS	Multiple passenger concessions	Separate company Railtrack	Vertical separation	Fully allocated access fees; by negotiation not demand-based	Private infrastructure investment	Continues for passenger services	Negotiated
Germany	Public	Separate divisions; competition from private operators possible but minimal		Separate division	Vertical separation	Fully allocated access fees; by tariff not demand-based	Public infrastructure investment	Continues	
Netherlands	Public	Separate divisions; competition from private operators possible but minimal		Separate administrative unit	Vertical separation	Access fee set at zero	Public infrastructure investment	Continues	

EXHIBIT 3 : CURRENT STATUS OF RAIL REFORM IN AUSTRALIA

	Operations/Ownership			Model	New Private Entrants	Infrastructure	Freight	Pricing
	Freight	Passenger	Infrastructure			Investment	Subsidy	to shippe
Queensland	Single operation by Queensland Rail/public			Vertical integration		Public		Negotiated
Western Australia	Westrail/private		Leased to Westrail for 49 years	Vertical integration		Private	No	Negotiated
Victoria	FreightVictoria/ private		Leased to Freight Victoria for 45 years	Vertical integration	Great Northern shortline	Private but state contributions may be required	No	Negotiated
South Australia	Australian Southern Railway/private		Land leased to Australian Southern for 99 years - track owned	Vertical integration		Private	No	
Tasmania	Tasrail/private		Land leased to Tasrail for 99 years - track owned	Vertical integration		Private but state contributions may be required	No	
New South Wales	FreightCorp/public		RailAccessCorp/public	Vertical separation	Austrac, Northern Rivers and Silverton shortlines	Public	Limited	Negotiated
Commonwealth (inter-state)	NationalRailCorp/ public	Great Southern Railway/private	AustralianRailTrack Corp/public	Vertical separation	Toll, SCT and Patrick	Public	Limited	Negotiated

- While privatization was more frequently associated with the vertically-integrated model, this was not universal as illustrated by the UK;
- Elimination of government subsidy was only accomplished under a fully privatized vertically-integrated model;
- Rail access by competing train operators under the vertically-integrated model is minimal;
- Under the vertically-separated model, access fees range from zero to fully-allocated but are not demand-based.

The current situation in Australia is more complicated. The following preliminaries should be noted:

- There are several isolated, private, profitable coal, iron, sugar cane and mineral railways that handle nearly 50% of Australian rail traffic – these railways are similar to the Quebec North Shore and Labrador iron ore railway. These Australian railways are shipper-owned and subject to export market competition;
- Inter-state transportation policies favour road over rail and are subject to jurisdictional dispute. As a consequence, most of the balance of rail freight traffic is intra-state;
- The right of access to rail infrastructure is mandated by the Commonwealth as part of a broader National Competition Policy package:
  - access may be negotiated privately, but securing access in cases of dispute is a complex process;
  - access pricing varies between tariffs, auctioning or negotiation between upper and lower bounds;
  - there are no common carrier obligations and no interswitching requirements; and
  - the few new private entrants with access handle only 3% of rail traffic.

With these preliminaries in mind, the following broad points may be noted from examination of Exhibit 3:

- Both vertically-integrated and vertically-separated models have been adopted;
- Privatization was more frequently associated with the vertically-integrated model, but again this was not universal as illustrated by Queensland Rail;
- Elimination of government freight subsidies was only accomplished under a fully privatized vertically-integrated model.

It may also be noted that Australian rail reform is still a work-in-progress and significant under-investment remains an outstanding issue.

General lessons drawn in 1998 by the OECD from international rail reform were as follows:

- Rail sector performance in many OECD countries has been poor due to a "soft budget constraint" which in turn is due to a lack of transparency in public service obligations ie implicit subsidies to end users;
- Reform should be focussed on improving the commercial incentives for railways, and eliminating, or at least making transparent, public service obligations and costs;
- When rate regulation is retained, price caps on a basket of services should be preferred to the control of individual prices;
- With a few exceptions, rail faces significant inter-modal competition. As a result regulation should be light-handed and focussed on markets where rail is dominant;
- Intra-modal competition should be encouraged through horizontal or geographical separation where possible;
- In those limited markets where inter- and intra-modal competition is absent, a degree of competition can be introduced by regulation to ensure access by competing train operators to the rail infrastructure. However significant problems relate to:
  - the determination of access fees;

  - losses of economies of scope; and
  - the assurance of non-discriminatory behaviour by landlord railways;
- With the vertical separation of rail infrastructure from train operations, an additional problem relates to the reduced ability of the infrastructure operator to price discriminate.

Many of these general lessons have resonance in Canada from past and present rail policy debates. More specific lessons drawn by industry analysts and the World Bank[4] include:

- International goals have generally been to improve the competitive position of rail **not** to enhance intra-modal competition. For example, the EU Directive 91/440 was not intended to address a "captive shipper" problem;
- Competition is not a necessary condition for improving efficiency and productivity – as illustrated by the outcome in New Zealand;
- Mandated access reduces economies of scope in train operations, coordination and administration and undermines efficient demand-based differential pricing;
- Proceeds from franchise sales were reduced under mandated access. For example, proceeds were 7.7 and 3.2 times revenue for the sale of franchises in Mexico and New Zealand, but only 40% of revenue in the UK;
- Argentina and Mexico debated mandated access and rejected it. Investors indicated no interest in franchises requiring private investment where a new entrant could appropriate the economic benefits, while subsequent vertically-integrated franchises received multiple bids;
- Incentives for private investment in a separated rail infrastructure are problematic – even with full cost recovery access fees as in the UK;

[4] "Best Methods of Railway Restructuring and Privatization", R Kopicki and L Thompson, World Bank, 1995.

- Attempts to encourage multiple train operators in Sweden and the UK have not been successful although the potential for new entrants exists. British rail was sold as 6 individual freight concessions but all but one have since merged into EWS, while two new entrants in Sweden were subsequently replaced by the public train operator SJ;
- New freight train operators in Continental Europe and Australia are essentially freight forwarders that package existing rail services for shippers – they do not own or operate equipment.

As a summary of the international efforts at rail reform, the schematic below which ranks the countries post-reform suggests that North American railways remain the most market oriented.



III COMPETITION IN THE ELECTRICITY AND GAS INDUSTRIES

International regulatory reform in the electricity and gas industries is too vast a subject to cover here comprehensively[5], and so a few key highlights to compare and contrast with rail will be selected for consideration.

Reform in these network industries has generally involved the unbundling or vertical separation among the following functions:

[5] For a comprehensive review see "Evolution not Revolution: International Experiences in the Reform of Regulated Industries", Conference Board of Canada, 1998.

- Gas production and electricity generation;
- Bulk transmission by grid or pipeline;
- Regional distribution; and
- Supply and marketing to end users.

The focal point of competition is the commodity **not** the "transport" network. Regulatory reform has generally created competition in production and generation – what might be termed "wholesale" competition – while the "transport" networks remain as natural monopolies, generally with a regulated rate of return based upon average cost pricing and limited price differentiation.

Given the homogeneity of electrons and gas molecules, the "transport" function is vastly simplified – involving one-way movement only with no enroute traffic control – and this makes direct comparison with rail largely irrelevant. In particular, with such product homogeneity and simplified "transport" function, competitive access to end users can reasonably be provided by secondary suppliers without infrastructure – what may be termed "retail" competition, and the rail equivalent of mandated running rights at origin or destination.

Note however that when a regional distributor is also an end user supplier, as in UK electricity for example, the regional distribution component – the rail equivalent of the line haul movement – is rate regulated. Even this regulatory constraint may be inadequate as UK electricity regulators have expressed concerns about such "retail" competition:

- Leading to discrimination in favour of the own supplier;
- Involving cross-subsidy from distribution to supply;
- The own supplier may have privileged information about competitors and the intentions of the distribution business; and
- Competition may be deterred by the perception of end users of better service from the vertically integrated supplier.

Overall, vertical separation in these industries has a quite different meaning than in the railway context, and mandated access – while more manageable in these industries due to product homogeneity and simplified transport function – involves significant regulatory oversight and is not without its problems.

IV COMPETITION IN TELECOMMUNICATIONS

Reform in telecommunications has involved three distinct wireline markets – domestic long distance, international, and local – and the wireless market. The markets handle voice/data messages as bits of data, which are unique to the customers, unlike electricity and gas, but homogeneous to telecom technology. The wireline markets are two-way "transport" networks[6] and the "transport" function has to cope with switching and interconnections, but there is no equivalent to differences in rail equipment by commodity or to the problem of empty backhaul. As in the previous network industries, the "transport" function is relatively straightforward when compared to rail.

The development of regulatory reform in telecommunications has been affected by whether the starting point was a public monopoly – as in the UK, Australia or New Zealand – or a collection of public/private regional interconnected providers usually with a dominant firm – as in Canada, the US and Finland.

For the first group of countries, reform has created competition in domestic long distance, international and wireless markets, but competition in local service – the rail equivalent of mandated running rights at origin or destination – is as yet minimal. Interconnection continues to be an issue and dominant firms remain.

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[6] In fact, a wireline telephone receiver has one twisted pair line for outgoing calls and one for incoming calls,which suggests that the "transport" function might better be described as two separate one way flows.

For the second group of countries, best characterized by Canada which has been deemed the most advanced jurisdiction, there is competition in all markets. Domestic long distance competition among facility based carriers is intense, sufficient that the regulator has foreborne rate regulation. Since 1997 local competition from facility-based carriers and "resellers" is permitted, and has arisen from facility-based carriers, cable companies and wireless.

However, it must be recognized that rapid technological advances in telecommunications have expanded service alternatives[7] and:

- Capital cost barriers to entry are now low and any traditional elements of natural monopoly have disappeared;
- The need for economic regulation is minimal; and
- Incumbents have survived due to the substantial increase in telecom traffic.

These developments are in contrast to railways where technological change and traffic growth have both been more modest.

V CONCLUSIONS

The breadth of the international rail reforms and the generality of the lessons drawn are not, in fact, readily applicable to the current rail industry in Canada. Railways in Canada (and the US) are largely more advanced in market orientation and in their independence from government involvement – while serving regional and national economies in a significant and efficient manner.

However, international experiments have indicated that mandated access has an adverse impact on the economics of an integrated railway, but does not generally lead to competing multiple operators. Furthermore, vertical separation exposes the importance of access

[7] Note however that pressures from reform have resulted in service degradations in some jurisdictions.

fees, and the potential for the need to substitute private infrastructure investment by public subsidy.

Examination of other network industries indicates that they differ significantly among themselves and from rail:

- Differences exist among products/services transmitted – they may be homogeneous (electricity and gas) or differentiated (telecommunications and rail) which significantly affects the "transport" function;
- Differences exist among the "transport" networks – they retain elements of natural monopoly (electricity and gas) or may be efficiently duplicated (telecommunications and rail).

What distinguishes the telecommunications and rail industries is technological innovation. Technology has both facilitated the reform of telecommunications and been a driver of reform, and the easing of new entrants into telecommunications with fibre optic cables, digital switching and cell phones has no foreseeable parallel in the rail industry over the medium term.

Roads A Decade After the Royal Commission

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Introduction

In 1992 the Royal Commission on National Passenger Transportation[1] recommended that government reduce its role in transportation. Two phrases from its report give the flavour: ". . . the basic philosophy that transportation should be provided through a system supported and maintained by its users and not through government departments and central controls;" and "transportation infrastructure and services . . . provided according to the willingness of travellers to pay for them."(Vol 1, p 9) A year later, the National Transportation Act Review Commission[2] echoed these thoughts. "The withdrawal of government from direct management of the transportation section . . . is a timely and appropriate policy."(Vol 1, p 19).

The two commissions recommended that the supply of transportation services be put on a more commercial basis.

This paper looks at one aspect of this—the way roads are supplied. The interest is to gauge how this has changed since these two commissions made their recommendations. The paper also considers developments in other parts of the world in an effort to understand what options are available.

The Recommendations

The Royal Commission argued that users should pay directly for the use of roads and that prices should be based on marginal social costs (additional road costs caused by one trip plus the cost of exter-

nalities). In practical terms—there are difficulties designing prices that accurately reflect marginal social costs—it recommended that fuel taxes and vehicle registration taxes be used for the pricing mechanism and that a new weight-distance tax be introduced for trucks. It also suggested that Ottawa abandon excise taxes on fuels, unless it could justify them as environmental charges.

Other than the call for a new weight-distance tax, these recommendations are hardly startling. Many people had already assumed that fuel and registration taxes were road charges. When they were first introduced, they were often treated as a specific tax on road users. Eight provinces, between the years 1924 and 1951, had legislation that in one way or another tied gasoline tax revenues to road construction or maintenance. These practices died out after World War II and, indeed, even the practice of using tolls (usually on bridges, but sometimes on highways) almost disappeared during the 1960s.[3] By the 1970s, roads were almost universally regarded as a public good to be paid for out of consolidated tax revenues.

To this extent, then, the Royal Commission recommendations were really suggesting that the pendulum had swung far enough in one direction and that it was time for it to start swinging the other way. Roads should be put on a more commercial basis and road taxes should be prices for the service provided.

The Commission recognized that road-user taxes would have to be increased significantly, but did not recommend the precise level. Nevertheless, the implications from the Royal Commission numbers are clear. Taxes would have to more than double to produce revenues even close to what total road costs are estimated to be.[4] The Royal Commission also recommended that highway departments be restructured as crown corporations. This, it argued, would encourage greater efficiency in the supply of roads and would increase accountability and transparency in pricing and investment decisions. While advocating that provincial/territorial fuel taxes be treated explicitly as a price for the use of the road, the Royal Commission did not want to see fuel taxes raised too high. Since marginal road costs

are low, it would be inefficient to raise fuel taxes much above these costs and thereby choke off road use that otherwise would occur. Prices based solely on (low) marginal road costs would not bring in enough revenues to pay for roads. Therefore, the Royal Commission appeared to favour vehicle registration taxes considerably higher than current (1989) levels and (presumably) reliance on a significant weight-distance tax on trucks to make up the shortfall. The one qualification about the level of fuel taxes is that the Royal Commission also saw these taxes as a means of charging motorists for externalities—the cost of emissions on low-level air quality and, presumably, global warming brought about by the emission of (mainly) carbon dioxide.

The Royal Commission had concerns about the impact of its recommendations on roads where population density was low (much of Canada). In these places, it did not think that road prices (fuel, registration and weight-distance taxes) would ever bring in enough money to pay for roads. Some other source—it suggested the property tax—would also have to be used.

The NTA Review Commission had less to say about roads. Its main interest was in federally regulated carriers, not infrastructure under the control, largely, of provincial, territorial and local governments. Nevertheless, it did argue that users should be more involved in the decisions made about investing in infrastructure. ". . . a continuous presence of users in the capital spending system is desirable." (p 154) And, in terms of taxes, the Commission argued for an expanded use of cost recovery—user fees based on cost causality with revenues ploughed back into infrastructure spending. The Commission shied away from making specific recommendations about highway taxes.

Impact of Commissions' Recommendations

The two commissions made recommendations for all aspects of transportation, not just roads. Seen from this perspective, it is possible to argue that the recommendations—calling for less economic regulation, less government involvement, and more financial accountability—have been heeded. The federal government's

National Airports Policy of 1994 committed it to commercialise most airports. In 1995, Canada and the United States entered into an "Open Skies" agreement; rail grain subsidies ended; subsidies, mainly to trucking, in Atlantic Canada ended; and CN Rail was privatised. In 1996 Ottawa announced its intentions to commercialise the Saint Lawrence Seaway by turning it over to a not-for-profit corporation. In 1997 another not-for-profit corporation, NAV Canada, took over the operation of the air navigation system. The 1998 Canada Marine Act gave port authorities more autonomy.

These changes might have occurred even without the commissions. Prior to their work, the federal government had introduced its "Freedom to Move" policy (1985) that laid the groundwork for the abandonment of economic regulation, the end of subsidies and the reduction of the government's role in transportation. In 1985 Ottawa and provincial governments agreed to the elimination of economic regulation of trucking; in 1987 Ottawa adopted a policy of turning airports over to local authorities; and in 1988 Ottawa began to privatise Air Canada. These events preceded the commissions' recommendations.

But whether the commissions shaped policy or simply confirmed an existing trend is not important. What is, is that in broad sectors of transportation—most carriers, much infrastructure—there has been a move to let market forces determine supply. Two major exceptions to this trend are in the case of urban transportation and roads. Local governments own roads and either own or regulate bus and taxi services in urban areas. Provincial and local governments own most non-urban roads and continue to provide them within the traditional government department framework funded from consolidated tax revenues. It is the supply or roads, urban or otherwise, that is of interest here.

Impact of Commission's Recommendations on Roads

At first glance it does not appear that the Royal Commission had much impact on the supply, operation and financing of roads.

No highway department has been restructured as a crown corporation. The federal government has not eliminated the excise tax on motor fuels (it has increased the tax rate) and, as far as is known, it has not yet justified these taxes as environmental charges. (The Kyoto Protocol could possibly change this.) No province or territory has conducted a cost-allocation study to determine marginal road costs, although some general work has been done in Ontario and Québec and a Transport Canada study looked at what would have to be done to collect the necessary data for such a study. Related to the previous point, no government has seriously tried to charge motorists for externalities—emissions such as NOx, CO, H_2S, etc; CO_2 and other causes of global warming, noise, congestion. (Some provinces, however, regulate emission levels.)

No government has admitted that any particular tax is really a price for using the roads. True, Finance Ministers rely on grand-sounding theories when introducing tax changes. They make a link between road users and such things as fuel taxes. But, in a legislative sense, there is no direct connection between any tax and road use. The term "road-user tax" in Canada is a judgement call, not a legal distinction. A few qualifications are discussed in the next section.

Finally, no weight-distance tax for trucks has been introduced or even seriously proposed.

Impact of Royal Commission Recommendations, A Closer Look
A more detailed consideration suggests that, in fact, there have been changes in the way roads are financed over the past decade.

Governments have taken the Royal Commission's implied recommendations about tax levels seriously. Between fiscal 1991/92—the year when the Royal Commission finished its work—and fiscal 1997/98—latest year available—provincial/territorial licensing/fee revenues from motorists have increased by 30.3%, provincial/territorial fuel tax revenues (net of an allowance for the general level of sales tax) have increased by 31.3%, and the federal government's revenues from the excise tax on fuels has increased by

32.5%.[5] Road expenditures, however, have not increased at all.[6] By way of comparison, the GDP price deflator has increased by 9%. In other words, the real price of driving on a road—assuming that, in fact, these taxes are road prices (a shaky assumption)—has increased significantly while real expenditures on roads have declined considerably.

In 1992, when the Royal Commission report was finished, there were only three toll bridges and one toll road (Coquihalla) in Canada. In addition, there were a half dozen or so toll bridges and tunnels between Canada and the United States—but these were toll facilities primarily because of US considerations on highway finance, not Canadian policy. Since the Royal Commission, the Confederation Bridge to Prince Edward Island has been built and new toll highways have appeared in Ontario (407), Nova Scotia (Cobequid Pass section of 104), and New Brunswick. In this last case, New Brunswick has just announced the termination of tolls but seems to have replaced them with some form of shadow prices. (Details were not fully available when this paper was written).

At least as significant as the fact that toll roads are once again being used to add road capacity is the manner in which these new roads were built. All of them were either financed or built with a greater degree of private-sector involvement than has traditionally been the case in Canada. One of them (407) was actually sold to the private sector after it was built. This same highway even uses a form of congestion pricing (tolls that vary with the time of day) that puts Canada in league with a few other select countries of the world (Norway, France, Singapore, the United States).

Several provinces have privatised aspect of road operations (generally maintenance services). While a full catalogue of this has not been made, Alberta was probably first in the mid-1990s when it privatized road engineering and maintenance services. Other provinces (BC, Ont) followed with either pilot projects or full-scale privatization.

In several urban areas—Vancouver, Victoria and Montreal—provincial governments have established agencies to help fund roads (and transit). These agencies receive money from special dedicated fuel taxes and other sources directly linked to users. Proposals have been made to follow these examples in other areas (Winnipeg). In other cases, provincial governments are giving cities a portion of fuel tax revenues from fuel sold within the city (Edmonton, Calgary).

Two provinces (New Brunswick and Nova Scotia) have played with the idea of establishing road funds that receive revenues from increased fuel taxes. Other provinces (Alberta) have had their highway departments produce annual reports comparing road expenditures with "dedicated" tax (fuel, etc) revenues. In all cases, however, there was probably more public relations value to these ideas than there was a fundamental change in the way roads were financed. But, even if true, at least provinces have entertained the idea of road funds and dedicated taxes.[7]

In one province (Saskatchewan) a mechanism has been developed to charge trucks operating under permit a fee based on a consideration of the value of the service with some commitment that the money raised is put back into the road network.

In another province (Ontario), the idea that property taxes might have to be used more to pay for roads in some areas seems to have borne fruit: Ontario has transferred 5,000 kilometres of highways to local governments and reduced or terminated its program of giving local governments grants for capital works on roads.

Finally, British Columbia has established the BC Transportation Financing Agency, a crown corporation with broad responsibilities to finance infrastructure. The BCTFA uses its known stream of dedicated fuel tax revenues to borrow money (about a billion dollars) and finance new road and related infrastructure.

Perhaps, then, the pendulum has swung and the recommendations of the two commissions (primarily the Royal Commission) have had

some impact. Road operations and finance are on a (slightly) more commercial footing in the year 2000 than they were a decade ago.

Does the Pendulum Need to Swing Any Further?
Is there, then, a problem with road financing that needs fixing in Canada? The answer, of course, depends very much on who is giving it. Certainly provincial highway departments, municipal governments and major user groups (automobile and trucking associations) continue to talk about the "financial crisis." They have a common interest: they want more money spent on roads.

It is estimated, for example, that $17.4 billion is needed to bring the most important roads—the 24,401 km National Highway System—up to some desirable standard.[8] To put this number in perspective, total road spending in Canada in 1997 by all three levels of government was about $12 billion.[9]

Short of Ottawa opening its purse strings and dedicating any of the $4.2 billion a year it collects from the excise tax on fuels to roads, there does not seem to be an immediate solution to this financial "crisis." With its most recent budget, Ottawa is obviously not ready to do this—unlike its counterpart in Washington which committed itself to spending an average of $36.2US billion a year (1998-2003) on highways under its latest legislation (TEA-21). The most recent budget in Ottawa actually seems to indicate that federal spending on roads will fall from the current annual level of $200-to-$300 million to about $150 million.

If it true that there is a shortage of money available for roads—and this assumption may need testing—and if it is unlikely that Ottawa is going to provide this money, is there something about the way roads are financed that could change? In particular, is it appropriate to continue to view roads as a public good paid for by consolidated tax revenues? Or, should the pendulum that has changed direction since the Royal Commission be given a harder shove? In contemplating these questions, it is instructive to look at developments elsewhere.

Developments Elsewhere

Many countries, generally after World War II, took a different approach to road finance than Canada. This was primarily because they faced large road-building requirements that could not be met if they relied on funding from consolidated tax funds.[10]

Some countries (France, Italy, Spain, and Japan) set up enterprises to build large networks of toll roads. Others (Argentina) have more recently followed these examples. But, while toll facilities are now being used in Canada to add small links in the network, it is not clear that a major network of toll freeways would work in Canada. Traffic volumes of 10,000 to 15,000 vehicles a day may be required to make toll highways viable.[11] Only the busiest 12% of major Canadian highways—the 45,000 km connecting large population centres—have traffic volumes this high.[12]

Other countries established road funds and earmarked certain tax revenues (generally fuel) to these funds. The best-known example of this is the US Highway Trust Fund established in 1956, but other countries that did this include Japan, New Zealand, and South Africa (as long ago as 1935). For years Germany dedicated one-third of fuel tax revenues to roads and gave the balance to local governments for local roads. During the 1960s and 1970s, a dozen or so developing countries also established road funds.

The problem, however, was that these early roads funds did not necessarily result in the delivery of a more efficient road system.[13] Simply telling a road department it has a relatively stable, guaranteed stream of income, immune from the vagaries of political spending priorities, does not necessarily mean that money is invested in roads in the most efficient way. Further, simply telling road users that a tax paid on fuel is going into highway maintenance or construction—while possibly a defensible tax principal—is not the same as a system of prices determined in the market that act to allocate scarce capacity and help guide investment decisions.

To expand on this problem with the first generation road funds, consider that, in the United States, the most hotly debated item at the time the legislation re-authorizing the Highway Trust Fund was considered was the formula used to determine how much money each states gets from the fund.[14] This, while no doubt politically important, has little to do with the question of where money could be spent efficiently on highway maintenance or construction. This same type of debate over revenue-sharing formulae has been seen in Canada in the funding schemes advocated for the National Highway System.

The World Bank has developed guidelines for a second generation of road funds. The country that comes closest to being a model for this is New Zealand.[15] A key feature of the financing mechanism is that the road fund (Land Transport Fund) is managed separately from the Road Agency (Transit New Zealand). While Transit New Zealand used to manage the fund, there was a concern that there might be an inherent conflict of interest in this. A road agency that sets the tax level and then decides how much money to spend on roads, or where to spend it, does not necessarily result in efficiency. There is large element of monopoly in the supply of road services. Accordingly, in 1996 the government created a separate board to manage the fund and advise the government on such topics as the appropriate level of funding. While Transit New Zealand sits on this board, other members are brought in to represent road users. Users, then, have a role to play in establishing the level of road-user charges and a role to play in determining how or where money is spent (recall the NTA Review Commission's recommendation on this point).

In the summer of 1999, New Zealand again re-thought the way it provides road services and there are now plans (it is not known how definite) to go one step further by creating a series of not-for-profit, government-owned corporations to operate roads at various levels (national, local). These corporations would be funded from the Land Transport Fund.

Summary Observations

Whether or not the recommendations of the Royal Commission—and, to a smaller degree, the NTA Review Commission—have been heeded, the pendulum on highway finance has begun to swing in the direction of a more commercial approach to roads.

The small, but important, changes to the way roads are paid for or the way roads are operated—tolls, dedicated taxes in several urban areas, privatization of some road operations like maintenance, greater involvement of the private sector in building new roads, the creation of the BCTFA, etc—are probably in the right direction. That is, this is the right direction if the criterion is making the delivery of road services more efficient. Social policy criteria could also be invoked—mobility, regional differences, ability to pay, etc—but are not considered here.

It is probably fair to observe, however, that most or all of these small changes have been taken by provincial governments out of fiscal necessity, not out any reliance on the guidelines of broad principle, let alone the principled recommendations of some Royal Commission. Provincial budgets have been squeezed and if new money is to be found, or even existing levels of funding maintained, governments have had to come up with new ways of doing this.

The last observation, and accusation of political expediency, is unsupported by any reference to the evidence. This may be unfair. True, but it is important. If the manner in which roads are paid for in Canada is to change, better to make the changes on the basis of a sound model and not just political expediency.

The danger now—now that the pendulum is swinging—is that there will be more road funds, or quasi road funds created in Canada. These may be small ones created when governments want to increase fuel taxes (NS and NB); they may be nothing more than a public relations exercise when road departments show "dedicated" tax revenues in annual reports; they may only deal with a small portion of road tax revenues and only some road expenditures as in the case of the

BCTFA; they may be local as in Montreal, Vancouver, Victoria; or they may cover only certain vehicles as in the case of permit trucks in Saskatchewan.

But, and whatever form these road funds take, the danger is that they may be established without sufficient mechanisms to ensure that they do, in fact, result is a more efficient delivery of road services. Pumping money into roads and using only engineering criteria—levels of pavement roughness or volume-to-capacity ratios deemed desirable—to determine where it is spent will not guarantee efficiency. If new road funds are used simply to "solve" the current perception that not enough money is being spent on roads, they likely will fail to deliver a more efficient road network. What is needed is a serious consideration of the road fund model proposed by the World Bank.

Endnotes

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[1] Royal Commission on National Passenger Transportation, 1992, *Directions: The Final Report of the Royal Commission on National Passenger Transportation*

[2] National Transportation Act Review Commission, 1993, *Competition in Transportation: Policy and Legislation in Review.*

[3] The early years are described in N. Bryan, 1972, *More Taxes and More Traffic*. Canadian Tax Papers, No. 55, Canadian Tax Foundation, Toronto.

[4] On Table 3-1(b) the RC shows intercity car drives paying $2.5 billion in user fees. Their share of road costs is shown at $4.5 billion and, if externalities (accidents, emissions) are added, their share is $5.9 billion. This suggests an increase of about 2.4 times 1991 road taxes.

[5] Transport Canada, *Transportation in Canada 1998*, Table 3-3. The increase in federal excise tax revenues includes small amounts from non-road modes (air, rail, marine).

[6] Ibid. Table 3-14 shows provincial gross expenditures (ie, including federal transfers) on roads declining by 2.7% between 1991/92 and 1997/98, and Table 3.17 shows local-government gross expenditures increasing slightly. To take an even longer view, provincial road expenditures per capita (including transfers to local governments) have fallen by almost one-half in real terms between 1981 and 1996.

[7] NS and NB both established highway funds in 1989. Neither fund resulted in any real change. The NB fund was abandoned in 1992/93; the NS fund still exists but there is no direct link between it and fuel taxes. In the early 1990s, the department responsible for highways in Alberta began to show in its annual report a comparison of expenditures with the "dedicated" tax revenues from fuel taxes and other transportation fees. As far as is known, however, roads continued to be financed from the consolidated tax fund.

[8] National Highway Policy Update Project Steering Committee, 1998, *The National Highway System: Condition and Investment Needs Update 1997.*

[9] Transport Canada, op cit.Tables 3-10, 3-14 & 3-17.

[10] R.Hirshhorn, "The Organization of Transportation Infrastructure" in RCNPT research report 13.

[11] I.Heggie, "Commercially Managed Road Funds: Managing Roads Like a Business, Not Like A Bureaucracy," *Transportation* 26: 87-111, 1999.

[12] B.Leore, 1997, "The State of the Canadian Intercity Highway System, 1986-1993," *Proceedings*, CTRF annual meeting, Toronto.

[13] The critique of the early road funds is based on the paper by Ian G. Heggie (World Bank).

[14] M.S. Bloom & N. Bennett, 1998, "U.S. Highway Financing: Historical Perspective and National Priorities," *TR News*, No. 198

[15] The description of New Zealand is based on (1) Heggie (op cit); (2) an earlier paper by Heggie (Heggie, Ian G., Shunsuke Otsuka, Setsuo Hirai, Martin Fletcher & Nancy Bennett, 1999, "Review of Selected Road Funds," Annex 3, World Bank, "Road Financing and Road Funds"); (3) a paper by Alice Galenson (Galenson, Alice, 1990, "New Zealand: Roads Operated Like a Public Utility," World Bank, Transport No. RD-1); (4) information in the 1991/92 Royal Commission report; and (5) and recent information by Andrew Wilson, an exchange student from New Zealand.

INTERMODAL FREIGHT TRANSPORT - A PROVINCIAL ANALYSIS

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Executive Summary

In 1998 the Policy Branch of the New Brunswick Department of Transportation commissioned the UNB Transportation Group to conduct a study of intermodal freight transport within the Province of New Brunswick. The study objective was to evaluate the intermodal movements and provide the first database on intermodal traffic:

- flowing through the Province without an intermediate stop;
- within the Province; and,
- those with either a destination or origin in the Province.

Data were collected from rail, track, air and marine centres. Trans-border (U.S. - Canada) traffic was monitored and a survey was carried out of shippers who were either using intermodal transport or were potential users of the service. Growth trends in intermodal transport were assessed. The concerns and issues of carriers and shippers with existing intermodal services were solicited and evaluated.

This paper provides an overview of the findings from the study.

1.0 INTRODUCTION

Intermodal freight transport involves the use of containers and other shipment boxes to transport, in a continuous movement, goods or freight from origin to final destination and uses two or more modes of transportation. Highway trailers, which are carried on rail cars or ships, also represent another form of intermodal freight transport. Although breakbulk goods may use more than one mode of transport, it is considered as multimodal rather than intermodal transport since the goods are repetitively loaded and unloaded as the goods are moved between each transportation vehicle. The advantage of intermodal transport is that freight can be moved in standardized units and handled with standardized equipment.

This paper is based on a study of intermodal transport undertaken by the Transportation Group of the Department of Civil Engineering of the University of New Brunswick. The study[1] was funded via a research contract by the Policy Branch of the New Brunswick Department of Transportation (NB DOT). At the time of the study, NB DOT did not have an inventory of intermodal transport movements within the Province to be used for planning, policy analysis, etc.

The objectives of the study included the collection and analyses of the current level of intermodal traffic movements by all modes within the Province of New Brunswick. The data collected provides a "snapshot" in time (1998) and formed an initial baseline for comparison of future intermodal traffic flows. The shippers' survey was designed to examine issues that affect shippers and the quality of services provided. The study also examined issues that could affect the use of intermodal

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[1] "Overview of Intermodal Freight Flows: Province of New Brunswick", November 1999, by Wilson, F.R. and Brander, J.R.G.

transport, including those external to the Province of New Brunswick

The study also examined recent and current events within the transportation sector that could impact intermodal transport. Trends in traffic data with the potential to estimate intermodal transport growth within New Brunswick were also evaluated.

2.0 EXISTING DATA SOURCES

Existing databases were reviewed as part of a search for a usable data source. The database published by Statistics Canada was found to be the only available database for intermodal traffic movements on a national basis. However, there are limitations to the Statistics Canada's database. The data are available only at an aggregate national level, and presently are not available at a provincial level and were not to a usable level of detail. For example, air cargo flows are only available by tonnage handled at each airport and do not include statistics on the origins or destinations of the freight, nor the commodities handled. Also, not all air carriers and air services are required to report to Statistics Canada.

The data on marine traffic do not include the origin-destination statistics of the cargo, although information is available for commodity tonnage and percent containerized. The data on TEUs handled at marine ports only lists the three top ports in Canada. The data for road and rail modes also exhibit limitations. Statistics for the rail mode presents only the total tonnage of TOFC (trailers on flat cars) and COFC (containers on flat cars) traffic. For the road mode, data for total container tonnage only are provided.

Due to these shortcomings, it was necessary to conduct studies to obtain data on intermodal movements at a provincial level. Extensive contacts were made with shippers, rail carriers, trucking firms, shipping lines, air carriers, border crossing stations, port officials and terminal operators

to construct a database of intermodal movements within the Province of New Brunswick.

3.0 SCOPE OF STUDY

The scope of the study was primarily directed to intermodal traffic movements within the Province of New Brunswick and issues that affect intermodal transport. Traffic that originated from or was destined to the Province of New Brunswick, or traffic that is transshipped through the Province, with or without an intermediate stop at a terminal located within the Province were included in the study.

The two major marine ports in Atlantic Canada where containers, passing through New Brunswick, are handled are: Saint John, New Brunswick, and Halifax, Nova Scotia. Both ports are serviced by rail and truck transport. The CN Laser terminal in Moncton and the NB Southern Intermodal Terminal in Saint John provide road-rail intermodal services. Fredericton, Moncton and Saint John each have an airport, part of the National Airport System, which handle air cargo. To obtain statistics on intermodal transport movements at these facilities, carriers, terminal operators, and port offices were contacted by way of personal interviews.

Interviews were conducted with Customs officials at the New Brunswick-Maine border crossings to solicit information on import/export container movements between Canada and the United States. Surveys were also conducted with a selected number of New Brunswick shippers with potential to use intermodal transport. The purpose of the shipper survey was to determine factors of choice that could influence shippers to use intermodal transport. The data from the survey and interviews enabled an estimate to be made of the current level of intermodal traffic moving within or through the Province.

4.0 SURVEY DESIGN AND DATA COLLECTION

This section provides an overview of the development of the intermodal traffic database.

4.1 Rail Movements

The four railway companies handling intermodal traffic in the study area were contacted and their cooperation obtained on the understanding that data would be aggregated to protect specific origin and destination identification.

The Canadian National Railway data consisted of traffic shipped through the Province of N.B. for import/export at the Port of Halifax and traffic movements with an origin or destination within the Atlantic Provinces that were handled at the Moncton Intermodal Terminal. A site survey at the terminal was also conducted where traffic flows, both inbound and outbound, were observed and the names of carriers handling the traffic at the terminal were identified.

Traffic forecasts for 1998 and planned estimates for 1999 were obtained for the intermodal service that was initiated in September 1998 (New Brunswick Southern Railway). Issues that could affect the NB Southern intermodal transport were identified.

4.2 Trucking Movements

The twelve major trucking firms handling intermodal traffic for the Laser Services at the Moncton Intermodal Terminal were surveyed, and issues affecting the trucking service to the terminal were identified. Data from the surveys provided an estimate of the trucking portion of intermodal traffic using the Moncton Laser Terminal.

4.3 Border Crossing Movements

The Canadian Customs offices at the border crossing in St. Stephen and Woodstock, N.B. were visited to obtain data on container traffic at these crossings. Existing records do not differentiate between different types of truck traffic, i.e. a container versus a flatbed or van trailer. Only total truck counts are recorded. Both crossings agreed to conduct a one-month survey of import (to Canada) traffic only as Customs do not monitor export traffic.

The Canadian Customs at the St. Stephen conducted the survey from March 22 to April 18, 1999. The daily average was approximately 2.5 containers per day at each of these two crossings. The Woodstock Customs officials conducted the survey from March 30 until April 30, 1999 during which time a total of 126 import containers were observed for a daily average of 3.9 units per day. Sample counts were conducted to confirm the approximate percentage of containers in the tractor trailer traffic flow. Canadian customs personnel, based on experience, was of the opinion that the survey period results were representative of annual flows.

The United States Customs had in 1998 conducted a special study in which they monitored and inspected container flow into the United States. The customs border crossings at Calais and Houlton participated in that study. From the period of February 25 until March 19, US customs officials recorded 183 export (to U.S.) containers at Houlton and 48 at Calais, yielding an approximate average of 8.0 and 2.1 export containers per day entering the United States at these two crossings.

4.4 Port Traffic

The Saint John Port Corporation and its partners initiated in 1998 a new intermodal service. This new service offers a choice for shippers between these facilities and CN's Laser terminal and the Autoport

facility located in Moncton. These new services have the capability to ensure that price competition exists for shippers in selection of intermodal transport services that uses sea transport.

The Port of Halifax contained at the time of survey three terminals: Ceres Corp., Logistec Stevedoring, and Halterm. These terminals provided a count of containers handled, the container mix at the terminal, and the approximate mode split between road and rail traffic feeding the terminals. The Halifax Port Authority were able to provide O-D statistics for this traffic.

However some limitations in the data existed. The O/D statistics were recorded by tonnage rather than by numbers of twenty-foot equivalent units (TEU's). This required a conversion of the data to the number of containers using a ratio of total tonnage to number of containers.

Additional data were available from the Port of Halifax which revealed that in both 1997 and 1998 approximately 10% of the intermodal traffic was classified as transshipments (arrived and left by ship) and the other 90% arrived and left the port by the road and rail transport modes.

4.5 Shipper Surveys

A survey of 52 firms currently using or considered to have the potential for utilizing intermodal transport was undertaken as part of the database construction phase of the study. The survey required development of two questionnaires to compile data on shipper intermodal transport requirements, mode preference, service requirements, growth potential as well as traffic flows for the survey year.

In the survey design phase reference was made to recent surveys of

intermodal transport.[2, 3, 4] There were few references to previous Canadian studies.

5.0 DATA ANALYSIS

This section presents a summary of the analysis of the results from the shippers' survey and the traffic database.

5.1 Shippers Survey

Fifty-two firms were selected for the shipper survey sample. Responses were received from 41 giving a response rate of 80%. A summary of the responses are presented below:

- nineteen of the forty-one, or 45 percent of the shippers indicated that they had in the last year made shipments using intermodal transport.
- in majority of cases, it was the shippers who had the responsibility for the decision making process in arranging for the movement of freight.
- most of the shippers relied on for-hire trucking firms to move their freight.
- sixteen shippers used truck/marine intermodal transport, eleven used truck/rail and only five used truck/air.
- most of the respondents indicated that between 5 and 10% of their freight moved via intermodal transport.
- several shippers indicated that they receive less than desired

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[2] "Twin City Region Intermodal Terminal Needs Survey", Friedrick's & Associates, Inc., 1995.

[3] "Maine Integrated Freight Plan", Cambridge Systematics, 1998 for Maine DOT.

[4] "Intermodal Freight Strategies Study", Metropolitan Area of Kansas City, 1994.

service from rail carriers.

- most respondents estimated a growth for their business between 10 and 20% for the next five years. For intermodal traffic, they expect little or no growth.
- improvements to the highway infrastructure was the most important issue for shippers, followed by improvements in rail services, port facilities and intermodal terminal facilities. Air facilities do not appear to have a high rating relative to intermodal transport.

The following is an aggregated list of responses relative to NB DOT's responsibility in the area of intermodal transport:

- continue to maintain and improve the highway system.
- assist in planning and upgrading of intermodal facilities

5.2 Intermodal Traffic Flow

The traffic data were aggregated to four categories of intermodal traffic movements:

- traffic originating in the Province;
- traffic destined to points in the Province;
- traffic originating outside the Province and being transshipped through intermodal terminals located in the Province; and
- traffic moving through the Province with no intermediate stop.

5.2.1 Air cargo

Intermodal traffic incorporating the air mode as part of the transport chain exhibited the lowest volume of intermodal traffic. The three main airports at Moncton, Fredericton and Saint John together handled in 1998 a total of 1,574 tonnes of inboard freight and 1,245 tonnes of outbound freight. All cargo arriving at or leaving the airport was handled by truck transport. The Moncton airport functions as a hub for air cargo however, the total volumes are low and the growth rate is expected to be low to moderate.

5.2.2 Container traffic at Port of Saint John

The only sea port within the study area (Province of New Brunswick) to handle the container traffic segment of intermodal traffic was the Port of Saint John. Export container traffic handled totalled 14,120 units with inbound container traffic amounting to 1,584 units. The containers were moved by marine mode to international destinations including Europe, Asia, Latin America and Caribbean.

5.2.3 Truck transport component of intermodal traffic

Intermodal traffic involving a movement by truck were of three types:

- Traffic between shippers/receivers located within the Province and intermodal terminals located either within or outside the Province. An example would be a container shipment from a New Brunswick shipper for an overseas shipment via a terminal at the Port of Halifax or Saint John.
- Traffic within an origin or destination outside of the Province and transshipped through intermodal terminals located within the Province. An example is a movement from an origin in Nova Scotia to the intermodal terminal in Moncton for rail movement to another pint within Canada.
- Traffic transshipped through the Province with no intermediate stop. An example is movement from Prince Edward Island to the Port of Halifax.

Other than transshipment of containers arriving at the port on railcars from outside the Province, the major intermodal traffic movements are containers and trailers moved over the highway system to intermodal terminals in the Province and to ports located in Nova Scotia and the New York/New Jersey area. Tables 1 to 5 inclusive present a record of the level of intermodal traffic moved by truck and its origins/destinations.

Table 1. Number of containers moved by trucking firms from intermodal terminals located in New Brunswick - 1998.

Destin-ation	Origin					
	Int'l	US	Ont	Que	W-C	Total
Que	113					113
PEI	237		346	208		791
NB	712	765	3,810	1,362	1,149	7,798
NS	221	236	2,473	817	538	4,285
Nfld	104	177	3,808	1,365	530	5,984
Total	1,387	1,178	9,709	3,752	2,217	18,971

Note: Int'l includes Europe, Asia, Latin America and the Caribbean. W-C is traffic from the four western provinces of Canada.

Table 2. Number of containers moved by trucking firms to intermodal terminals located in New Brunswick - 1998.

Destin-ation	Origin						
	US	Que	PEI	NB	NS	Nfld	Total
Int'l	10	996	2,097	2,773	849	96	6,821
US				705	217	162	1,084
Ont			1,140	3,932	2,374	3,150	10,596
Que			386	1,492	949	1,244	4,071
W-C				1,217	480	404	2,101
Total	10	996	3,623	10,119	4,869	5,056	24,673

Table 3. Number of trailers moved by truck from intermodal terminals located in New Brunswick - 1998.

Destin-ation	Origin				
	US	Ont	Que	W-C	Total
PEI		88	46		134
NB	136	1,009	362	256	1,763
NS	42	656	217	95	1,010
Nfld	31	961	279	95	1,365
Total	209	3,014	904	445	4,272

Table 4. Number of trailers moved by truck to intermodal terminals located in New Brunswick - 1998.

Destin-ation	Origin				
	PEI	NB	NS	Nfld	Total
US		124	38	29	191
Ont	221	1,182	584	801	2,788
Que	86	335	298	315	1,034
W-C		269	85	70	424
Total	307	1,910	1,005	1,215	4,437

Total 5. Number of containers moved by truck over New Brunswick highways to and from the ports of Halifax, New York and Sydney - 1998.

Destination	Origin							
	Int'l	US	Ont	Que	W-C	PEI	NB	Total
Int'l	-	4,500	-	2,562	-	908	7,990*	15,960
Nfld	200	339	6,958	2,609	934	-	3,800	14,840
Total	200	4,839	6,958	5,171	934	908	11,790	30,800

*includes transborder traffic

An additional 2,190 trailers were transported by truck over the N.B. highways system from the Port of Halifax and Sydney, N.S. with 2,340 units moving to the Ports.

5.2.4 Rail transport component of intermodal traffic

The rail component of intermodal transport was found to serve two functions. The first was providing intermodal service to and from the Port of Halifax in the form of transshipment of containers through the Province. The second service was the transport of both containers and trailers to and from the two intermodal terminals located in New Brunswick. In this case the intermodal service was comprised of a rail movement combined with an over the highway movement to and from the terminal . Tables 6 to 8 document the level of traffic and principal origins and destinations.

Table 6. Number of rail intermodal units shipped direct through the Province of New Brunswick to and from the Port of Halifax in 1998.

Destin-ation	Origin				
	US	Ont	Que	W-C	Total
Int'l	35,000	71,000	66,000	5,000	177,000
NS	-	6,282	5,034	-	11,316
Nfld	-	5,060	2,400	-	7,460
Total	35,000	82,342	73,434	5,000	195,776

Table 7. Number of intermodal units moved by rail to intermodal terminals located within the Province in 1998.

Destin-ation	Origin					
	Int'l*	US	Ont	Que	W-C	Total
Int'l**			2,490	4,443		6,933
PEI			434	254		688
NB	451	901	4,818	1,694	1,405	9,269
NS	139	278	3,129	1,034	633	5,213
Nfld	104	208	4,769	1,644	624	7,349
Total	694	1,387	15,640	9,069	2,662	29,452

Note: Int'l includes Europe, Asia, Latin America and the Caribbean. W-C is traffic from the four western provinces of Canada

*includes traffic offloaded at the Laser Terminal

**includes traffic offloaded at the Port of Saint John

Table 8. Number of intermodal units moved by rail from intermodal terminals located within the Province in 1998.

Destination	Origin					
	Int'l**	PEI	NB	NS	Nfld	Total
Int'l*			414	128	96	638
US			829	255	191	1,275
Ont	282	1,361	5,113	2,988	3,951	13,695
Que	503	472	1,722	1,250	1,569	5,596
W-C			1,486	565	474	2,525
Total	785	1,833	9,614	5,186	6,281	23,729

*, ** - see notes bottom Table 7.

6.0 STUDY FINDINGS

The study provided the first database on intermodal traffic being handled by the road and rail infrastructure in the Province of New Brunswick. The problems encountered in construction of this database are similar to the challenges that would be faced by transportation planners and policy development staff in other jurisdictions in Canada because of the scarcity and disaggregation of intermodal traffic data.

The following observations define the level of activity and some of the problems facing the intermodal industry in the study area:

- There does not exist any single source of data on intermodal traffic moving within or through the Province of New Brunswick.
- Given that the distance from New Brunswick to Boston and other New England markets are within the range of truck transport it is unlikely that there will be a significant growth in the transborder intermodal transport mode.

- The shippers in the area either using or having potential to use intermodal transport indicated that significant growth in intermodal transport is not expected in the immediate future time frame.
- Approximately 25% of the containers handled at the Port of Saint John originated or were destined to points within New Brunswick. All other containers were moved by rail or road modes to and from points within Prince Edward Island, Nova Scotia, Quebec, Ontario and the United States.
- Although the intermodal traffic is segmented, there was in 1998 a total of 332,110 intermodal movements made over the New Brunswick highway and rail infrastructure.
- The truck mode moved 18,971 containers from terminals located at Moncton and Saint John. Approximately 40% of the containers were destined to points within New Brunswick.
- The truck mode moved 24,673 containers to New Brunswick terminals. Approximately 40% of the containers originated from New Brunswick.
- The truck mode moved 4,272 and 4,437 intermodal trailers from and to intermodal terminals located at Moncton and Saint John. Approximately 70% of the trailers originated from Ontario and approximately 40% of the trailers were destined to points within New Brunswick.
- The truck mode moved over New Brunswick highways 13,108 containers to and 16,492 containers from the Ports of Halifax, New York and Sydney.
- The truck mode moved 2,190 trailers from and moved 2,340 intermodal trailers to the Ports of Halifax and Sydney. These traffic flows originated in or were destined to Newfoundland.
- The pressure from environmental demands and fuel prices are not expected to result in major increases in intermodal traffic. The largest potential for mode shift appears to be in diversion from over the road tractor-trailers to the intermodal rail terminals.

THE POTENTIAL FOR MODAL SHIFT: CONTESTABLE TRUCK TRAFFIC

Catherine Kim and Terry Ganton
Transport Canada

Introduction and objectives

This paper provides an overview of a modal shift analysis done by Transport Canada in 1998 in support of the deliberations of the Transportation Climate Change Table.

Previous work on modal shift has tended to focus either on specific shipments using detailed data, or on a larger scale, using aggregated publicly-available data. The objective of this work was to develop a tool to assess the potential for modal shift from truck to rail, producing a complete picture of national and transborder transportation, and at a level of detail made possible by carrier data available to Transport Canada.

Scope

The analysis included the following:

- A classification of 1996 traffic data based on commodity type, origin and destination, modal share and a number of other factors such as yield, distance, shipment size and commodity value
- Selection of parallel or "matched" flows, occurring in both the truck and rail data
- The development of "contestability criteria" to filter matched flows
- A scenario analysis, using selected contestability criteria and producing estimates of contestable truck traffic.

For the purposes of this work, "contestable truck traffic" designated those truck flows which had, for a given commodity, origin, destination and (for domestic traffic, distance), matching flows in the rail data and which met certain contestability criteria.

The study was undertaken principally to explore potential modal shifts and did not attempt to link contestable traffic with greenhouse gas emissions. No presumption was made that any shift from truck to rail would necessarily results in a reduction in emissions. Further, the study made no speculation as to what measures would be required to actually produce a modal shift of contestable traffic.

Data and data limitations

Domestic Traffic

Rail freight traffic data from CN and CP's confidential reports to Transport Canada served as the source of data for the domestic rail traffic analysis. This data set also includes shortline traffic interchanged with these Class I railways. Flows which originate and terminate on a shortline, and flows on those shortlines which do not interchange with CN or CP were therefore excluded from this analysis.

Trucking freight data from Statistics Canada's For-hire Trucking (Commodity Origin/Destination) Survey served as the source of data for the analysis of domestic truck traffic. The data includes only Canadian-domiciled for-hire carriers with annual revenues exceeding $1 million. It should also be noted that true origin and destinations are reported, so piggyback traffic which may move by rail at some point in a trip is not distinguished in the truck data. The effect of exclusion of small operators and private operators from the work was taken to be minimal since shipment size and corporate policy would render a modal shift to rail in these cases unlikely. The truck data is a sample survey, structured to produce reliable information at the

national level; the data is therefore less reliable at disaggregated levels than is the rail data.

Data elements extracted from these two sources included: origin and destination, commodity type, distance transported, tonnage, tonne-kilometres (calculated), revenue, yield (revenue per tkm).

Transborder Traffic

The transborder analysis was based on Statistics Canada trade data, which includes all road freight carriers. Origins and destinations in the export records represent true ODs, but for imports the province of clearance is captured rather than the province of destination[1]. Yield and distance data is available for only the domestic portion of the trip.

From the trade database, the following elements were extracted for truck and rail: origin and destination, commodity type, tonnage, commodity value, number of transactions (a proxy for number of shipments). Value per tonne and an approximation of shipment size were calculated from the available data.

For both domestic and transborder data, records were aggregated by commodity type (46 categories[2]) and provincial/state OD. The geographical aggregation allowed for increased ease of manipulation of the data. However the loss of detail affected the ability to factor in accessibility to rail. To the extent possible, issues of rail accessibility were addressed by the development of contestability criteria for distance, relative yield, value and modal share. Shorter distance, highly divergent modal yields or values and a very high or very low modal share were assumed to be indicative of incontestable traffic.

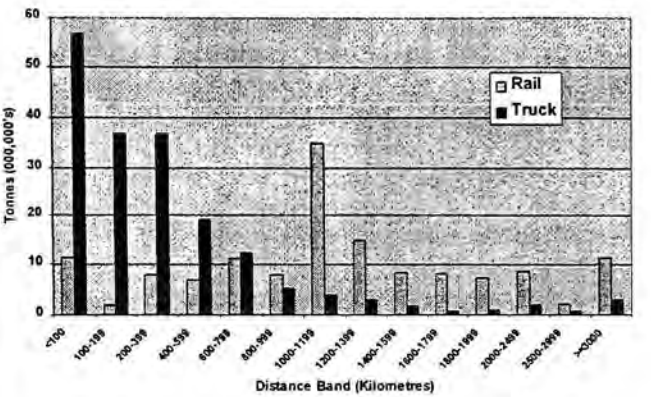
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[1] Customs data is used.

[2] Intermodal traffic is flagged in the rail data, but is not identified in the trucking data, so the designation of an "intermodal" commodity category for the analysis was not possible.

Data were also aggregated by distance transported. Fourteen distance bands with widths of 100, 200 and 500 kilometres were used. Figure 1 shows total traffic for rail and truck by distance transported, and illustrates the importance of the distance consideration.

Figure 1: Domestic Truck and Rail Traffic by Distance Band



Beyond consideration of the annual tonnage associated with traffic flows, it was not possible to assess the influence of shipment size on the contestability of domestic traffic except in a qualitative sense[3]. For the transborder analysis, "number of transactions" was used as a proxy for shipment size.

It was also not possible to *directly* address issues related to directionality (balanced loads) and rail access, although these issues

[3] The potential influence of shipment size was considered in the context of the establishment of distance thresholds for contestability as explained later.

were considered qualitatively in the process which established distance thresholds for each commodity[4].

Matching truck and rail freight flows

For each mode, total traffic was aggregated by OD pair, commodity group and, in the case of domestic flows, distance. From that data set, matched flows were determined by selecting only those records where a particular combination of OD, commodity and distance was present in both the truck and rail data. Table 1 summarizes the results.

More flows are filtered out for domestic flows than for transborder flows. This is attributed largely to two factors. First, large rail movements of bulk products are more likely to be seen in the domestic market and are unlikely to be echoed on the trucking data. Second, trade flows are more likely to consist on finished and semi-finished products between major centres, also served by rail.

TABLE 1. Total flows and matched flows

	RAIL TRAFFIC		TRUCK TRAFFIC	
	Total	Matched	Total	Matched
DOMESTIC				
Tonnes (M)	141.7	67.0	181.9	121.1
Tonne-km (B)	188.7	94.2	71.5	51.9
Revenue ($B)	4.3	2.4	6.2	4.4
TRANSBORDER				
Tonnes (M)	61.6	60.4	103.5	88.6
Value ($B)	64.3	64.0	257.0	220.3

[4] For example, the choice of 800 km as the distance below which trucked newsprint is considered incontestable reflects the lack of direct rail access to destinations and acknowledges existing truck backhauls of waste paper.

Other proposed criteria for contestability

Domestic

Distance

The development of distance criteria attempted to address economic, accessibility and other logistical issues including shipment distance. These distance criteria were defined on a commodity-by-commodity basis. For example, after viewing an OD matrix with distance bands for truck and rail transportation of newsprint, the critical distance for newsprint was set at 800 km. Newsprint transported over distances greater than 800 km was assumed to be contestable by rail, while accessibility, shipment size and backhaul factors were assumed to be constraints at lower distances.

A number of commodity groups were designated completely incontestable. These were cases where truck flows and rail flows generally occupied different parts of the OD matrix (geographically dissimilar), or where one mode had very little presence. For example, iron ore, potash and phosphate rock were considered incontestable by truck because of the bulk nature of these flows; fuel oil and furniture were considered incontestable by rail because of the tendency for destinations of these products to be geographically dispersed.

For each of the 46 commodity groups, either a distance threshold was set or a designation of 'incontestable' was assigned.

Modal share

The rail modal share criteria filters out traffic where rail has a modal share of 10% or less, or a modal share of greater than 90%. The presumption is that truck dominates the market at the lower bound (and would continue to do so) because of such factors as small shipment size, lack of rail accessibility and other service-related requirements. Truck traffic moving in the rail-dominated upper bound would be unlikely to shift for similar reasons.

Truck flow volumes

The criterion for truck traffic volume attempts to provide for volumes of traffic that may be too small to be attractive to rail. Annual traffic volumes of less than 1,000[5] tonnes are filtered out with the application of this criterion.

Yield

The yield ratio criterion was used to filter out flows with large discrepancies between rail yield and truck yield on the premise that traffic exhibiting extremely divergent yields would be unlikely to shift under any reasonable circumstances. The criteria for yield ratio (the ratio between rail yield and truck yield) eliminates flows with ratios of 0.6 and less and ratios greater than 1.4.

Transborder

Distance

In the absence of OD distance data in the trade database, the distance criteria for transborder movements filtered out truck movements between adjacent provinces and states, including:

- Canadian Atlantic and Quebec to/from U.S. Northeast region[6]
- Ontario to/from New York, Pennsylvania, Michigan, Ohio, Wisconsin and Minnesota
- Prairies to/from Minnesota, North Dakota and Montana
- BC to/from Montana, Idaho, Washington and Alaska

[5] Since 47% of the *rail* matched flow records involved flows of 1,000 tonnes or less, this threshold was thought not to be unreasonably low.
[6] Connecticut, Massachusetts, Maine, New Hampshire, Rhode Island, Vermont, New Jersey, New York and Pennsylvania.

These short-distance movements were assumed to be incontestable by rail.

Truck flow volumes

As for domestic movements, this criterion was set to filter out annual transborder volumes of less than 1000 tonnes.

Shipment size

Trucking is assumed to be more suited to handle traffic involving small shipment sizes. Application of the shipment size criterion filters out the traffic with less than ten tonnes per shipment

Commodity value

Identical commodities should have a consistent value regardless of the mode chosen. However, since commodities were split into only 46 groups, some commodity groups (like the organic, inorganic and other chemicals groups) have a large number of individual products comprising the group. The value of these products may therefore vary substantially. The commodity value criterion attempts to compensate for this by filtering out flows where the ratio of truck value per tonne to rail value per tonne is greater than three or less than 1/3.

Rail modal share

As for the domestic analysis, transborder matched flows where modal shares were less than 10% or greater than 90% were filtered out by this criterion.

Each of the above domestic and transborder criteria was dynamically linked to the data set to allow for changes to thresholds with immediate recalculation of results.

Estimates of contestable traffic

Domestic

Table 2 gives the results of application of contestability criteria to domestic truck flows singly and in combination.

Table 2. Estimates of contestable truck tonnage and tonne-kilometres: domestic flows.

Criteria applied to domestic truck flow data	Volume (Mt)	% of total truck flows	Tonne-km (billion)	% of total truck tonne-km
(None)	181.9	100.0	71.5	100.0
Matched flow (MF)	121.1	66.6	51.9	72.6
MF and V	96.9	53.3	44.9	62.8
MF and D	24.9	13.7	31.0	43.4
MF and Y	47.2	25.9	19.5	27.3
MF and S	30.2	16.6	4.8	34.7
MF and D + V	24.7	13.6	30.6	42.8
MF and D + Y	9.1	5.0	11.5	16.1
MF and D + S	15.2	8.4	20.7	29.0
MF and V + Y	47.2	25.9	19.4	27.1
MF and V + S	30.1	16.5	24.6	34.4
MF and Y + S	13.1	7.2	10.0	14.0
MF and D + V + Y	9.1	5.0	11.4	15.9
MF and D + V + S	15.1	8.3	20.5	28.7
MF and D + Y + S	5.3	2.9	7.5	10.5
MF and V + Y + S	13.0	7.1	10.0	14.0
MF and D + V + Y + S	5.3	2.9	7.4	10.3

V= volume, D = distance, Y = yield, S = share.

The following observations can be made:

- One-third of trucked tonnage (by commodity, distance band, and OD) is unique to trucking. This corresponds to just over one-quarter of trucked tonne-kilometres.

- When applied to matched flows in combination with any other criteria, the volume criteria has very little effect[7].
- The application of contestability criteria generally has a lesser effect on tonne-kilometres than on tonnage. This supports the notion that shipments more susceptible to diversion from truck to rail are those which travel over longer distances.

Application of three or four criteria results in estimates that the amount of truck traffic contestable by rail is less than 10%. However, any reduction in tonnage trucked may result in a corresponding three-fold reduction in tonne-kilometres as a per cent of the total.

The sensitivity of the model was checked by changing the thresholds for the four criteria:

A. Changing the modal share threshold from the upper and lower 10% to the upper and lower 30%
B. Changing the yield ratio thresholds from 0.6 and 1.4 to 0.8 and 1.2
C. Changing the truck volume threshold from 1,000 tonnes to 10,000 tonnes
D. Applying a uniform distance threshold of 600km for contestability[8]
E. Applying a uniform distance threshold of 1000km for contestability

Results are shown in Table 3 along with original estimates for comparison.

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[7] This may be due to the fact that either this criterion is ineffective or that the minimum traffic level assumed to be required to make the traffic attractive to rail was too low.
[8] Excluding commodity groups initially designated as completely incontestable.

Table 3. Sensitivity of results to threshold changes: contestable tonnage.

Criteria	*Compare*	*A*	*B*	*C*	*D*	*E*	*A,B*	*A-D*
D+V+Y	*9.1*	9.1	4.1	8.1	9.4	4.2	4.1	4.4
D+V+S	*15.1*	7.8	15.1	13.8	12.8	6.6	7.8	5.6
D+Y+S	*5.3*	2.6	2.1	5.3	5.3	2.5	1.3	1.2
V+Y+S	*13.0*	5.1	6.0	12.3	13.0	13.0	2.1	2.1
All	*5.3*	2.6	2.1	4.7	5.3	2.5	1.3	1.2

D = distance; V = volume; Y = yield, S = modal share.

The most constraining criteria result in an estimate of 1.2 Mt of contestable truck traffic[9].

Transborder

Application of criteria to the matched transborder data gave the results shown in Table 4. Only results for the use of single criteria and combinations of four and five criteria are shown.

Application of all available criteria results in the identification of 13.1 Mt of truck traffic as being contestable by rail (10.5 Mt exports, 2.6 Mt imports). This amounts to 12.7% of total transborder truck flows, or 19% of exports and 6% of imports. In other words, under this scenario, imports are less likely to be contestable than exports.

The shipment size criterion has in general a greater effect on the import data than on the export data. The value and modal share also have a heightened effect. For example, application of these three criteria to the data result in 47.7% of exports, but only 11% of imports being designated contestable. The shipment size criterion alone designated 79.8 % of exports but only 37.7% of imports contestable. The greater likelihood of imports to be finished and semi-finished products supports these findings.

[9] This corresponds to 1.7 B tkm.

Table 4. Estimates of contestable truck tonnage: transborder flows.

Criteria applied to transborder truck flow data	Volume (Mt)	% of total truck flows
(None)	103.5	100.0
Matched flow (MF)	88.6	85.6
MF and distance	37.3	36.1
MF and volume	87.8	84.8
MF and size	63.2	61.1
MF and value	70.9	68.5
MF and share	44.1	42.6
MF and distance + volume + size + value	18.8	18.2
MF and distance + volume + size + share	15.3	14.8
MF and distance + volume + value + share	15.5	15.0
MF and distance + size + value + share	13.3	12.9
MF and volume + size + value + share	32.0	30.9
MF and distance+volume+size+value+share	13.1	12.7

Conclusions/Applicability of results

The analysis considered a variety of factors in attempting to address the issue of potentially contestable truck traffic. The thresholds used and estimates provided demonstrate what kind of results can be produced with the data available.

Given the thresholds used above or any alternative thresholds, resulting designations of contestable traffic would represent an upper limit for modal shift. It is likely that some local portions of the shifted movements would still be carried out by truck.

In general, the scenarios presented suggest that there exists only limited scope for modal shift of truck tonnage to railways, but that the corresponding shift in tonne-kilometres would be proportionately greater.

The results of the study indicate that truck and rail have each, to a large degree, specialized in transportation markets differentiated by characteristics such as shipment distance, shipment volumes and shipment value. It may be tempting to assume that it follows that these specializations preclude an interest and ability for rail to appropriate "dissimilar" truck traffic. This is not necessarily true: for example, truck flows in the Quebec-Windsor corridor by truck might be deemed incontestable in the above analysis due to short shipment distances despite the availability of viable rail intermodal options.

Isolation of truck traffic moving in such rail corridors would further refine the results obtained using the above methodology.

Executive Summary

NORTH AMERICAN FREIGHT MOVEMENT: A CASE STUDY USING DATA FROM THE NORTH AMERICAN TRANSPORTATION STATISTICS PROJECT

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Implementation of the North American Free Trade Agreement (NAFTA) and the trend by industry towards just-in-time distribution are based on effective domestic and cross-border movement of freight. Comparable statistics compiled as part of the North American Transportation Statistics (NATS) project furthers understanding of transportation among the three NAFTA partners. This paper provides a statistical overview of the structure of freight transportation in Canada, Mexico and the United States and the role of modes such as trucking and rail in the continental flow of commodities. The discussion begins with an overview of NATS project and its contribution to the development of comparable transportation related statistics between Canada, Mexico and the United States. Using NATS project data, the second part of this paper discusses freight movement in terms of economy, employment and domestic activity in each country. Finally, the third section of the paper describes freight movement from an international perspective, focussing on the value of cross-border trade by mode of transportation and a description of major border crossing and points of entry for trade among the three NAFTA partners.

Improving Public Transit Access to Large Airports: A Case Study of Pearson Airport in Toronto

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INTRODUCTION

Lester B. Pearson International Airport is the largest airport in Canada and the fourth largest entry port into North America after John F Kennedy, Miami, and Los Angeles International airports (1). Annually 40 million passengers are expected to use Pearson Airport by the year 2006 (1). Increase in airside activity, from 24.5 million passengers in 1997, will cause a simultaneous increase in groundside activity at Pearson Airport. Expanded airside activity is expected to exert additional pressure on the street network that feeds passengers to the airport.

Increase in airside activity will have a greater impact on the origin-destination (OD) passengers. At the same time, number of connecting passengers at Pearson Airport (20% in 1996) is expected

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to decrease in future since direct service to other airports, such as Ottawa and Winnipeg has been improved.

A new terminal at Pearson Airport is being constructed to accommodate future air travel demand. This terminal will replace the existing terminals 1 and 2. However, not much is being done to improve groundside access to the airport. Numerous reports have been commissioned to study alternatives to improve public transit access to Pearson airport. Those studies, with the exception of a few, suffered from 'bounded rationality' as they focussed exclusively on rail-based alternatives, overlooking the bus transit. Thus, in the absence of a comprehensive, multi-objective evaluation of public transit alternatives, such studies have often compared rail-based alternatives alone, while overlooking market-based bus transit alternatives.

This study argues that spatial distribution of OD trips prevents any isolated rail route to achieve the desired public transit mode split. However, bus transit, operated on exclusive right-of-way from numerous nodes within the Greater Toronto Area (GTA), is more likely to improve public transit mode split. In addition, bus transit offers market-based solutions. Already, private sector has expressed interest in operating bus transit to Pearson Airport. On the other hand, rail-based alternatives rely on public money for capital and operating expenses.

This paper opens with a review of previous research into the subject, followed by description of the spatial analysis. Later, a bus transit alternative is discussed in detail.

A recent study by the IBI Group concluded that the "most feasible route to the airport is via the existing CN Weston Subdivision railway line" (2). The IBI Group study suffers from two shortcomings. The study disregarded the actual OD pattern of trips in the GTA. In addition, bus transit alternatives were overlooked in the study. A similar study recommended an identical rail link along with other developments in transit infrastructure (3).

The fact remains that a rail-based service between downtown Toronto and Pearson Airport can only carry passengers from downtown Toronto, leaving the majority of the Pearson-based commuters still dependent on automobile.

An earlier study in 1994 proposed an exclusive bus-based transit link to the airport (4). However, the study did not include any spatial analysis of trip origins and destinations. In March 1997, a detailed version of this paper was presented to the Greater Toronto Airports Authority (GTAA). Louis Turpen, head of the GTAA suggested a similar bus-based transit system as proposed in this paper (5). In addition, Ontario Motor Coach Association recently proposed to the Toronto Board of Trade to operate bus transit between downtown Toronto and Pearson Airport on a dedicated right-of-way along the GO rail line, without disturbing the existing rail service.

In the United States, eight airports are linked directly to the metropolitan subway systems. Washington Transit, the most successful in airport access in the US, reported a public transit mode-split of 15 % for the airport-based trips. The remaining seven airports averaged around 5% for public transit mode-splits. On the other hand, airports in Europe fared better in mode-splits. Zurich airport at 35% has the highest mode-split for rail-based public transit, while Munich airport has the highest public transit (rail and bus combined) mode-split of 40% (6). The American experience with rail transit to airport suggests that a rail-based alternative may not be the most appropriate solution for North American cities, which are characterised by urban sprawl and low population densities.

METHODS

The data analysed in this research was extracted from the Transportation Tomorrow Survey (TTS) conducted in 1996 (7). TTS surveyed 115,193 households (312,000 persons) in the GTA and obtained detailed information about their weekday trip making. No information was collected for weekend trips. Pearson-based trips (Zone 1209) were extracted from TTS 1996 data. To study the spatial

trends in the data, trip ends were geocoded to the centroid of traffic zones that they fell under. Forty-two hundred factored trips (85,527 non-factored trips) to or from the Pearson Airport were reported in TTS. The data set also included the expansion factors for each reported trip. On average, one surveyed trip represented 20 actual trips. For temporal comparisons, data from previous surveys in 1986 and 1991 has also been included in the analysis.

TTS did not cover trips made by non-residents (e.g., visitors staying at hotels) to and from the Pearson Airport. In addition, explicit information was not available on trip purpose. Thus, trip-makers were not explicitly identified as air passengers, or greeters and well wishers.

RESULTS

In this section, descriptive analysis of trips recorded under TTS for the years 1996, 1991, and 1986 is presented. Private auto was the most dominant mode of travel for airport-based trips (Figure-1). Almost 90% of the total trips were automobile-based (auto-driver + auto-passenger). Transit trips accounted for less than 4% of the total trips. Figure-1 reveals that mode-split has remained almost the same between 1986 and 1996.

To capture the effect of income on mode choice, we plotted a composite graph showing mode choice by occupation. We used occupation as a proxy for income. Figure-2 reveals that 40% of trip-makers arriving at airport by auto-driver mode were professionals. Trip-makers employed in sales and manufacturing followed professionals in their preference for auto-driver mode. As expected, auto-passenger was the most preferred mode of travel for unemployed, comprising mostly of elderly and children. Professionals predominantly used taxis for trips to the airport.

Peak period of activity at Pearson Airport coincide with the AM and PM peak traffic in the GTA. Figure-3 reveals that periods of high activity at Pearson Airport are between 7:00 a.m. and 9:00 a.m. in the morning and between 4:00 and 7:00 p.m. in the afternoon. Since the

airport-based traffic's peak periods coincide with the AM and PM peak traffic in Toronto, a rail link between downtown and airport would further aggravate traffic problems in downtown Toronto. A direct rail link between Union Station and Airport would increase the incoming traffic into downtown Toronto during the AM peak and would also contribute additional trips to the outgoing traffic during the PM peak.

Based on the trip length data, we observed that almost 60% of trip origins and destinations were concentrated within a 20-km radius of Pearson Airport. In addition, 25% of trips fell within a 12-km radius. This suggests that a significant percentage of trips are based in the municipalities of Mississauga and Etobicoke. The actual trip origins and destinations in Mississauga and Etobicoke are significantly higher for the reason that trip-makers who stayed at hotels were not interviewed for TTS.

SPATIAL ANALYSIS OF AIRPORT-BASED TRIPS IN THE GTA

In this section results from the spatial analysis of airport-based trips are presented. The actual spatial layout of the airport and other infrastructure is delineated in Figure-4. Union Station in downtown Toronto is marked with a U on the map. CN Weston rail route to Pearson Airport is also shown on the map. Current layout of runways at the Pearson Airport along with the major highways in the GTA has also been marked on the map.

The best alternative for increasing mode-split for airport-based trips is the one that recognises the spatial distribution of airport-based trips in the GTA. Figure-5 presents the spatial distribution of the airport-based trips. Municipalities of Mississauga, Etobicoke, City of Toronto, North York, and Brampton have relatively higher concentration of airport-based trips. Pearson Airport is located in the municipality of Mississauga. From the figure, one can see that Mississauga contributes the maximum number of trips (19%, characterised by darker shades) to the airport. As for trip densities,

municipalities of Etobicoke (71-trips per square km), York (82-trips per square km), and Toronto (102-trips per square km) fare better than the rest[2].

Figure-6 presents a different trip density map, where trips per 1000 people by municipality are mapped. Residents of Brampton, Caledon, and Mississauga made the highest number of trips per 1000 inhabitants to the airport. It can be argued that residents of the above-mentioned municipalities portray higher propensity to travel to the airport in the GTA. The propensity to travel to the airport does not necessarily translate into propensity for air-travel. Though inhabitants of Caledon reported the highest number of trips per residents, 39 trips/ 1000 people, the actual trip share for Caledon was one of the lowest (1.6% of total airport-based trips). Trip statistics for selected municipalities are presented in the following table.

Table-1: Trip characteristics of various municipalities in the GTA.

MUNICIPALITY	TOTAL TRIPS	% of TOT-TRIPS	TRIPS/1000 POP	TRIPS/ SQ KM
Mississauga	16045	18.69	34.62	55.63
Toronto	10168	11.84	16.00	101.8
Etobicoke	8874	10.33	28.62	71.13
North York	8369	9.752	14.87	47.50
Brampton	7675	8.94	32.73	28.54
Scarborough	5194	6.05	9.902	27.70
Oakville	2958	3.44	25.80	21.32
Burlington	1920	2.23	14.82	10.40
York	1908	2.22	13.58	81.77
Caledon	1366	1.59	39.06	1.96
East York	1014	1.18	9.87	47.75

In order to present spatial distribution on a finer scale we generated colour thematic maps for traffic zones in the GTA. We created a buffer map (Figure-7) with buffers of 2-km radius pivoted at the centroids of traffic zones. Thus each traffic zone reports the total

[2] Not shown on maps.

number of trip origins or destinations within a 2-km of radius of the centroid of that particular traffic zone. The outcome is a colour-thematic map that identifies spatial trends and identifies locations for the proposed nodes for bus transit. On the map, stars present the proposed node locations. Figure-7 shows that downtown Toronto along with some major intersections along Yonge Street, among others, are strong candidates for node locations. What is evident from Figure-7 is the fact that one rail-line from downtown Toronto to Pearson Airport cannot achieve the desired mode-split, since the trips are disbursed over the entire GTA.

In the following paragraphs an attempt is made to assess the number of trip-makers that could be attracted to the dedicated airport line proposed in other research (2,3). Three concentric buffers of radii 1.5 km, 3.0-km, and 5.0-km (Euclidean distances measured from the rail line) were created along the CN Weston rail line (see figure-4). Using a GIS, all trip origins/destinations that fell within those buffers were calculated. This exercise revealed a very rough, yet probable catchment for the dedicated airport line. For comparisons, a simultaneous set of buffers was created for an alternative transit route (not shown in the maps) for bus transit. The same procedure to assess actual trip origins and destinations within buffers was adopted for the alternative route. Results of the analysis are presented in the following table.

Table-2: Number of trip origins and destinations falling in the concentric buffers along the transit routes.

	Down-town Link			Alternative Route		
Buffers	*1.5-k*	*3.0-k*	*5.0-k*	*1.5-k*	*3.0-k*	*5.0-k*
Entire Trips	7,319	17,250	26,311	10,831	20,896	30,934
Percentage of Tot-Trips	8.5%	20.1%	30.7%	12.6%	24.3%	36.0%

TTS data covered 85,827 non-factored airport-based trips. For the downtown rail link, only 8.5% trips fell within the 1.5-km distance of the proposed rail line. The 3.0-km buffer contained 20% of all

trips, while the 5.0-km buffer retained 31% of trips. For comparison, one can see that a randomly selected bus route had greater number of trip origins/destinations in its catchment. These results indicate that if reliability of bus transit is improved by offering service on HOV lanes, bus-transit can compete for a larger pool of trip-makers. Similarly, if bus transit were operated on routes that already carry airport-based traffic, bus transit would be available as an alternative to a large number of trip-makers.

BUS-BASED SOLUTIONS FOR PEARSON AIRPORT

In this section, a bus transit system is proposed to improve access to Pearson Airport.

At the heart of the proposed bus transit system is the notion to expand airport-related activities near actual trip origins and destinations. The proposed solution recommends buses operated from strategically located bus stations (nodes) whose locations are sensitive to the OD pattern of the trips made to and from Pearson Airport. Those nodes would be different from ordinary bus stations. In fact, nodes would operate very much like airports and offer remote baggage handling and check-in facilities. Out-sourcing of some traditional airport activities can thus restrict the centralised expansion of airports. The important features of the proposed transit system are following:

- Strategically located nodes within a 25-km radius of Pearson Airport,
- Remote baggage handling and check-in facilities at each node,
- An integrated Intranet computer network, jointly operated and controlled by major airlines serving Pearson Airport,
- Specially designed buses equipped with Global Positioning System (GPS),
- Sufficient on-board luggage space in buses,
- Immediate and direct access to terminals, instead of access to a central ground transportation centre,

- Transit Priority/HOV Lanes to operate buses,
- Development of extensive retail facilities at nodes,
- Provision of sufficient parking facilities at nodes for air passengers, and greeters and well-wishers.

Sufficient on-board space in buses is provided for passengers to store their heavy luggage. These buses could have both on-board and restricted luggage spaces. The restricted space should only be accessible to the driver to store the luggage checked in by passengers at nodes. In Zurich, baggage check-in facilities are available at over 100 train stations (6). Other facilities could include dissemination of travel-related information through a television screen within buses and/or telephone facilities.

Integrating Airline Communications

Integrating booking and baggage handing services can further extend the existing co-operation between airlines, which are heading toward four major international alliances. A centralised, Intranet-based communication system, which shares information with airlines operating at Pearson Airport, can eliminate the need of separate airline offices at each node. Airlines could form a consortium to finance the construction and later operation of these nodes.

Using GPS to Locate Bus Movement

Buses should be equipped with GPS to enable authorities at the airport to determine their exact location on the street network. Routes susceptible to congestion could be monitored by close-circuit television to advise bus drivers for alternative routes. Buses should head straight to the terminals instead of a central ground transportation centre. By providing direct access to terminals, an additional transfer can be avoided at the airport. Buses operating on transit priority lanes will offer better travel times than automobiles, taxis, and limousine services. Regional municipalities in the GTA in their future transportation improvement plans have provisions for HOV lanes on freeways.

The nodes should have tourism-oriented retail space. Gift shops, currency exchange, and restaurants would induce further commercial development in the neighbourhood. Nodes should also have rooms for small communication centres where passengers can use fax, telephone, email, or Internet. Since air passengers at nodes would be closer to their trip origins, in case of a delay or cancellation, passengers might opt to return to their residence or work instead of staying at a hotel. In addition, greeters and well wishers could pickup or drop-off air passengers at these nodes.

CONCLUSIONS

Spatial distribution of trip origins and destinations in the GTA call for a multi-node transit service through strategically located nodes. These nodes will be conveniently accessible to a very large number of trip-makers, who are spread all over the GTA. Bus transit is preferred over rail transit because of the greater flexibility and considerably lower capital costs.

A single rail line linking downtown Toronto with Pearson airport cannot improve groundside access to Pearson Airport. Several rail transit services from numerous locations to Pearson Airport are needed to achieve high transit mode-splits. This proposition would cost billions of dollars. An alternative solution, offering bus transit from numerous nodes could do the same job efficiently, but with a considerably smaller price tag. This study has not attempted to calculate costs of the proposed alternatives. A comprehensive multi-objective evaluation of competing alternatives was beyond the scope of this study. However, such a study would significantly contribute to a better understanding of the issue at hand. In addition, a mode choice model, using up-to-date data, could significantly contribute to the understanding of groundside activities at Pearson Airport. Further studies are needed to explore the possibility of an integrated communication system, shared by all airlines operating at Pearson Airport.

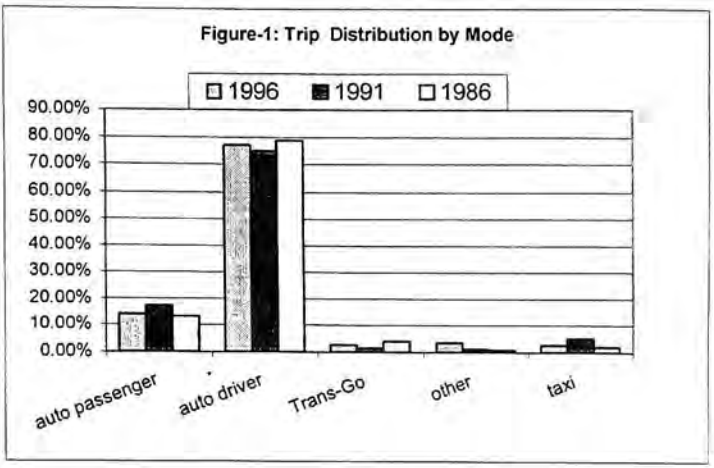
Certain activities could only be performed at airports. However, activities, such as confirmation of seats or flight times, getting computerised tags for luggage, and greeting an incoming passenger, could be performed outside of the airport at the proposed bus stations (nodes).

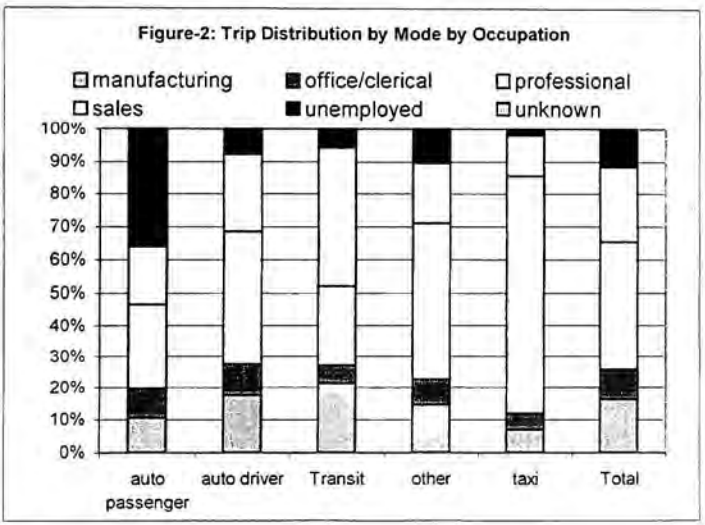
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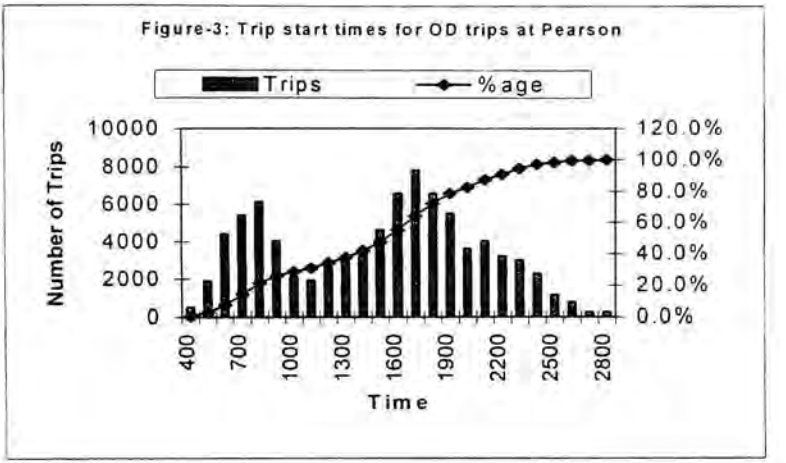
The author would like to express his gratitude to Professor Richard Soberman at the Department of Civil Engineering, University of Toronto, for his valuable insights, directions, and continued support.

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Figure-1: Trip Distribution by Mode
1996
1991
1986
90.00%
80.00%
70.00%
60.00%
50.00%
40.00%
30.00%
20.00%
10.00%
0.00%
auto passenger
auto driver
Trans-Go
other
taxi


Figure-2: Trip Distribution by Mode by Occupation
manufacturing
office/clerical
professional
sales
unemployed
unknown
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
auto passenger
auto driver
Transit
other
taxi
Total



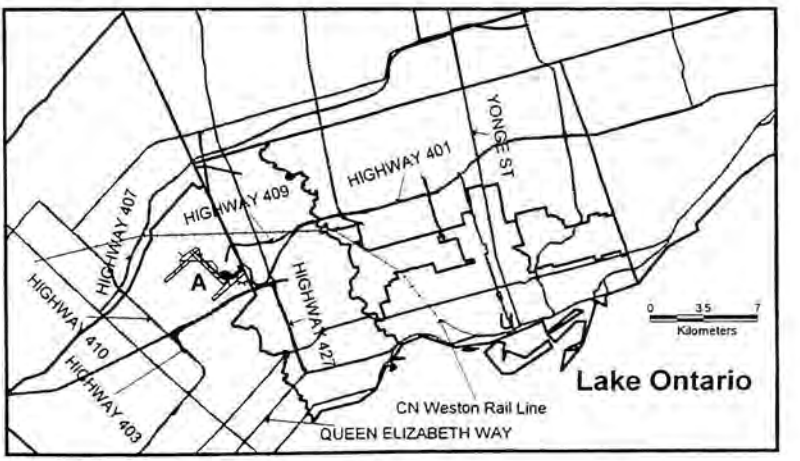


Figure-4: Actual layout of transportation infrastructure in the GTA.

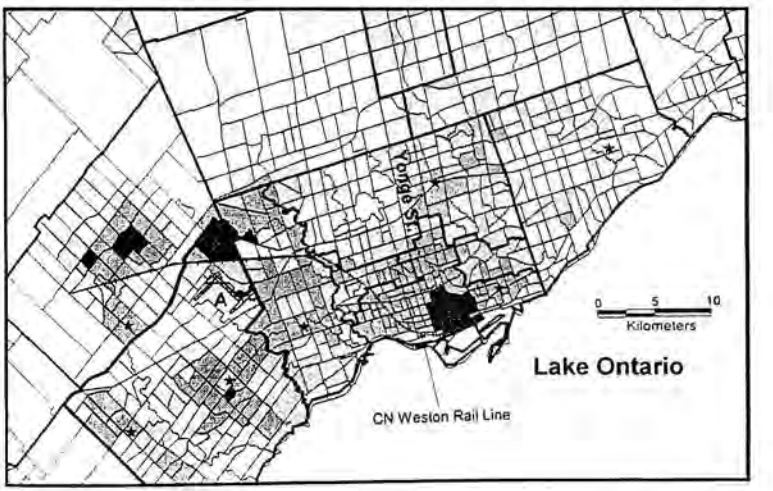
Figure-5: Spatial distribution of airport-based trips in the GTA (%age of trips by municipality).



Figure-6: Spatial distribution of trip density in the GTA (trips/ 1000 residents).



Figure-7: Colour-thematic map identifying spatial trends in airport-based trips.



A Cost Analysis of Construction Staging Options for Four Lane Highway Resurfacing Projects

Introduction

Transportation infrastructure is a huge investment. In Ontario, the current replacement cost of the provincial highway system is estimated to be $ 27 billion [1]. Unfortunately, this infrastructure is aging and in need of extensive rehabilitation. Maintaining these assets is an enormous task, which involves the resurfacing of asphalt pavements on average every 15 years [2]. The exercise of maintaining our highways is further complicated by increasing traffic volumes, increasing traffic speeds and increasing driver frustration. Many motorists identify highway construction with delay and disruption, not improvement of a service. Canadians have begun to expect two seasons on their highways, winter and construction. The result is that highway engineers must now design highway improvement projects so that inconvenience to the travelling public is minimized and safety of the construction workers is maximized. Contractors must also assist in this effort. Motorists too frequently travel through construction zones with lane closures, only to find no construction or maintenance activity underway. This adds to driver frustration and leads to distrust for construction signing and possible ignorance of traffic control devices, which are interpreted to not accurately describe the situation.

This report reviews three possible construction staging options and compares the estimated direct capital costs (i.e. contractor bid prices) as well as the indirect costs (i.e. social costs associated with construction). Social costs or indirect costs are not clearly defined but incorporate traffic delays, driver frustration, traffic safety and worker safety. For highway projects, a major component of the social costs are the traffic delay costs for which there are a number of accepted principles as outlined in the Highway Construction Manual (HCM) [3] to quantify their costs. Other social costs such as the

safety of the construction workers and the travelling public are more difficult to quantify as there is no definitive statistical information available on the increased risk to worker safety or vehicle safety in construction zones. In addition, there are no definitive costs associated with a fatality or injury. In selecting the appropriate construction staging alternative, a responsible owner should consider not only the direct capital costs but also the quantifiable and un-quantifiable social costs.

Construction Staging Alternatives

This report reviews the costs associated with three construction staging alternatives. These alternatives are as follows:

Alternative 1 - Closing one of the two lanes to perform resurfacing in the closed lane while maintaining the movement of traffic in the adjacent lane. Traffic is later switched onto the newly resurfaced lane so that resurfacing can take place on the other. Alternative 1 is illustrated in Figure 1.

Alternative 2 - This alternative is similar to the above mentioned method with the addition of full time police presence to provide additional protection to the workers from the traffic in the adjacent lane. The use of full time police presence on highway construction projects is becoming more common in Ontario as a result of concerns about worker safety. Alternative 2 is illustrated in Figure 2.

Alternative 3 - Detouring traffic away from the work area to the other side of the highway and separating the opposing traffic with temporary traffic delineating posts. This alternative involves constructing a temporary detour across the highway median. This report considers the median to be a ditched median. Ditched medians are the typical median for four lane divided highways in Canada. Alternative 3 is illustrated in Figure 3.

Determination of Direct Costs for the Construction Staging Alternatives

The direct capital cost comparison is based on the following variables outlined in Table 1. These cost breakdowns do not include the actual construction costs for the resurfacing itself, as these costs will essentially be equal for all alternatives.

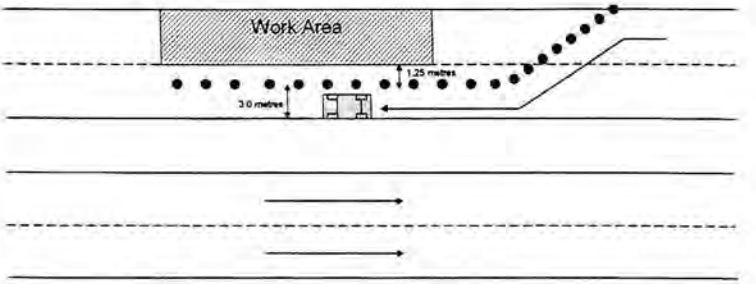


Figure 1 – Construction Staging Alternative 1

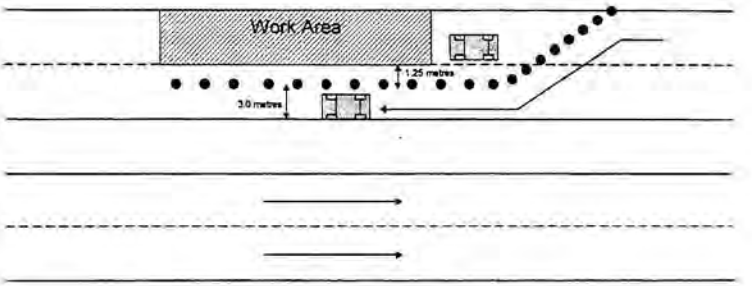


Figure 2 – Construction Staging Alternative 2

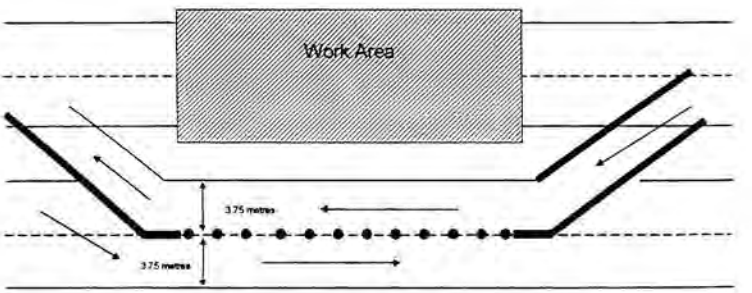


Figure 3 – Construction Staging Alternative 3

Table 1 - Direct Costs Associated with the Various Alternatives

	Alternative 1	Alternative 2	Alternative 3
Full Traffic Control	Yes	Yes	
Police Protection		Yes	
Partial Traffic Control			Yes
Median Detour			Yes
Detour Removal			Yes

Costs are derived primarily from the Ontario Ministry of Transportation Project Value System (PVS) database, which provides the average of the 3 low bid prices for individual items on all capital construction projects. Costs for police protection ($70/hr) are based on standard charge out rates of $65/hr from the Ontario Provincial Police who are responsible for all provincial highways plus overhead and profit of $5/hr. This includes a police vehicle and paid duty police officer. Similar costs are incurred if the police vehicle and officer were replaced with a truck mounted crash attenuator (crash truck) and operator. Both methods provide protection to the workers although the police presence provides a deterrent to speeding and other aggressive driving. As the cost for barrier vehicles is based on an hourly rate, it is dependent on a contractor's production rate. Costs were compared based on typical low, medium and high production rates. The comparison showed that the costs of a barrier vehicle, for different production rates has only a small impact on the total direct costs. Based on this, the costs based on a medium production rate of 1500 tonnes of hot mix per day were used for this report.

The item prices for full traffic control and partial traffic control from 4-lane highway resurfacing projects were normalized to provide a unit cost per kilometre to account for different contract lengths. The cost to construct a crossover detour is based on the unit prices of the individual materials and the theoretical design quantities for the materials. A detailed breakdown of these prices, design quantities and costs are provided in [4]. No cost has been allocated for the removal of the median crossovers. The removal cost is assumed to be

offset by the salvage value of the materials (hot mix and granular) or the removal cost is already included as part of the actual item price (temporary concrete barrier and temporary crash attenuator). The crossover costs are considered to be independent of the contract size as four crossovers are required per project for projects up to 8 kilometres in length. Projects greater that 8 kilometres in length are assumed to require more than one set of four detours to account for interchanges and driver frustration that can set in if restricted from passing for more than 8 kilometres [5]. The costs for temporary traffic posts and their relocation could not be determined from PVS due to the special nature of this item and limited use in Ontario. Costs were determined based on the bid costs from three trial projects undertaken in recent years. The normalized average costs are summarized in Table 2.

Comparison of Direct Costs

The direct costs for the three alternatives are considerably different. The direct costs for Alternative 1 range from about $21,000 to $83,000 depending on the length of project (i.e. 2 km to 8 km). The direct costs for Alternative 2 are based on the costs for Alternative 1 with a premium of about $4,000 to $13,000 for the police protection. The direct costs for Alternative 3 are considerably higher due to the very high cost of building the median crossover. These costs range from about $500,000 to $540,000. The high cost of the median crossovers is clearly a significant deterrent to the selection of Alternative 3.

Table 2 – Cost Summaries

Construction Staging Operation	Alternative 1	Alternative 2	Alternative 3
Full Traffic Control ($/km)	$10,384/km	$ 10,384/km	
Police Protection ($/hr)		$ 70/hr	
Partial Traffic Control ($/km)			$ 1,207/km
Median Detour and Removal (lump sum + $/km)			$ 484,988 + $ 4747/km
Total Cost for 2 km Project	$ 20,800	$ 24,100	$ 496,900
Total Cost for 5 km Project	$ 51,900	$ 60,300	$ 514,800
Total Cost for 8 km Project	$ 83,100	$ 96,500	$ 542,100

Determination of Indirect Costs from Traffic Delays

Traffic delays are common during road construction activities. The delays are a result of the traffic congestion occurring in the area of construction and typically result from the closure of a lane and/or the reduction of a lane width occurring from the construction activities. These delays can be separated into two categories. Slowing delays which are the delays resulting from a reduced travelling speed through the construction area and queuing delays which are the delays from traffic backups as a result of traffic volume exceeding the roadway capacity. Traffic Delays are calculated based on the principles outlined in the 1994 Highway Capacity Manual HCM [3].

From the traffic delay calculations it is possible to determine an estimate of the social costs incurred by the road users. A responsible transportation agency should incorporate these costs into the total cost associated with any construction project although designers tend to overlook these costs, as they are not borne directly by the agency but indirectly by society.

Slowing delays are determined by the difference in time for a vehicle to travel through a construction zone during construction as compared to the normal travel time without construction. Slowing delay is calculated by the following equation:

$$D_S = \left(\frac{L}{V_{(reduced)}} - \frac{L}{V_{(normal)}} \right) \qquad [1]$$

where: D_s = Slowing delay due to reduced speed (hr)
L = Length of the construction zone (km)
$V_{(reduced)}$ = Reduced speed in the construction zone (km/hr)
$V_{(normal)}$ = Normal speed (km/hr)

The normal speed and reduced speed through construction zones are determined based on the lane capacities within the construction zone. Lane capacities are primarily influenced by the roadway lane width and the presence of trucks and other large vehicles such as recreational vehicles. When drivers are forced to travel through narrow lanes they tend to compensate by slowing their speed and leaving a greater distance between their vehicle and the vehicle

ahead. This longer spacing reduces the capacity of the roadway. Trucks and other large vehicles have reduced operating capabilities (acceleration and deceleration) and also lower the capacity of a roadway. The capacity of a roadway can be adjusted for lane width and the presence of heavy vehicles as outlined in equation 2.

$$CAP = CAP_n \times F_W \times F_{hv} \qquad [2]$$

where: CAP = adjusted capacity of a lane (vphpl)
CAP_n = normal capacity of a lane (vphpl)
F_w = adjustment factor for lane width
F_{hv} = adjustment factor for heavy vehicles

The typical average capacity for single lane traffic through a resurfacing construction zone (on a 4 lane highway) is 1200 vehicles per hour per lane (vphpl) based on Table 6-2 of the HCM [3]. As discussed previously, highway capacities are adjusted (reduced) for situations where narrow lanes are encountered. However, the assumption is made for comparison purposes of this report that the single lane capacity provided for a construction zone considers the narrow lanes required for a resurfacing project. Therefore, no narrow lane reduction factor was applied to this capacity for the narrow lane width of 3.0 m (3.75 m lane + 0.5 m partially paved shoulder – 1.25 m delineation). For the 3.75 m lane width present for Alternative 3, the construction zone capacity was increased by dividing by the narrow lane capacity reduction, thus, eliminating the narrow lane reduction factor assumed to be present in the lane capacity. The appropriate narrow lane reduction factor for adjusting a 3.75 m lane to 3.0 m was determined to be 0.70 based on the single lane traffic principles in Table 8-5 of the HCM [3]. The HCM [3] provides a similar adjustment factor for 2 lane and 4 lane divided highways.

The average capacity for single lane traffic through a construction zone is assumed to incorporate only a small reduction factor for heavy vehicles as it is derived from urban freeways. Therefore, a further reduction factor for heavy vehicles of 0.80 based on Table 3-4 of the HCM [3] is used to adjust for the higher truck traffic on intercity highways. The adjusted capacities for the three alternatives are as follows in Table 3:

Table 3 - Adjusted Lane Capacities for the Staging Alternatives

	Alternative 1	Alternative 2	Alternative 3
Capacity (vphpl)	960	960	1370

Research has shown that speed is fairly insensitive to volume in single lane situations where significant grades or turning traffic are not present [6]. These conditions are consistent with the conditions present through a construction zone on a 4 lane divided highway. The basic relationship between average speed and traffic volume (for a 80 km highway) is defined by the following equation with the modification that in a free flow environment (i.e. small traffic volumes) traffic will travel at 10 km above the construction speed limit of 80 km/hr:

$$V_r = FFS - 25 \times \frac{HV}{CAP} \qquad [3]$$

where: FFS = free flow speed (90 km/hr)
V_r = reduced speed (km/hr)
HV = hourly volume (vphpl)
CAP = hourly capacity (vphpl)

As various sections of highways have different traffic volumes this report considers various different daily traffic volumes ranging from low volume with 6,000 vehicles per day per direction (vpdpd) to high volume with 16,000 vpdpd. For the analysis, daily highway traffic volumes are considered to be constant and hourly volumes for intercity highways are assumed to be evenly distributed during the day (7 am to 7 pm) and evenly distributed during the night (7 pm to 7 am) at one-third of the daytime volume. This assumption is consistent with Figure 2-11 of the HCM [3].

Queuing delays occur when traffic flow exceeds capacity. Where lane capacity is exceeded for a long period of time such as a construction operation, queuing delays can grow to be very large and far exceed the slowing delays outlined above. For a 12 hour duration of exceeded capacity as assumed in this report, the average queuing delay is 15 minutes for every 40 vehicles over the capacity for

Alternatives 1 and 2. Queuing delays can be determined from the following equations:

$$Q_V = (HV \times CAP) \times t \qquad [4]$$

and,

$$D_Q = \frac{Q_V}{CAP} \qquad [5]$$

where: Q_v = volume of vehicles in a queue
HV = hourly volume of vehicles (vphpl)
CAP = hourly capacity (vphpl)
t = time (hours)
D_Q = queuing delay (hours)

From equation 1, the delays per vehicle for a number of possible construction zone lengths can be calculated. For Alternatives 1 and 2, the work area is considered to be 1.5 km, which is the typical length for a hot mix paving operation. The remainder of the construction zone for Alternatives 1 and 2 is assumed to have a reduced speed limit for the construction zone of 80 km/hr in both directions to protect the safety of the construction workers. This is common practice for 4 lane divided highways. For Alternative 3, the single lane situation is for the total length of the project and applies to both directions of traffic. Knowing the delay time for each alternative, the delay cost can be calculated by assuming an hourly value for time per vehicle of $25 per hour. This value is based on previous reports by [7,8,9,10]. The hourly value selected for an analysis will have a large impact on the delay costs determined from an analysis.

A summary of traffic delays is provided in Table 4 with an illustration of the traffic delay costs for a 5 km project in Figure 4.

Comparison of Indirect Costs from Traffic Delays

The traffic delay costs for Alternatives 1 and 2 are the same as they involve the same traffic restrictions. For low and medium traffic volumes, the traffic delays are greater for Alternatives 1 and 2. For a 2 km project with low traffic volumes the costs are more than twice the cost of Alternative 3. As the traffic volume increases and the project length increases, traffic delay costs increase faster for Alternative 3. For example, Alternative 3 has a higher traffic delay

cost for a 8 km project with high traffic volumes (but no queuing). However, once the traffic volumes exceed the capacity of Alternatives 1 and 2, queuing occurs and the delay costs for these alternatives rise rapidly. When the lane capacity is exceeded by 40 vehicles per hour, the delay costs for Alternative 1 and 2 have reached as much as 30 times the delay costs for Alternative 3. The delay costs for this condition now become a significant factor in the comparison of the three alternatives. As traffic volumes increase past the level of high traffic (1000 vphpl) these delay costs will continue to rise at very fast rate.

Table 4 - Summary of Traffic Delay Times and Costs

		Alternatives 1 and 2			Alternative 3		
	Traffic Volume	Project Length			Project Length		
		2 km	5 km	8 km	2 km	5 km	8 km
Total Delay Time (hrs)	Low (500 vphpl)	210	1058	2546	96	602	1542
Total Delay Cost ($)	Low (500 vphpl)	5247	26451	63655	2410	15060	38554
Total Delay Time (hrs)	Med. (750 vphpl)	380	1749	4079	228	1427	3653
Total Delay Cost ($)	Med. (750 vphpl)	9491	43727	101963	5708	35677	91332
Total Delay Time (hrs)	High (1000 vphpl)	610	2592	5854	429	2679	6857
Total Delay Cost ($)	High (1000 vphpl)	15254	64803	146351	10714	66964	171429
Total Delay Time Incl. Queuing (hrs)	High (1000 vphpl)	12610	32592	53854	429	2679	6857
Total Delay Cost incl. Queuing ($)	High (1000 vphpl)	315254	814803	1346351	10714	66964	171429

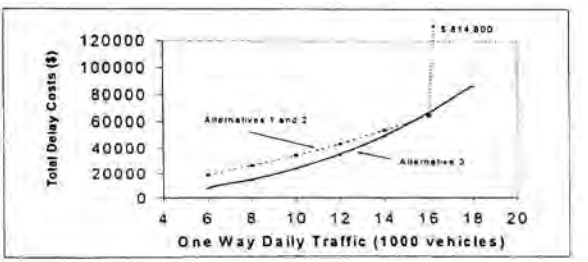


Figure 4 – Comparison of Traffic Delay Costs for a 5 km Project

Total Cost Comparison

The total cost of the three alternatives is the total of the direct costs and the traffic delay costs. Alternative 1 is the most cost effective

alternative for all lengths and all traffic volumes except when queuing occurs. The costs for Alternative 2 are very similar to Alternative 1 with the difference being a premium of about $4,000 to $13,000 for the police protection. The costs for Alternative 3 are considerably higher by as much as $500,000 for a 8 km project with high traffic and no queuing. Once queuing occurs for Alternatives 1 and 2, the cost advantage of these alternatives is lost. Alternatives 1 and 2 become considerably more expensive for 5 km and 8 km projects to the amount of $700,000 for an 8 km project. Although Alternatives 1 and 2 are still cheaper for a small 2 km project with queuing, the traffic delay costs are a major cost and are very sensitive to small changes in the queuing time. A summary of the costs is shown in Table 5. The total costs for a 2 km and 5 km project are shown in Figures 5 and 6.

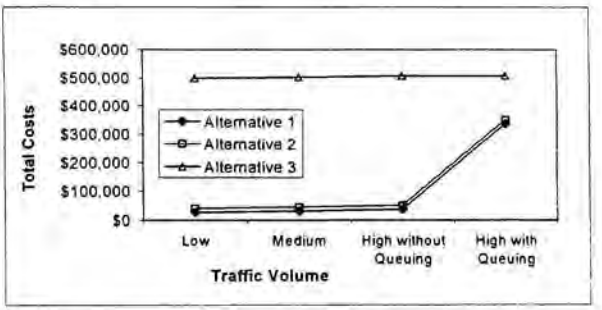


Figure 5 – Total Costs of Various Traffic Volumes for a 2 km Project

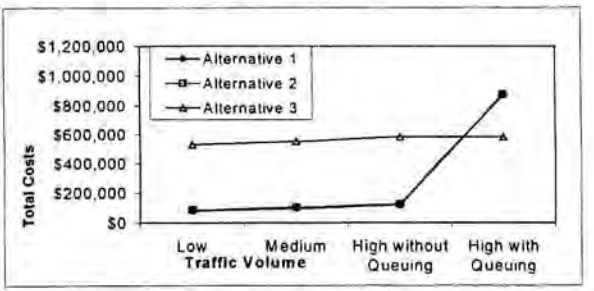


Figure 6 – Total Costs of Various Traffic Volumes for a 5 km Project

Table 5 – Total Cost Summary

		Traffic Vol (vphpl)	Project Length 2 km	5 km	8 km
Alternative 1	Direct Costs ($)		$20,800	$51,900	$83,100
	Traffic Delay Costs ($)	500	$5,247	$26,451	$63,655
	Traffic Delay Costs ($)	750	$9,491	$43,727	$101,963
	Traffic Delay Costs without Queuing ($)	1000	$15,254	$64,803	$146,351
	Traffic Delay Costs incl. Queuing ($)	1000	$315,254	$814,803	$1,346,351
	Total Costs ($)	500	$26,047	$78,351	$146,755
	Total Costs ($)	750	$30,291	$95,627	$185,063
	Total Costs ($) without Queuing Delays	1000	$36,054	$116,703	$229,451
	Total Costs incl. Queuing Delays ($)	1000	$336,054	$866,703	$1,429,451
Alternative 2	Direct Costs ($)		$24,100	$60,300	$96,500
	Traffic Delay Costs ($)	500	$5,247	$26,451	$63,655
	Traffic Delay Costs ($)	750	$9,491	$43,727	$101,963
	Traffic Delay Costs without Queuing ($)	1000	$15,254	$64,803	$146,351
	Traffic Delay Costs incl. Queuing ($)	1000	$315,254	$814,803	$1,346,351
	Total Costs ($)	500	$29,347	$86,751	$160,155
	Total Costs ($)	750	$33,591	$104,027	$198,463
	Total Costs ($) without Queuing Delays	1000	$39,354	$125,103	$242,851
	Total Costs incl. Queuing Delays ($)	1000	$339,354	$875,103	$1,442,851
Alternative 3	Direct Costs ($)		$496,900	$514,800	$542,100
	Traffic Delay Costs ($)	500	$2,410	$15,060	$38,554
	Traffic Delay Costs ($)	750	$5,708	$35,677	$91,332
	Traffic Delay Costs without Queuing ($)	1000	$10,714	$66,964	$171,429
	Traffic Delay Costs incl. Queuing ($)	1000	$10,714	$66,964	$171,429
	Total Costs ($)	500	$499,310	$529,860	$580,654
	Total Costs ($)	750	$502,608	$550,477	$633,432
	Total Costs ($) without Queuing Delays	1000	$507,614	$581,764	$713,529
	Total Costs incl. Queuing Delays ($)	1000	$507,614	$581,764	$713,529

Other Considerations for Selecting Alternatives

In addition to the cost comparison presented above, the designer should also consider a number of considerations that are not easily quantified. These considerations include the following:

1. Worker and Road User Safety - Highway designers focus on balancing the direct costs of a project with the inconvenience to the road users while neglecting the safety of the workers. The annual cost to society from highway work zone accidents in the United States is estimated by the National Asphalt Paving Association (NAPA) to be $ 3.04 billion [11]. Society can debate the cost of highway work zone accidents but there is agreement that the impact of work zone accidents is significant and should not be overlooked when selecting the method of construction operation. With the increasing risks associated with highway construction and

maintenance operations, the use of truck mounted attenuators and/or law enforcement are becoming more common of highway construction projects. These costs have tried to be quantified in Alternative 2. Further safety measures can also include the use of changeable message signs, which can alert drivers to specific dangers and/or situations ahead. Changeable message signs are especially effective in warning drivers of stopped traffic ahead which results from traffic queuing. Clearly Alternative 3 has significant safety feature over the other alternatives as traffic is completely separated from the work area.

2. Ease of Construction - Alternative 3 enables the contractor to have greater flexibility in their operation. The contractor's staff and equipment are not restricted by traffic adjacent to the work zone. Furthermore, with half of the construction zone designated as the work zone the contractor is free to move about the entire work zone without constantly adjusting their traffic control. This flexibility can allow a contractor to have a number of operations underway at a time, thus speeding up the completion of the project. The impact on completion time can be greatest when a resurfacing contract involves additional work along with the paving such as crack repairs, frost-heave repairs and/or other grade repairs. The flexibility in operation also allows the contractor to utilize (or the agency to specify) construction methods that are not feasible under Alternatives 1 and 2. Specifically, the technique of paving in echelon where two lanes are paved at the essentially the same time. This method is desirable as it provides a hot joint between the two lanes, thus providing a better quality product by eliminating the construction joint that occurs with conventional paving. Another quality improvement from Alternative 3 is that it eliminates the problem of traffic driving on a warm asphalt mat. Hot asphalt takes approximately 12 hours to fully cool following placement. Under a conventional operation, the hot asphalt is usually open to traffic within one or two hours of placement. This can contribute to premature pavement rutting.

3. Driver Familiarity - Drivers are better prepared when they know what to expect on a roadway. For most paving projects (i.e. Alternatives 1 and 2) the work zone is continually moving and the

traffic can not become familiar with the roadway and its restrictions. Alternative 3 will provide the same roadway restrictions for a considerable amount of time. The project consists of essentially two traffic stagings (one for construction of each side of the highway). Drivers that travel through the construction zone on a regular basis become familiar with the restrictions and are better prepared to react to them.

4. Driver Frustration - Accident rates rise with driver frustration levels which are directly related to their delay time. Alternatives 1 and 2 result in significantly higher delay times once the highway capacity is exceeded and queuing occurs.

5. Traffic Accidents - Traffic accidents are an inevitable part of managing traffic and result in a short-term reduction in the capacity of a roadway. Some accidents can block a lane for a significant length of time, particularly when an overturned truck or multiple vehicles are involved. Alternatives 1 and 2 have the advantage of restricting a smaller section of single lane traffic and the flexibility to discontinue construction operations for the day to re-open the lane under construction.

6. Traffic Variation - The general assumptions made about daily and weekly traffic volumes are valid approximations of traffic behaviour, although a designer should not overlook the fact that these are in fact approximations. These approximations do not account for the variation that occurs with all traffic flow and the variation resulting from special events such as long weekends. Alternatives 1 and 2 can be modified to incorporate operational constraints to restrict the contractor from closing a lane during peak traffic periods such as the beginning and end of a long weekend.

7. Variation in Analysis - The traffic delay costs are based on theoretical traffic volumes and general assumptions about its daily and weekly distribution. For actual projects, the traffic data available will be only an estimate of the actual traffic volume. As discussed above, when the traffic flow exceeds the traffic capacity, traffic delays increase substantially. If the estimated traffic volumes are estimated to be near the theoretical capacity of the roadway, the designer should recognize that queuing delays may occur.

Consideration should be given to updating the traffic volume estimates and reviewing the criteria used for the reduced roadway capacity calculations.

Conclusions

The following points summarize the analysis:

1. The construction of a median crossover detour with opposing single lane traffic provides a greater roadway capacity than conventional single lane traffic through a resurfacing project.
2. The delay costs from queuing can be very high and are sensitive to even small amounts of traffic exceeding the roadway capacity.
3. The conventional way of staging highway resurfacing projects (i.e. Alternatives 1 and 2) is considerably more cost effective than detouring traffic across the median (i.e. Alternative 3) until the traffic volumes exceed the roadway capacity and queuing occurs.
4. When the traffic volumes exceed the lower roadway capacity of conventional staging, the delay costs from queuing quickly exceed the higher direct cost of building a median crossover.
5. Other factors must be considered when selecting the best construction staging alternative. These include the additional safety provided to the workers provided by constructing a median crossover and the higher flexibility to accommodate peaks in traffic volume through conventional staging.
6. The additional cost of police protection or a barrier vehicle is small when compared to the costs associated with controlling traffic on a highway resurfacing project and the traffic delay costs that result.
7. A responsible transportation agency must incorporate traffic delay costs, worker safety and road user safety into the selection of the optimum construction staging alternative.

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TRANSPACIFIC FLIGHT: The Case for a Strategic Hub

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EXECUTIVE SUMMARY

This study outlines the practical feasibility of a U.S. carrier establishing a strategic, directional and complexing hub in order to facilitate the flow of passengers across the Pacific Ocean. Presently, American carriers fly nonstop to very few Asian cities and are limited by market demand as to the number of locations they can serve through nonstop flights. Gaining access to more Asian cities hinges upon the Fifth Freedom right or the ability of the airline to pick up passengers in a second country and fly them to a third country. Only Northwest Airlines, because of a 1952 treaty, has established a hub in Japan serving the Asian market but even this privilege is being negotiated away with the push for Open Skies between the U.S. and Japan. By creating a transpacific hub on American soil, U.S. carriers - like American Airlines and Delta Airlines - could gain access to several transpacific city-pairs and not be concerned with obtaining 5th or 7th Freedom rights.

Ideally, such a hub would lie along the Great Circle route between Northeast Asia and the United States. Otherwise, the trade-off will be the longer flight times versus the traditional Great Circle routes. However, a non-Great Circle route could still be justified if it involved a one-stop connecting flight from interior North American cities to business centers in the Asia/Pacific region that are presently reached through at least two stops. According to Tretheway and Oum (1992), medium-sized communities have traditionally been serviced indirectly through the major gateway cities. To make the analysis complete, however, both medium and large cities were included in the study.

This study discovered that to serve the entire Asia/Pacific region, Honolulu would be the most viable candidate for the

transpacific hub. Honolulu provides access from North America, Asia, and Australia/New Zealand with an average flight time of nine hours and is accessible by a medium-capacity, aircraft like the Boeing 767-300ER. This contributes to the profitability of the potential hub by overcoming the need for a large capacity jet. The 9-hour flight time for the longest leg in a potential transpacific system via Honolulu eliminates the requirement of maintaining a dual crew onboard.

In conclusion, the main benefit to be gained by an airline establishing a hub in Honolulu is the creation of a strategic asset that could be the source of competitive advantage in a market with strong long-term growth potential. Advantages for passengers travelling across the Pacific via Honolulu include:

i) a single transfer point in markets where there are presently two stops enroute
ii) enhanced quality of service aspects provided by a single carrier from origin to destination
iii) well-timed connections
iv) reduced trip times
v) an attractive stopover point for the leisure traveler

The state of Hawaii would be an essential stakeholder and tax breaks for the hub carrier could very well be offered in exchange for creating jobs, investment and additional tourism for the state.

INTRODUCTION

The air transportation industry is governed by a host of bilateral conventions and agreements between nations. These bilateral treaties, like the Bermuda II Agreement signed in July 1977, control access to destinations, frequencies of flights, and beyond rights of an airline. Whereas 3rd and 4th Freedom rights -- the ability to carry traffic from the home country to a foreign country and vice versa -- have long been in place, very often airlines require 5th and 7th Freedom rights. These rights allow a carrier to pick up traffic in a

foreign country and fly to yet another foreign country (Oum, 1999).

So far 5th and 7th Freedom rights have been harder to obtain and, as a result, carriers often find it difficult to justify the opening of a new international route. For instance, in the U.S., only two passenger carriers -- Northwest Airlines and United Airlines -- have been traditionally permitted beyond rights from Japan (United having acquired their rights from Pan American). Consequently, other American carriers have been left out of the normally lucrative transpacific market since they could not justify a "non-hubbing" nonstop service between many city pairs.

According to Northwest Airlines' President and CEO, Mr. John Dasburg, the Narita airport hub in Japan is a strategic asset for the carrier and serves to illustrate the importance of 5th and 7th Freedom rights (Dasburg, 1994). In his strategy video communicated to 45,000 employees at Northwest Airlines, Dasburg claims, "....we have a very, very special position in Japan and we can actually have a hub and spoke system in Japan and fly between Japan and Asian countries carrying local traffic." Both Japan Airlines and other U.S. carriers have long been pressuring their respective governments to re-negotiate the one-sided 1952 treaty that was signed between the two countries after the Second World War. On January 30, 1998 (Sekigawa and Schifrin, 1998), a new U.S.-Japan air services agreement was signed that was a modification of the 1952 pact allowing more access to other U.S. carriers like American, Delta, and Continental (Donoghue, 1998). Whereas this is a step in the right direction, Japan's busiest airport, Narita, remains slot constrained and American, Delta, and Continental still do not enjoy the rights of Northwest and United Airlines.

Therefore, the success of U.S. carriers seeking market penetration in the Asia/Pacific region hinges upon the successful establishment of an alternate strategic and directional hub. This transpacific hub would serve as a logistical transfer point in order to connect traffic from flights arriving from North America to flights departing for the Asia/Pacific region and vice versa.

DEVELOPING A STRATEGIC HUB

The Hub and Spoke System

Passengers always prefer non-stop routes; however, very often a route may not generate enough traffic to justify frequent non-stop services. Naturally, in-frequent services are not as convenient for the traveler as they do not offer a choice of departure and arrival times. Convenient departure and arrival times are especially important for the business traveler. By organizing their route networks into hub and spoke systems, airlines can use the same number of aircraft to connect more city pairs or to increase the number of frequencies offered.

Although the circuitous routing via the hub, the necessary additional descent and ascent at the hub, and the connecting time on the ground are all time penalties adding to the duration of the trip, a non-stop flight that is offered less frequently will present the traveler with a schedule delay (Oum, 1995). A schedule delay is the difference between the passenger's desired time of departure and the actual departure time. For example, in a twenty-four hour period, a route offering just one non-stop flight will incur a schedule delay time of twelve hours on average. With the increased possible frequencies through the hub, although a passenger's travel time might increase, his/her schedule delay will compensate for this increase. The total effect on travel time is therefore the difference between the time penalties described above and the reduction in the schedule time delay (Oum, 1995). Since the proposed transpacific hub would be optimal in addressing thinner markets, it would not be competing against any non-stop flights (like Japan Airlines' Los Angeles to Tokyo flights) and therefore is expected to be a time saving strategy. The Los Angeles (LAX) to Tokyo (NRT) type route would not be optimal because the hub system will increase a passenger's travel time and therefore negatively affect demand on this and any other route with an already established frequent or nonstop service (Tretheway, 1991).

Example of a Transoceanic Hub

Presently, U.S. carriers use the hub concept successfully in their domestic network. Could the hub concept safely be expanded to include international routes? Icelandair is currently successfully carrying out an analogous operation on transatlantic routes linking North America and Europe. Through the coordination of schedules, passengers arriving from six different cities in North America at Icelandair's Keflavik terminal are transferred immediately to eighteen destinations in Europe[1]. The synchronization of arrival and departure times means that most connections are made within the period of one hour. Icelandair's hub at Keflavik is an example of a complexing hub in which flights on all spokes are timed to arrive and depart within a short period of time.

Choosing a Transpacific Hub

According to Ashford (1996), the critical success Factors for a hub airport to be effective depend upon the following criteria:

i) The geographic location.
ii) The availability of flights to multiple destinations.
iii) The capacity of the airport system to handle aircraft movements and passenger volumes.
iv) The ability of the terminal layout to accommodate passenger transfers.

Oum and Tretheway (1992) also add base traffic or the hub city's ability to generate traffic to this list. The choice of a transpacific hub would therefore be governed by the following basic criteria:

i) Well-situated geographically in order to collect traffic from throughout North America and transfer traffic to points throughout the Asia/Pacific region including Australia/New Zealand.
ii) Ability to use medium-size aircraft (like the 767) on routes to and from the hub. This will help establish more frequencies

[1] http://www.icelandair.com

(than with larger equipment) while providing load factors exceeding the break-even point.

iii) Room for augmenting airport capacity at the chosen hub location.

iv) Sufficient destination traffic to and from the hub originating from North America, Asia and Australia/New Zealand.

In addition, the chosen location should be on U.S. soil to avoid the need for obtaining 5th or 7th Freedom rights. Flights between the Asian country and the hub would then be considered 3rd and 4th Freedom flights -- already permissible -- as would flights between the hub and Canada or Mexico. All other flights would be domestic U.S. flights. Finally, in order to generate sufficient and consistent destination traffic, the hub should ideally be an all-season destination in itself.

Clearly, the hub would have to be based in the western United States to make it purely directional and thereby avoid backtracking. Possible candidates would then be Anchorage (ANC), Honolulu (HNL), Los Angeles (LAX), Seattle/Tacoma (SEA), and San Francisco (SFO). From appendix 2(b) it becomes clear that any hub in the lower 48 states would eliminate several routes from Southeast Asia and Australia since the distance involved would be out of range for a medium capacity aircraft like the 767. This would constrain the development of the hub by imposing higher capacity aircraft on the thinner routes from Southeast Asia and the South Pacific.

Appendix 3 shows a comparison of the remaining two candidates i.e. Anchorage and Honolulu. Although Anchorage is more ideally located since it lies on the Great Circle route from Northeast Asia to points in the United States, Anchorage's northerly position makes it unsuitable for flights from the South Pacific region. For example, a passenger going from Sydney to Houston is likely to travel an additional 2659 kilometers connecting through Anchorage than through Honolulu. Therefore, although Honolulu becomes less desirable as a connecting point for the Northeast Asia to United States route (example Seoul to Atlanta), Honolulu is more ideally located

overall to funnel traffic from all over the Pacific Rim.

The proximity of Honolulu to all points around the Pacific Ocean means that very few proposed routes would require a dual flight crew thereby contributing to the profitability of the operation. Furthermore, Hawaii's year-round mild climate makes it an excellent destination in itself. In contrast, the tourist season in Alaska is only from May to September. Both prospective hub cities are close enough to almost all proposed points in the Asia/Pacific region and North America, to be served exclusively by a mid-to-long range, medium capacity aircraft type (like the Boeing 767). However, here too Hawaii enjoys a slight edge in that Melbourne, Australia is the one exception being out of range from Anchorage even on the 767 extended-range version.

While Anchorage airport seems to be focusing on transpacific cargo traffic and expanding its domestic terminal, Honolulu already considers itself a crossroads for flights across the Pacific and is encouraging airline investment[2]. In 1997, when Continental Airlines announced that it was planning to build a maintenance facility near the airport for its Pacific route aircraft, the governor of Hawaii offered the airline a $2 million tax break for generating additional jobs for the state[3]. According to a survey conducted by Airport Council International - Pacific Region, "....planning for the future of the Pacific island hub (Honolulu) is moving ahead full force....A new US$250 million international arrivals building is planned for completion in 2005[4]."

Overall, it was determined that Honolulu is the top choice for locating a transpacific hub. However, not all routes will be viable through Honolulu. For example, the business traveler flying the major routes from western United States to Asia like LAX-HKG and SFO-NRT will not always find it attractive to add a connection into

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[2] http://starbulletin.com/97/04/04/business/story3.html
[3] ibid
[4] http://www.aci-pacific.org/Issues/Body_Congestion.htm

the journey when frequent nonstop flights are readily available. On the other hand, many other travelers (both business and tourist alike) may find a stopover in Hawaii an added bonus to the start or end of a trip across the Pacific Ocean. An airline using the Honolulu model, should therefore examine carefully the demand between the city pairs offered through this hub, the demand for destination traffic, and then compare the benefits of such a service versus existing passenger routings.

PLANNING VIABLE ROUTES

Demand for Air Travel in the Pacific Region

The currency and economic upheaval in many Asian countries has resulted in a slow down in the demand for air-travel to and from the region. For a number of years, rapid growth in air travel was typical of this region. According to ICAO, the average annual growth rate of RPKs enjoyed by Asia/Pacific airlines was 9.5% (Flint, 1997). IATA has slashed short-term traffic growth projections for the Asia/Pacific region from 8% to 4% per annum (anonymous, 1998). Despite the weak short-term traffic projections, the devaluation of currencies in the region imply that there will be continued strong traffic to the tourist markets like Thailand and Indonesia (Cameron, 1998). In the long-term, according to Thomas and Schifrin, "the slight scaleback is expected to be a blip on an increasingly upward curve" (Schifrin and Thomas, 1998). IATA's Monthly International Statistics (1998), for instance, show that by July 1998, the Far East region had again experienced positive change in RPKs over the previous year (after several months of negative year-over-year growth). For example, December 1998 was 8% better than December 1997 in terms of RPKs (see appendix 4).

Demand plays an important role in the operation of an airline route. According to the Bureau of Transport and Communications Economics (1994), there are several factors that influence demand like consumer income, ticket price and the quality of the airline's service, as well as the price and quality of a substitute mode of transport. In the case of major international routes across the pacific, there is really no substitute today for air travel. So given a certain

level of income and assuming airlines price in a similar fashion, an individual is likely to choose an airline based upon the quality of service aspects. The Bureau of Transport (1994) concluded that these include travel time, convenience of service times, frequency of service, availability of nonstop service, the airline's overall network coverage and onboard service, safety and security.

Feasible Routes Via the Transpacific Hub

Among the quality of service considerations, travel time was regarded as the most important factor. This is defined as the total time elapsed from a passenger's origin to destination. By analyzing existing services versus the proposed routes (via Honolulu), it can be determined which routes will be attractive to passengers in terms of travel time. Of course, competing nonstop routes are dropped at the outset as these would not be appealing to the business traveler. Frequencies of the proposed service and service times were not analyzed because they would be a subsequent step following an airline's decision to operate the Honolulu hub.

Sixteen cities in the Asia/Pacific region were proposed as potential spokes connecting to thirty cities in Canada, the United States, and Mexico. Since the hub is an east-west directional hub, Asia to Asia connections and North America to North America connections will be neither practical nor permitted by the model. Therefore, each of the 16 Asia/Pacific cities would have traffic to 31 cities (30 connections plus Honolulu destined passengers). Since this provides 496 city pairs[5] in each direction, it was necessary to start with a scaled-down version of the concept. Thus 16 cities in the Asia/Pacific region were analyzed with 3 U.S. destinations namely, Atlanta, Dallas, and Boston. In each case, 9 of the 16 city pairs proved viable in that they offered travel times of less than or equal to the typical existing route with an average benefit to the traveler of 3.7 hours (appendix 5).

[5] 16 x 31 = 496 city pairs in each direction.

In several cases, the existing service was a combination of multiple carriers that were not even in the same global alliance system. For example, the Boston to Bangkok route is most popularly served by an interline connection between British Airways and Thai Airways in London. British Airways is part of the One World Alliance while Thai Airways belongs to the competing Star Alliance. In another instance, the Dallas to Manila route is typically served by connecting an inbound American Airlines flight to an outbound Northwest Airlines flight in Osaka; these two airlines are competitors and belong to different global alliance systems. A passenger changing airlines halfway through his/her itinerary is usually inconvenienced in a number of ways. The passenger would not get frequent flier mileage recognition on a single plan for the entire itinerary and would have to split the miles between two different airline plans. If the two airlines do not have an interline baggage agreement, the passenger would have to clear customs at the transfer point and check-in a second time enroute to the destination. In the preceding British Airways to Thai transfer, if the passenger is a frequent flier on Thai Airways alone, he/she will not be allowed to use the British Airways lounge at Heathrow airport in London. Therefore, passengers usually prefer travelling on a single carrier from their origin to their destination.

Overall, it can be determined (from appendix 5) that the viable routes through Honolulu are generally those that are *not* currently served by nonstop flights as well as those where the connecting time or a second stop adds to the duration of the trip. Of the routes analyzed in the scaled-down model from the three originating cities of Atlanta, Dallas and Boston, those that saved the passenger the most time were:

i) Dallas to Kuala Lumpur (9.4 hours saved via Honolulu due to the alternative lengthy connection time in Frankfurt)

ii) Boston to Beijing (8.3 hours saved via Honolulu due to the alternative lengthy connection time in Frankfurt)

iii) Dallas to Jakarta (7.6 hours saved via Honolulu due to the alternative 2 stop routing through Seattle and Taipei).

Tokyo, Osaka, Seoul, and Hong Kong consistently did not make the list of viable routes although Hong Kong was marginally a likely candidate out of Atlanta. Despite this fact however, these four Asian cities must not be completely ruled out as they could still be feasible from some other North American cities with limited nonstop service today. Tokyo becomes very attractive from Washington and Orlando for instance where the present route (via Frankfurt) takes 24.5 and 25.7 hours respectively. The Honolulu connection, in this case, results in a trip time of 17.3 and 17.2 hours respectively creating a significant competitive advantage. Ideally, all thirty major North American cities should be analyzed versus the potential sixteen Asia/Pacific destinations for the existing traffic and routings in order to pinpoint *all* the viable market pairs.

FLEET PLANNING

Aircraft Selection

Airline Fleet Planning departments spend considerable time and effort in determining which aircraft type is best suited to a route. There are presently 56 different jet and turboprop aircraft models with 1,226 variations in existence (Miller and Plumb, 1998). Basically, two major criteria go into selecting an aircraft type namely operating costs and the route structure. In a hub operation, by doubling the number of flights inbound and outbound, you actually increase the possible city pairs by more than double. This is because 10 flights in and out produce 100 possible connections whereas 20 flights in and out will produce 400 connections. Airlines with hubs therefore find it beneficial to increase the number of flights arriving and departing the hub. Miller and Plumb (1998) concluded that this creates a demand for more jets but pushes the size of the aircraft required downwards in order to make the operation economically feasible.

Matching Aircraft Type to Route Structure

In the case of the transpacific hub, the Boeing 767 aircraft is proposed as a typical likely candidate for the following reasons:

i) The Boeing 767 is a medium capacity jet making it profitable even on thinner routes. The Airbus A340, Boeing 777, and Boeing 747-400 are all larger capacity jets requiring between 80 and 200 more passengers per flight to fill capacity.

ii) The 767-300ER has a maximum range of 7,080 statute miles (or 11,390 kilometers) making it capable of executing the longest route in the proposed plan namely, Honolulu to Kuala Lumpur which is 6,811 statute miles (or 10,960 kilometers). This aircraft can carry 218 passengers in a three-class configuration. (The 767-200ER has a slightly longer range of 7,655 statute miles but carries only 181 passengers in a three-class configuration).

Both these variants of the 767 could prove to be useful in the operation of the hub at Honolulu. Since a maximum of 30 North American cities are making connections with 16 Asia/Pacific cities in this model, it may be useful to use the smaller capacity 767-200ER jets on the mainland North America to Hawaii leg and the larger capacity 767-300ERs on the Hawaii to Asia leg of the journey. This will help maintain profitable load factors on both sides of the hub (see appendices 6(a) and 6(b)). Furthermore, appendix 6(b) shows that about 6 to 7 passengers per destination would be needed per flight in order to achieve a 72% system load factor target.

By keeping to one aircraft type for the entire Pacific region, an airline could save on maintenance costs, training costs, insurance, spares cost and acquisition costs (Miller and Plumb, 1998). Many airlines like Southwest Airlines in the United States and Westjet in Canada are using these principles of fleet commonality to curb operating costs successfully.

CONCLUDING REMARKS

Although air traffic growth is projected to be slow in the Asia/Pacific region for the next 5 years, the long-term outlook remains attractive. Traditionally, some U.S. carriers -- other than Northwest Airlines, United Airlines, and Federal Express -- have

been denied access to much of the market because of the U.S.-Japan treaty signed in 1952 that restricted their access to and from Japan and their ability to carry passengers beyond Japan. Japan was important because it was the source and destination of the greatest numbers of transpacific passengers amongst Asian countries. Nonstop services to thinner markets in Asia were not considered viable by these airlines (like American Airlines and Delta Airlines) if they did not get the coveted 5th Freedom rights that allowed them to pick up and drop off passengers in Japan. The Honolulu hub provides a solution since it would be on U.S. territory and therefore involve only 3rd and 4th Freedom rights.

By establishing a directional and complexing hub in Honolulu an airline could potentially serve over 400 city pairs in each direction that would connect points in the Asia/Pacific region to points within North America. The key nonstop markets like Los Angeles to Tokyo would not be benefited by such a hub; however, many thinner markets like Washington to Tokyo, Dallas to Singapore, and Atlanta to Sydney would reap significant time savings anywhere from 2 to 7 hours (see appendix 5). Many of the proposed routes are reached today by either 2 stops or through an uncoordinated interline connection making travel difficult and inconvenient.

Honolulu presents a unique solution in that it is situated mid-Pacific and therefore able to funnel traffic from all around the Pacific region serving as a logistical transfer point for transpacific passengers. Due to the proximity of Honolulu to points around the Pacific Ocean, the flights would not need to carry a dual crew. Honolulu also has the added benefit of being a year round tourist destination and can attract the destination traveler in addition to the transfer traffic. Finally, being within reach of a medium capacity jet from all over the Pacific region strengthens the feasibility of the transpacific hub concept.

Potential benefits are not limited to passenger service and airline operations. The state of Hawaii would be a key stakeholder in any plan for the Honolulu hub and tax benefits could be handed down

to the prospective carrier in lieu of creating jobs, investment and additional tourist revenue for Hawaii.

NOTE

To review the appendices, please contact the author directly at zubin@ultranet.ca

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