CTRF

Transportation: Emerging Realities



Les Transports: realités en puissance

VOLUME 1

Canadian Transportation Research Forum
Proceedings of the 32nd Annual Conference
Toronto, Ontario May 25-28, 1997

Le Groupe de Recherches sur les Transports au Canada
Actes de la 32ième conférence annuelle
Toronto, Ontario 25 au 28 mai, 1997

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

PROCEEDINGS
of the 32nd Annual Conference

ACTES
de la 32ième Conférence annuelle

TRANSPORTATION: EMERGING REALITIES
LES TRANSPORTS: RÉALITÉS EN PUISSANCE

Toronto, Ontario
May 25-28 / 25 au 28 mai
1997

Proceedings Printed by

University of Saskatchewan
Printing Services

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President's Message

Welcome to CTRF's 32nd Annual Conference!

These Proceedings include the papers presented at the Annual Conference, together with the winning papers from CTRF's student paper competition. A summary of the keynote address and panel discussion will be distributed at a later date.

Organizing a conference of this sort is a major undertaking and I am sure you will agree that this year's conference team has done a first-class job. The team was spear-headed by David Cape and Janet Weiss and included Bill Raney, Rod Taylor, Christine Robinson, Fred Nix and John Heads. Their efforts are greatly appreciated.

Thanks are also due to the sponsors who have helped to make this conference a success, and to everyone who is presenting a paper, chairing a session, participating on a panel, or otherwise helping to make this a lively, informative event.

Message du Président

Bienvenue à la 32e Conférence annuelle du GRTC!

Ces actes comportent les communications présentées à la conférence annuelle ainsi que les publications gagnantes de la compétition des étudiants. Un résumé du discours - programme et des discussions en atelier sera distribué à une date ultérieure.

Organiser une conférence de cette nature constitue un grand défi et vous conviendrez avec moi que l'équipe qui a préparé celle de cette année a effectué un travail de tout premier plan. Cette équipe, dirigée conjointement par David Cape et Janet Weiss, comprenait aussi Bill Raney, Rod Taylor, Christine Robinson, Fred Nix et John Heads. Leurs efforts sont hautement appréciés.

Nos remerciements vont aussi aux commanditaires qui ont contribué au succès de cette conférence et à chaque personne qui a présenté sa publication, qui a présidé une séance, qui a participé à un atelier ou qui a apporté une aide quelconque qui a permis d'en faire un événement vivant et fructueux.

George Clark

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

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

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

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

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

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

..... ANNOUNCING .....

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WATCH FOR CALL FOR PAPERS COMING IN SEPTEMBER 1997

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Keith Scott, Alberta Economic Development
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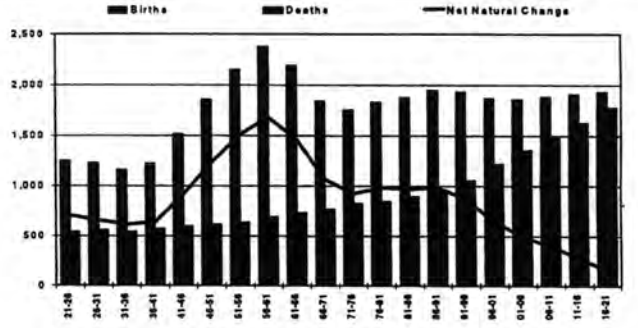
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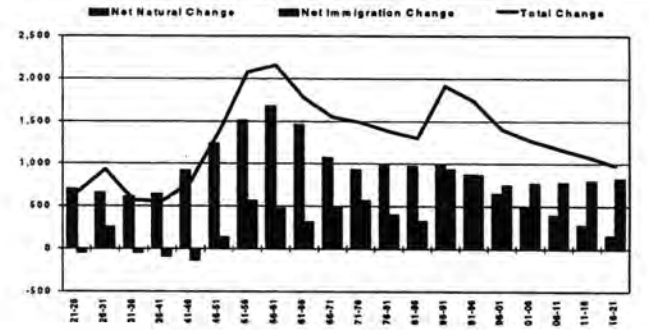
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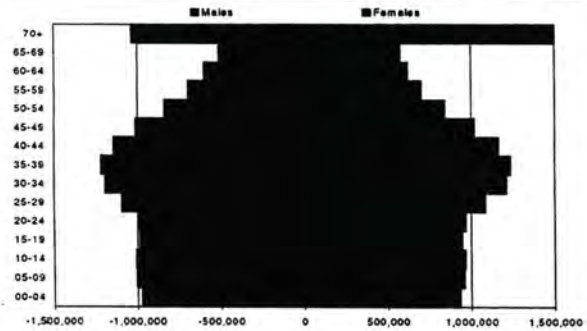
Canada's Net Natural Population Growth 1921 to 2021 (5 Year Periods in Thousands)



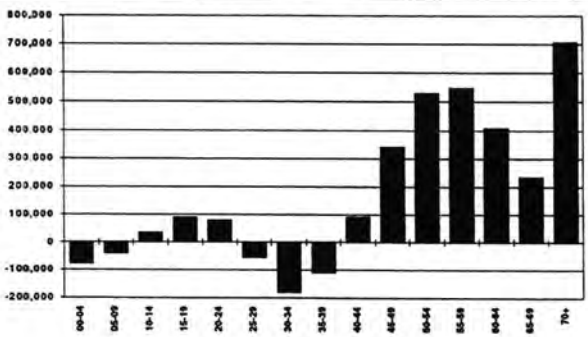
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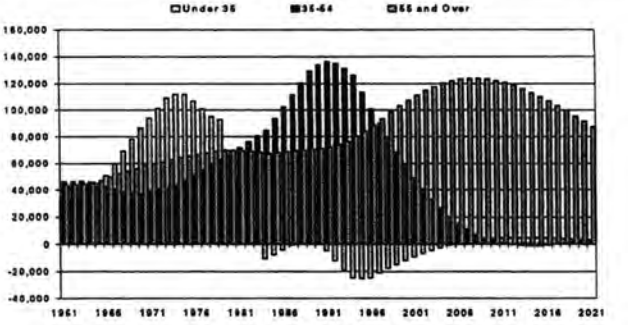
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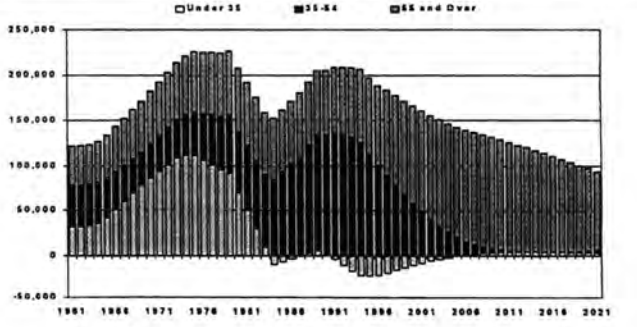
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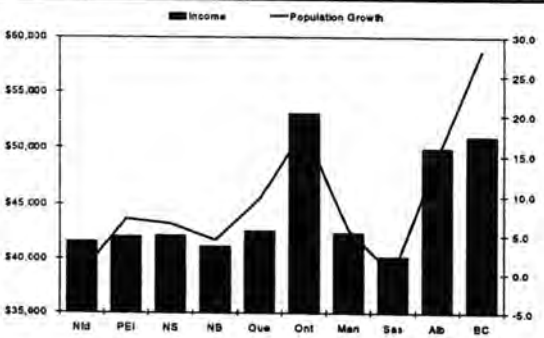
Demographic Change in Households By Age of Household Head 1961 to 2021



Demographic Change in Households By Age of Household Head 1961 to 2021



Average Household Income (1995)
Population Growth (% Change 1985-1995)



Population by Province
1996 and 2006 (Thousands)

Province	1996	2006	Change 96-06	Percent Change 96-06
Newfoundland	563	555	-8	-1.5
Prince Edward Island	136	145	9	6.8
Nova Scotia	924	959	35	3.8
New Brunswick	738	758	21	2.8
Quebec	7,187	7,622	435	6.1
Ontario	10,823	11,926	1,103	10.2
Manitoba	1,122	1,166	45	4.0
Saskatchewan	1,000	1,018	17	1.7
Alberta	2,717	2,974	257	9.4
British Columbia	3,731	4,402	671	18.0
Yukon	29	31	2	5.8
Northwest Territories	63	71	8	12.5
Canada	29,033	31,626	2,593	8.9

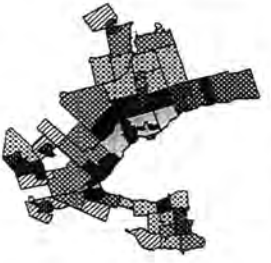
Employment by Industry 1985 and 1995 (Thousands)

	1985	1995	Change	Percent Change
Agriculture	481.5	430.5	-51.0	-10.6
Other primary	296.5	295.7	-0.8	-0.3
Manufacturing	2063.9	2,060.9	-3.0	-0.1
Construction	608.2	723.6	115.4	19.0
Transportation, communication	918.5	1,032.8	114.3	12.4
Trade	2087.8	2,306.7	218.9	10.5
Finance	660.2	809.2	149.0	22.6
Business services	527.3	867.1	339.8	64.4
Education	767.6	943.9	176.3	23.0
Health, social services	1011.8	1,339.6	327.8	32.4
Accommodation, food, beverages	664.1	861.0	196.9	29.6
Other service industries	824.6	1,024.7	200.1	24.3
Public administration	830	809.9	-20.1	-2.4
Total employment	11,742.0	13,505.6	1,763.6	15.0

Canada's Population by CMA Percent Share of Canada Total in 1996



Canada's Population Concentration
Ontario's Golden Horseshoe (Plus)



- 6.2 million in 1996
- 6.8 million in 2006
- up 11.0 percent (96-06)
- 21.3% of population (1996)
- 26.2% of growth (96-06)
- 24.7% of income (1996)

Canada's Population Concentration
British Columbia's Lower Mainland

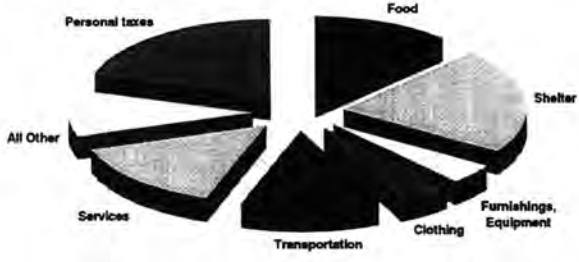


- 2.0 million in 1996
- 2.4 million in 2006
- up 18.1 percent (96-06)
- 7.0% of population (1996)
- 14.1% of growth (96-06)
- 7.8% of income (1996)

Canada's Major Urban Growth Areas Population 1996 to 2006

Major Urban Growth Areas	1996	96-06	% Change 96-06
Toronto	4,232,791	497,614	11.8
Kitchener	387,517	46,298	11.9
Hamilton	626,051	58,118	9.1
Barrie	113,050	33,483	29.6
Oshawa	258,817	24,778	9.6
St. Catharines-Niagara	379,302	21,718	5.7
Guelph	104,204	10,186	9.7
Brantford	102,305	7,591	7.3
Golden Horseshoe Plus	6,193,836	679,595	11.0
Vancouver	1,811,934	313,047	17.3
Abbotsford	135,365	32,227	23.8
Chilliwack	74,089	20,931	28.3
BC's Lower Mainland	2,021,388	366,206	18.1
Montreal	3,258,807	197,637	6.1
Ottawa-Hull	1,006,187	126,361	12.6
Calgary	827,570	109,396	13.2
Quebec	677,165	47,500	7.0
Edmonton	885,003	43,406	5.9
Kelowna	126,835	36,969	27.1
London	406,402	36,856	9.1
Other Major Growth Centres	7,180,859	596,164	8.3
Rest of Canada	13,657,373	948,041	7.0
Canada	28,053,457	2,593,009	9.9

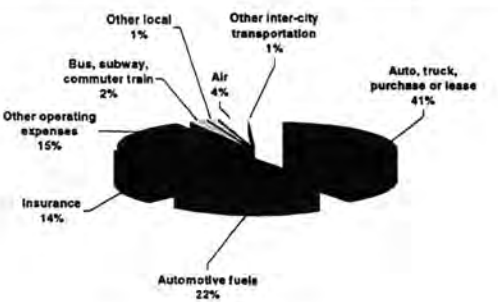
Household Spending by Major Category



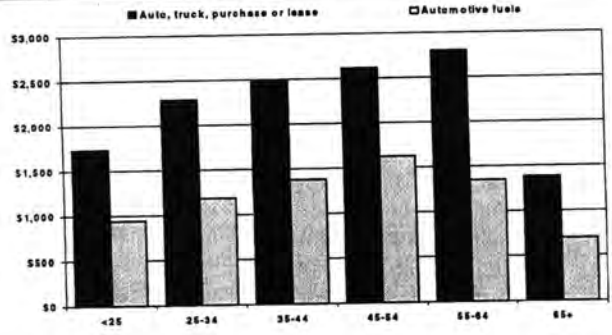
Household Spending by Major Category Demographics Driven Growth 1996 to 2006

Spending Category	Growth Rate	Growth Rate Index
Food	1.19	109
Shelter	1.04	95
Household operation	0.95	87
Household furnishings and equipment	1.02	94
Clothing	1.00	91
Transportation	1.20	110
Health care	1.39	127
Personal care	1.06	97
Recreation	0.99	90
Tobacco, alcohol	0.99	91
Miscellaneous	1.15	105
Personal taxes	1.13	103
Security	0.89	81
Total	1.09	100

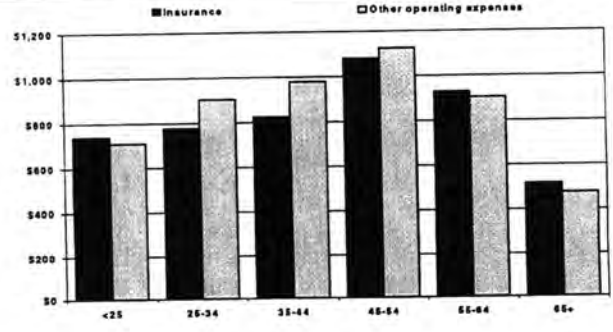
Household Spending Transportation by Category in 1992



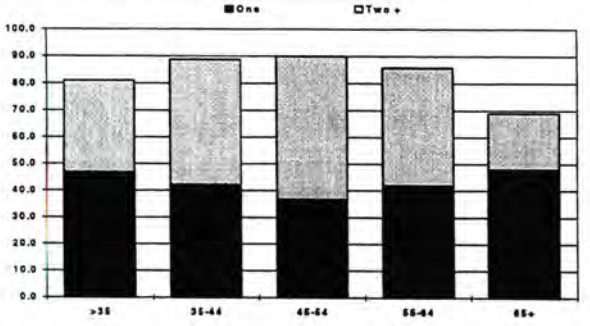
Household Spending on Transportation Dollars per Household by Age



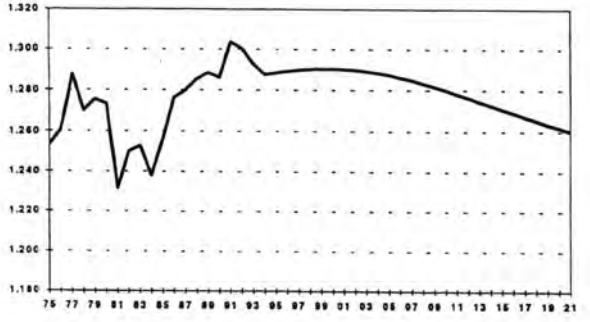
Household Spending on Transportation Dollars per Household by Age



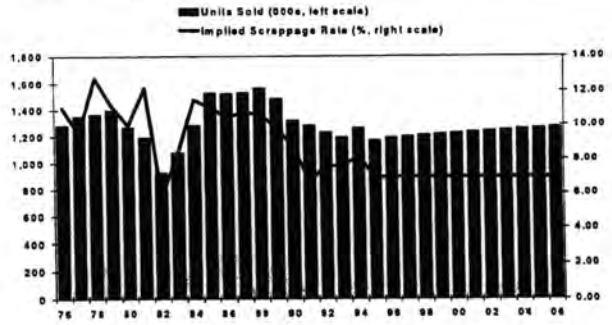
Motor Vehicle Penetration by Age
% Share of All Households in Group



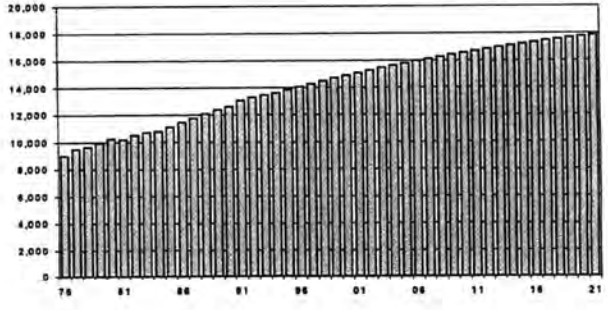
Motor Vehicles per Household
1975 to 2021



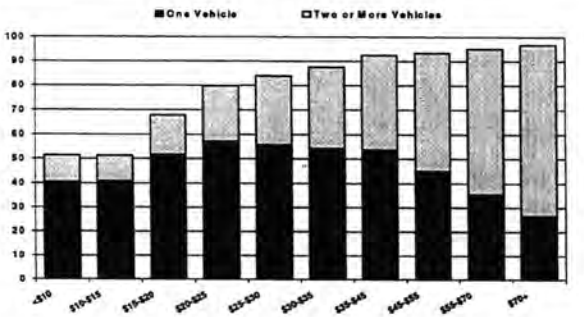
Motor Vehicles: Sales and Scrappage Rates 1976 to 2006



Motor Vehicles in Operation 1976 to 2021 (Thousands of Units)



Motor Vehicle Penetration by Income
% Share of All Households in Group



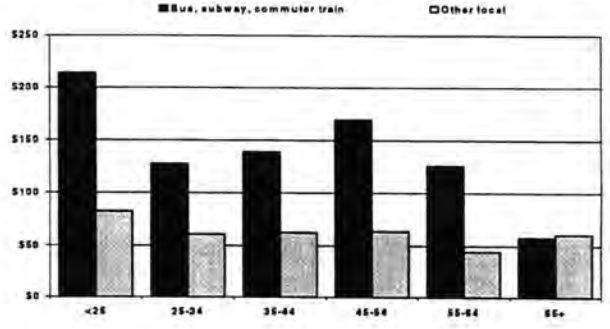
Transportation Spending by Category
Demographics Driven Growth 1996 to 2006

	Annual Growth % 96-06	Relative Growth Index
Transportation	1.20	110
Private Transportation	1.19	109
Purchase of automobiles and trucks	1.21	111
Automobiles	1.36	125
Purchase of automotive accessories	0.69	63
Automobile radios and tape players	0.54	49
Rented and leased automobiles and trucks	1.13	103
Rented automobiles and trucks	0.18	17

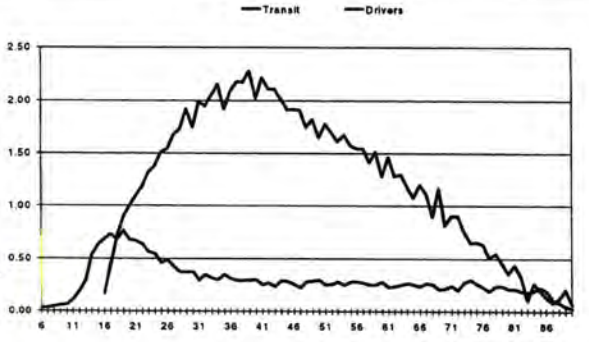
Transportation Spending by Category
Demographics Driven Growth 1996 to 2006

	Annual Growth % 96-06	Relative Growth Index
Transportation	1.20	110
Operation of automobiles and trucks	1.19	109
Automotive fuels	1.19	109
Tires	1.12	102
Batteries	1.27	116
Other maintenance and repair supplies	0.77	71
Maintenance and repair jobs	1.17	107
Oil changes and lubrication	1.36	125
Tune-ups	1.17	107
Other mechanical and electrical	1.04	96
Body (including painting)	1.33	121
Other maintenance and repair	1.22	111

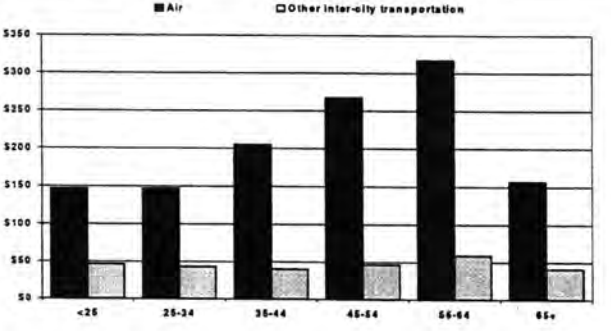
Household Spending on Transportation
Dollars per Household by Age



Greater Toronto Area Trips by Mode 1986 (Trips per Day by Age)



Household Spending on Transportation Dollars per Household by Age



Transportation Spending by Category
Demographics Driven Growth 1996 to 2006

	Annual Growth % 96-06	Relative Growth Index
Transportation	1.20	110
Public transportation	1.33	121
Local and commuter transportation	1.04	95
City bus, subway, street car	0.93	85
Local taxi service	1.30	119
Inter-city transportation	1.54	141
Air	1.57	143
Highway bus	1.39	127

Demographic Change in Canada
Key Implications for Transportation

- automobile dependence will intensify
- public transit use will decline
- road congestion problems will increase
- inter-city air travel will grow rapidly
- airport usage congestion will rise (Toronto, Vancouver)
- freight trends will be impacted geographically
-
-

How Might Canadian Experience Contribute to the Transition of the Russian Urban Transportation?

Elizaveta B. Bedniakova
The University of Calgary
The State Academy of Management, Moscow, Russia

Introduction

The Russian Federation has an effective modern transport system, which has all types of modern transport, which provide long-distance transportation characterized by very a high capacity. The growth of technical transport equipment, improvement of the technology, and organization of the transport process provide the possibility, on the whole, of meeting the growing demand of the national economy and population. The economic importance of transportation is well known: transportation develops the national economy, connects production and consumption, and joins different regions, republics, and industries into one economic system. Industries can not function without transportation, which helps to bring new resources into economic circulation. The transportation sector is very important to the life of modern Russian cities. Urban transport is a type of territorial transport formation, which appeared between the XIX and XXth centuries, and grew to fulfill the transport demands of the city dwellers and its economy.

The structure of Russian urban transportation

The character of the transportation system's functions, which serve the city, is usually presented by two large subunits. First is intra-city transport, which is called "City passenger transport", and consists of bus, trolleybus, taxi, tram, and metro. Second is inter-city transport - railway, sea, river, air, and automobile. Inter-city transport plays a very active role in satisfying the transportation needs of urban population, especially in suburban transport. The rail passenger stations, sea and river terminals, bus terminals, air terminals, and different facilities which provide freight transportation, all function in close contact with urban transport systems inside the city. The inter-city transport, except air-transport, also

provides intra-city transportation, if the routes are passing through the city. In many Russian small towns, all passenger transportation is provided by only buses and taxis. The structure of intra-city transport is shown in figure 1, and the main indexes of the operating work are in table 1.

In 1993, the average one-end-work-trip time for the public transit was 43 min. in Russian cities, and the average waiting time, for a bus, was 16 min., for a trolleybus, 14 min., and for a tram, 13 min. Every fourth tram and trolleybus passenger and every third bus passenger needed to wait at the stop for more than 20 min. However, these data depend on the city district and size, and the organization of public transit in the individual town.

In 1993, six Russian cities (Moscow, Saint-Peterburg, Ekaterinburg, Nijnii Novgorod, Novosibirsk, Samara) had metro. Seventy cities had tram transportation, and four of them had high speed trams (Volgograd, Ijevsk, Starii Oskol, Ust-Ilimsk). Eighty-six cities had trolleybuses, and 1321 cities had bus transportation. The ridership data is shown in table 2.

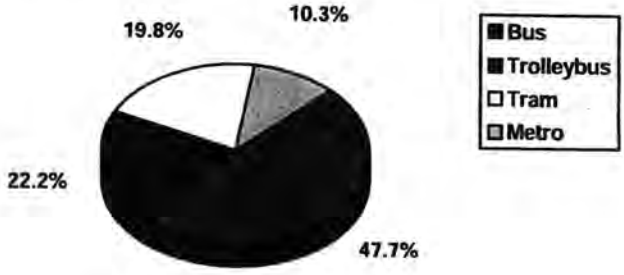


Figure 1. The structure of public transit, per cent of passengers.

Table 1.
The main indexes of public transit operating work.

Index	1980	1990	1991	1992	1993
Number of routes					
bus	7904	9693	9440	9029	9044
tram	...	703	...	695	696
trolleybus	...	910	...	891	907
Number of rolling stock, thousand					
bus	68.0	60.3	59.8	56.1	56.6
tram	12.5	14.9	14.7	14.5	14.0
trolleybus	12.1	14.2	14.0	13.8	13.9
metro car	3.7	5.2	5.4	5.5	5.6
Rolling stock capacity, per cent					
bus	74.9	74.9	71.5	67.7	66.5
tram	76.3	73.7	70.6	67.2	66.5
trolleybus	76.4	73.2	71.9	70.4	71.4
metro car	79.6	74.3	74.8	76.6	76.4
Number of trips, million					
bus	217.7	254.8	228.4	206.3	195.2
tram	...	...	37.2	36.7	36.1
trolleybus	...	...	58.2	56.4	56.7
metro train	...	...	...	4.6	4.7

Table 2.
Transit passengers carried, million.

	1980	1990	1991	1992	1993
Bus	17503	22869	21359	19821	19486
Tram	5695	6000	7619	8071	8125
Moscow	524.8	602.5	1279.3	1455.2	1429.4
Saint-Peterburg	890.4	985.8	933.0	969.5	835.2
Volgograd	115.7	129.5	153.7	242.0	204.0
Ijevsk	111.2	143.8	172.5	165.8	149.3
Starii Oskol	-	6.6	6.7	6.6	5.3
Ust-Ilimsk	-	6.9	7.1	6.5	2.6
Trolleybus	4739	6020	8005	8619	9102
Moscow	806.3	1049.5	1691.7	1837.4	1769.1
Saint-Peterburg	490.1	564.6	635.6	669.1	607.7
Metro	3036	3695	3229	3567	4212
Moscow	2318	2580	2321	2581	3162
Saint-Peterburg	718	977	777	821	836
Ekaterinburg	-	-	3	3	13
Nignii Novgorod	-	60	56	61	62
Novosibirsk	-	65	62	92	118
Samara	-	13	10	9	21

Urban transportation fares and financial situation

After 1990 Russia had significant changes in the average price of passenger traffic due to the inflation of the Russian economy. So, in 1980 one ruble equaled 43 USA cents, but in 1993 one USA dollar equaled 3,500 rubles. Now in Moscow the price of a pass is 180,000 rubles (around one third of the average salary), while in 1980, it was only 6 rubles (around 3-4 % of the average salary). The Russian fare system does not include transfers, and people cannot make payment by cash. They need to buy metro tokens and a book of tickets for surface transit. The latter is more expensive to buy at the operator. But in spite of the significant growth of fares, they cover about 40% of expenditures for one passenger trip in suburban buses, 10-15% in suburban rail trains, 35% in metros, 20% in city buses and trolleybuses, and 13% in trams. The average cost of passenger travel is shown in table 3.

Previously, Russian public transit had worked due to municipal and federal investments, but in 1990 it entered a critical phase, and begin to lose large sums of money.

Technical indexes of urban transit

The transport in Russia consumed 8% of electric energy, or 76.7 billion kwh in 1993. All metros used 2 billion kwh and trams and trolleybuses used 4 billion kwh in 1993. (Russian trolleybuses use only electric power.)

The situation with the service of the urban and suburban population is critical due to the bad technical conditions of rolling stock (each third suburban train, fifth bus, eighth tram, tenth trolleybus is working beyond normal operating time), and financing problems. In 1994, the number of city bus routs increased from 1993, but decreased by 15% from 1991. In December of 1994, in each fifth city 15%, or more, of scheduled bus, tram, and trolleybus routs were not made.

Table 3.

The average price of one passenger trip by intra-city transport , kopeek.

	1980	1990	1991	1992	1993
Bus	7.0	8.3	...	270.0	2804.2
Tram	5.5	7.6	12.6	162.1	1830.3
Trolleybus	5.7	6.6	11.8	138.4	1618.7
Metro	4.6	7.1	20.6	205.8	2324.1

Note: one ruble equals 100 kopeek.

The role of railways in urban passenger transportation

The rail transport plays an important role in the transport service of city and suburb populations and provides a high traffic speed, capacity, and the possibility of improved capacity with increasing size of passenger flows. In the new market conditions, the rail transport has a lot of financial difficulties and, at the same time, a high socio-economic significance. The beginning of a substantial decrease in growth rates of the transportation capacity of buses and railways dates from 1990. Russian suburban rail transportation takes up a large part of the total capacity of passenger transportation (more than 90% for departure capacity and 30% for volume capacity). Until the end of the 1980s this transportation grew consistently (table 4, figures 2 and 3).

Table 4.
Railway passengers carried in Russian regions

Years	1991*	1992			1993		
Regions	Total passengers, thousand	Passengers, thousand		% of suburban passengers in total	Passengers, thousand		% of suburban passengers in total
		Total	Suburban		Total	Suburban	
Russia	2676575	2373595	2125012	0,90	2322785	2068058	0,89
Sverdlovskaya	68685	73487	64799	0,88	83189	74176	0,89
Novosibirskaya	59406	63655	56610	0,89	65750	57637	0,88
Permskaya	55013	59719	55234	0,92	62412	58404	0,94
Nijegorodskaya	54524	58875	54267	0,92	72171	67441	0,93
Chelyabinskaya	34669	38024	32337	0,85	42585	36973	0,87
Krasnoyarskii kray	28282	35048	29058	0,83	34323	30129	0,88
Kuybishevskaya	27734	28969	25182	0,87	34856	31115	0,89
Volgogradskaya	25802	24371	20697	0,85	21560	17615	0,82
Saratovskaya	15696	19913	15675	0,79	22289	17730	0,80
Omskaya	12978	14328	12207	0,85	16386	14186	0,87

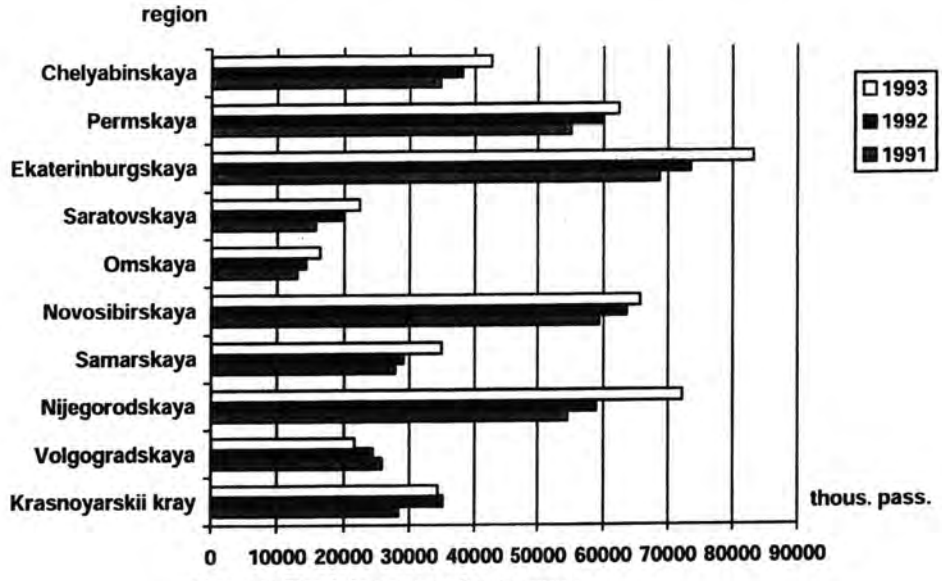


Figure 2. Total departure of passengers.

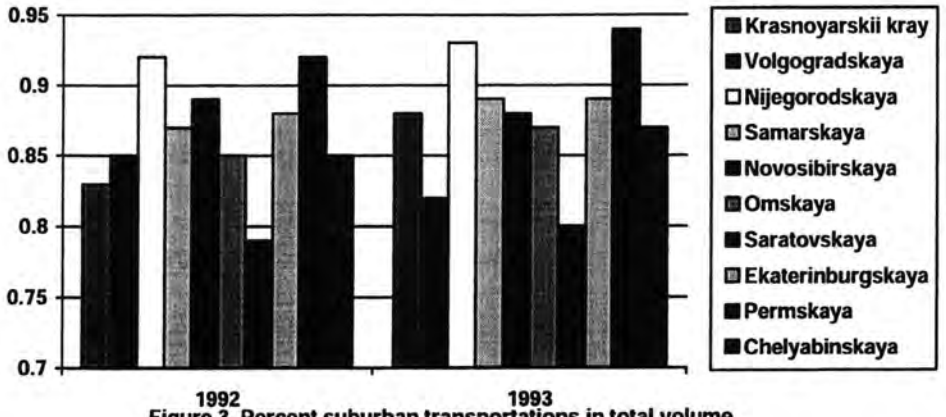


Figure 3. Percent suburban transportations in total volume.

The structure and main indexes of suburban rail transportation

Sharp changes have occurred in the volume and structure of suburban rail transportation in Russia due to political and economic instability. The study of it after 1990 has demonstrated that the volume of suburban traffic has doubled in comparison to average statistic indexes, and the number of carried passengers at this time was around 70 per cent of the twenty-four-hour flow of passengers. As a result, the real capacity of the suburban train in peak-period was more than the norm by 1.5-2.0 times. On weekends the growth of train capacity could be explained by the increasing number of riders who are going to and from suburban residences.

The eight biggest transport junctions in Russia and other republics have more than 50% of all rail suburban transportation, which could be explained by the inefficient system of industrial location - Moscow has 29.7%, Saint-Petersburg has 10.3%, Riga has 3%, Kiev has 2.9%, Harkov has 2%, Minsk has 1,7%, Nijnii Novgorod has 1.3%, Novosibirsk has 1.2%. And Russia operates around 45% of all transportation. Thus, Russian railways master the biggest part of transportation.

The average trip length of passenger suburban rail transportation is stable enough: during the whole ten-year period (1980-1990) it was around 30-32 km. In 1993 this index increased to 44 km (table 5). This situation was characteristic of other types of public transport, and is explained by the growing geographical mismatch between job opportunities and housing. Due to changes in the Russian economy and industry, people have changed work places and now they possibility work at move than one place at one time. And in many cities the pensioners have free use of the transit. The prices on goods and food are different in the stores and open markets. Hence, people, and especially, pensioners, go to another edge of the city to buy products. The coefficient of population mobility approached 20.6 in suburban transportation in the Novosibirskaya region in 1993 (table 6). That means that one dweller had on average of 20.6 trips a year. The average capacity of a rail car has stayed stable around 41 pass./car. Moreover, in 1975-1988 this index tended to decrease. The same situation occurred with a stretch speed. The number of suburban stations has been increasing uninterruptedly: in 1960 - 2111 units, in 1965 - 2403, in 1970 - 3018, in 1975 - 3148, in

1980 - 3717, and so on. The number of such stations had almost doubled at the end of the 1980s, in comparison with 1960, to around 4000 units, or 40% of all rail stations. It was necessary to improve the service of urban and suburban population.

Table 5.

Average trip length of passenger public suburban transportation, km

Type of transport	1980	1990	1991	1992	1993
Railways (includes intra-city transportation)	...	32	35	39	44
Buses	13,1	16,0	15,0	14,2	14,2
Sea (includes domestic transportation)	...	...	16,7	14,9	15,2
River	9,8	16,2	19,4	20,0	18,8

The financial situation of the rail suburban transportation

In comparison with automobile transportation, suburban electric rail transport is more economical. But revenues from suburban rail transportation equal 15-17% of all rail passenger revenues. The price of suburban transportation is different and depends on the kind of power (electricity or diesel) and the region.

Rapid inflation distorted previous proportions of expenditures on transportation (table 7). If it is oriented with 1988-1989 indexes, when the economic crisis only started to gain power though the railways still worked stable enough and the financial situation did not portend any serious difficulties, we can make some conclusions. It is well known that, the more people using transport, the lower the price of transportation. Railways as Moskovskaya, Oktyabrskaya, Ugo-Zapadnaya, Kuybishevskaya, and so on with high level of passenger flows had the lowest indexes of price for electric traction (4.2 - 6.5 kopeek for 10 passenger-km). The price of suburban transportation by diesel trains was 2-3 times more expensive than that of electric trains (10-20 kopeek for 10 passenger-km). The average revenue rate of suburban transportation in all transport networks was 4.9 kopeek for 10 passenger-km in 1988, which was a lot less than the average price of suburban transportation (6.8 kopeek for 10 passenger-km). This fact is very important, because fares of transportation were established according to the revenue rate, but not the price. Therefore, there was a significant negative difference between fares and necessary prices of transportation. As a result,

suburban transportation involved around 250 million rubles annually in the middle of 1980s. Almost 60% of passengers used a privilege-subscription (special subsidized) tariff, which was established in 1919. Until 1990, with stable prices on rolling stock, energy, materials and equipment rail transportation were not unprofitable, because 20% of loses were covered by government budget, others by cargo revenues. Table 8 shows loses of suburban transportation in some Russian regions.

Table 6.
Coefficient of population mobility by suburban railways (1993)

Regions	Passengers, thousand	Average annual population, thousand	Coefficient of population mobility, %
Sverdlovskaya	74176	4682	15,8
Nijegorodskaya	67441	3690	18,3
Permskaya	58404	3099	18,8
Novosibirskaya	57637	2798	20,6
Chelyabinskaya	36973	3626	10,2
Samarskaya	31115	3317	9,4
Krasnoyarskii kray	30129	3038	9,9
Saratovskaya	17730	2725	6,5
Volgogradskaya	17615	2667	6,6
Omskaya	14186	2174	6,5

In ensuing years, despite the fact that the level of tariffs increased, the deficit from suburban rail transportation has not decreased, but increased significantly. In 1993, not only suburban transportation, but also long-distance transportation was unprofitable. Passenger railway transportation's loses were 964 billion rubles in the Russian Federation, and in the first quarter of 1994 the loses were 670 billion rubles. The biggest part of these loses was in suburban transportation. During this period, railways became one of the most economically attractive modes of transportation due to sharply increasing prices of air, sea, and river travel. This created large demands on rail transportation, and, at the same time, service failure on terminals and trains, which railway staff have been struggling to rectify.

Table 7.
The structure of railway expenditures, %

	Year	Total expendi-tures	including					
			material	fuel and electric energy, only	salaries and wages	on social needs	depreciation	miscellaneous
Railway	1992	100,0	25,5	16,9	26,9	9,9	6,9	30,8
	1993	100,0	22,9	16,8	28,4	10,7	1,5	36,5
All types of transport	1992	100,0	40.6	15,9	20,2	6,7	6,6	25,9
	1993	100,0	32,8	17,9	25,5	8,8	1,8	31,1

Table 8.
Railway expenses of suburban transportation in Russian regions (1993)

Regions	Passengers carried, thousand	Expenses	
		Total, million rubles	For 1 passenger, rubles
Sverdlovskaya	74176	7848	106
Nijegorodskaya	67441	7558	112
Permskaya	58404	3839	66
Novosibirskaya	57637	7700	134
Chelyabinskaya	36973	11799	319
Samarskaya	31115	5729	184
Krasnoyarskii kray	30129	7429	247
Saratovskaya	17730	3348	189
Volgogradskaya	17615	2422	137
Omskaya	14186	2128	150

The principle advantages of the rail suburban transportation

The data above, however, do not reveal evidence of the low economic and social efficiency of suburban railways. On the contrary, the suburban rail transport is the most effective. It has high economic, social, and ecological advantages; it has a high capacity potential; and provides not only suburban, but also intra-city transportation. Rail transit is more space-efficient than others, and, especially, private automobiles. Less land is required to move a small number of trains than to move a large number of buses or cars caring the same number of people. In major cities, an urban rail infrastructure is likely to carry as many passengers as a 6-8 lane expressway, which would require a 35-40 meter right of way. However, the rail line only requires a 9-12 meter right of way. Land not used for transportation is freed up for other active uses, for walking, or for public open space. Therefore, a railway has less impact on the environment than a highway, and more profitable for government and city dwellers. In many cases the quality of the environment, the quality of life, and the economic competitiveness and vitality of rail-transit-oriented urban areas are all higher than those of bus-automobile-oriented urban areas.

Under comparable conditions, according to expert estimates of Russian scientists, the price of suburban rail transportation is less than trams by 1.5-2.0 times, and the average speed is higher by 2.0-2.5 times. The traveling conditions in suburban electric rail cars are better than in subway cars - lower noise levels, natural light, good ventilation, and so on. City buses, trams, and trolleybuses are over crowded in rush hours, and these types of transit constitute 60% of all types of urban transportation. Hence, such transit is not profitable for the government, because the labor productiveness after 10 minutes of using the over crowded transit decreases by 3-4%.

Railways have been used to meet the growing demand for urban rapid transit over journeys longer than 5 km. In countries with available urban rail infrastructure, this option is more attractive than long and costly subway construction projects.

Now the 189 km of surface railways are inside Moscow, and they are used for suburban and intra-city transportation. The Moscow railway has 86 stations, and the capacity in one hour in one direction on head stretches reaches 45-50 thousand passengers. Every day more than 2 millions people use the rail transit service.

Novosibirsk has 58 km street railways in its boundaries, 34 stations, with hour capacity of more than 25 thousand passengers, and four directions of rail transportation. Volgograd has more than 100 km of street railways and 20 stations, Chelyabinsk has 45 km of railways and 22 stations, and Ekaterinburg has around 70 km and 15 stations.
In order to form complex transport systems and organize rapid city and suburban transit, the most important thing is the choice of the optimal type of transit for current conditions. First, it belongs to the high-speed intra-city railway and subway systems. Both these types of transit can radically resolve rising transit problems in Russian cities and suburbs. Both these types of transit are the most comfortable and accessible, but require capital investments, more than others. Therefore, some years ago transport engineers thought that building these types of transit was necessary in cities and agglomerations with populations of more than one million or more, and where strong passenger flows are constant on the long distances.
The intra-city railway and subway have many common features: speed, scheme of traffic organization, separate tracks with surface and tunnel lines and, sometimes, viaducts, station dislocation automatic systems, stage length, traffic graphics construction and formation of trains. According to Soviet statistics, the length of the intra-city and suburban surface railway network exceeds the length of the subway by more than 200 km. In order to provide normal reliable utilization of suburban rail lines on a modern level, government investments from federal and municipal budgets are necessary.
At the present time in Russia only suburban surface railways can provide passenger trips between a city and a suburb. In comparison with foreign countries (Germany, Italy), Russian trams and subway have never gone outside city boundaries, and have never served suburbs.

The present state of the intra-junction rail lines

Hence, Russia should devote the most attention to the main, intra-junction rail lines, which are diameter inter-city lines with station equipment. These lines are connected with the suburban railway network, and are the basis for formation of the future electric railway infrastructure in the city-suburb zone. These intra-junction rail lines are multifunctional, and are used for freight, passenger, transit, and local transportation. They are characterized by a significant length (50-60 km), a large size of traffic, and sometimes they exceed the long-distance traffic. The intra-city lines have also a large proportion of the freight

work, and this fact complicates other stations and line work, and hinders passenger traffic. In many cases the diameter of the intra-city railways is located in large, built-up transport centers, which causes many problems with intersecting roads and highways, and leads to delays of other types of transport and crossing passengers.

The development of intra-city lines in close connection to adjoining lines and roadways will be able to provide non-transfer traffic in metropolitan areas.

The common length of intra-city rail lines in such big cities like Moscow, Saint-Peterburg, Nijnii Novgorod, Novosibirsk, Ekaterinburg, Samara, Omsk, Chelyabinsk, Perm, Kazan, Ufa, Rostov, Volgograd, Krasnoyarsk, Saratov, Vladivostok is about 3400 km. These lines have 547 stations, and around 40 mill. people gravitate towards these lines. These data is presented in table 9.

Almost all junctions use electric traction, and only some of Nijnii Novgorod's, Ekaterinburg's, Chelyabinsk's, Volgograd's and Saratov's lines use diesel traction.

A peculiarity of the operation in these cities is the high percentage of suburban trains in the whole traffic volume. So, in some of them it equals 30-35% (Krasnoyarsk - 15%, Novosibirsk - 26%, Samara - 35%).

Table 9.

Population and suburban passenger transportation in big Russian transport junctions.

City	Population (census 1989), thousand	Size of suburban passenger traffic, pairs of trains in 24-hour period
Moscow	8972	1499
Saint-Peterburg	5024	954
Nijnii Novgorod	1438	107
Novosibirsk	1437	195
Ekaterinburg	1365	88
Samara	1241	81
Perm	1091	77
Kazan	1094	58
Ufa	1078	63
Rostov	1019	54
Vladivostok	634	143

For many junctions the route traffic speed on main intra-junction lines is between 25-66 km/h (see table 10). Higher speeds are not possible, because these lines go through built-up cities and suburbs. Hence, it would result in too many crossings with roads and streets, and a short distance between stations.

Table 11 shows sizes of suburban traffic dependent on the volume of passenger transportation on city populations. We can see that cities have different suburban railways provision. Thus, Novosibirsk has high population mobility in suburban traffic (29 trips per dweller per year), but the index for Rostov, Chelyabinsk, Ekaterinburg is lower. This can be explained by the historic peculiarities of each junction, the planning structure, and dislocation of residential and industrial development.

Table 10.
The operating speed of intra-junction lines.

The junction	The length of the line, km	The time of the train traffic, minutes		The operating speed, km/h
		even	odd	
Kazan	31.0	24	32	36.5
Saratov	22.0	53	54	25.0
Kuibishev	22.0	30	32	42.6
Novosibirsk	17.0	35	35	29.1
Sverdlovsk	17.0	32	31	32.9
Omsk	13.0	32	31	24.8

Table 11.
The provision of transport junctions by suburban railways.

City	The city population, thousand	Sizes of suburban traffic, pairs of train per 24-hour period	The population mobility of suburban traffic, trips per dweller
Nijnii Novgorod	1438	107	18
Novosibirsk	1437	195	29
Ekaterinburg	1365	88	9
Chelyabinsk	1143	36	10
Kazan	1094	58	14
Rostov	1020	54	9
Volgograd	633	28	12

The length of intra-junction lines in operation of examined junctions equals 893 km, and the track miles equal 1600 km. The ratio of the track miles to the length of lines in operation is 1.8. This means that for each kilometer of main intra-junction lines we have 1.8 km of head lines. But this index is higher for main intra-junction lines, than for transit lines, for which it equals 1.5 (5065 km to 3360 km). The data base of junction distribution by the length of main intra-junction lines is presented in table 12.

Examined junctions have usually more than two approaches. Do they continue into the junction? If they do, then the number of main lines must be at least one half of the number of main lines on approaches. This condition applies for the biggest part of the junctions. So, the ratio of the main lines on approaches to intra-city lines of examined junctions is: the number of intra-city lines are less than half - 0%, the same - 20%, equal the half - 36%, more than half - 44%. The first group includes junctions in sidings. But lines in the junctions and on approaches can have different equipment, and capacity will be unequal.

The junctions have a different number of intra-city main lines: 26% of them have one, 64% two, 6% three, and 4% four.

Table 12.
The distribution of main intra-junction lines by length.

The gradation of the length of main intra-junction lines	Percent of examined junctions		The gradation of the length of main intra-junction lines	Percent of examined junctions	
	by the length of lines in operation	by the track miles		by the length of lines in operation	by the track miles
less then 10 km	30	14	60-70 km	-	4
10-20 km	36	22	70-80 km	-	4
20-30 km	26	18	80-90 km	-	-
30-40 km	4	16	90-100 km	-	-
40-50 km	2	6	more then 100 km	-	2
50-60 km	2	14			

The whole length of intra-city lines of examined junctions equals 3400 km; the number of stations is 547; the average length of the intra-city stage equals 6.2 km. Fourteen per cent of the junctions have a stage length of 3-4 km, 38% 4-6 km, 28% 6-8 km, 16% 8-10 km, and 4% 10-12 km. More than half of the junctions have an average length between stations of less than 6 km. This is significantly less then the average length between stations outside junctions.

The intra-city *main* lines

The dislocation of intra-city *main* lines is more dense. In 10% of junctions this index equals 2 km, in 29% 2-4 km, in 27% 4-6 km, in 19% 6-8 km, in 10% 8-10 km, in 4% 10-12 km, and in 1% over 12 km. So, around 40% of all junctions have a stage length less then 4 km. Stages longer then 8 km are rarely found (15% cases).

The whole length of the *main* intra-city lines equals 893 km, and the number of stages is 168. Thus, the average length of a stage equals 5.3 km, and it is less then the average length of all intra-city lines equal 0.9 km.

The traffic control and traction system

Around half of the examined junctions have an automatic system of traffic control, and another half have the old system, that decreases the capacity of lines. The main portion of junctions has the same system of traffic control on the approaches as on the intra-city lines.

We can judge the ability of the intra-city junctions by existing types of the traction. Electric traction is dominant (80% of the traffic). Some junctions use mixed traction (electric and diesel). And 14 railways use diesel trains.

The most common features of Russian and Canadian urban transportation

Thus we can conclude that the quality of urban passenger transportation in Russia has decreased significantly, and requires new economic and engineering alternatives. Russia uses traditional technology for public transit like tramways. In Russia, where most of the traditional systems are to be found, the slow growth of automobile ownership and urban population growth have ensured a continued role for rail systems. It also means that innovation has been relatively limited. The automobile growth started from the low level, but, in Moscow, has been doubled to

1.6 million since 1990. [12, p.92] Therefore, in the metropolitan areas of Russia and Canada, there is a high degree of automobile usage. This high usage consequentially creates congestion and an increasingly deteriorating environment, thus influencing a worsening of the social-psychological climate within the cities.

Historically, developments in the cities of the both countries have influenced the existence of different urban transit systems. Although one main line of government policy, especially after the Second World War is similar, this is an early development of urban rail transportation in the cities of Russia and Canada. "Between 1950 and 1990, Canada succeeded in keeping urban transit functioning as a widely used travel option... Canadian governments invested heavily in transit infrastructure, including North America's first postwar subway line in Toronto and Montreal's extensive metro system". [4, p.263] In Russia an underground system or "metro", trams and intra-city railroad lines have developed. In Canada a subway and light rail transit has developed in the cities where traffic is of the order of 20 thousand persons per hour. [3, p.69] But Russian cities are older then Canadian, and therefore the sequence of the construction of metro systems and buildings is different. In Russia the metro systems were built under the developed districts. Canadian cities have built the metro systems into undeveloped areas.

The new alternative

The new alternative for Russian transportation would be a modern light rail transit (LRT), which does not have such a high level of noise and vibration as traditional systems. Therefore, it would not cause a serious problem in dense, urban Russian areas, especially when the new routes are introduced. The design of overhead power supply equipment is less bulky and intrusive than that associated with the traditional streetcar systems. Cars are narrower than those in heavy rapid transit and fit within the maximum allowable highway width. Single-track sections are possible where space is tight and the ensuing capacity limitations are acceptable. This enables tunnel or underpass sections, where unavoidable, to be correspondingly narrower and less expensive than in metros. The wide multiple doors also provide faster loading and unloading. In some cities transport systems can be more widely adapted to make the most effective use of new light rail lines, road traffic circulation modified to reduce mixed running and traffic conflicts, and bus services reorganized to act as feeders to LRT. Of course, LRT cannot always do a full metro's job, but it provides high capacity, quality public transport at a cost that is only a fraction of full metro costs, and can

operate in cities and corridors where metros would simply not be viable. Also, the economic and environmental cost of automobile use is driving the search for other, more cost-effective means of hand passenger movement in busy corridors. Besides, LRT can usually be planned and built in less time and with lower costs and fewer environmental impacts than other types of rapid transit. [1, p.67-69; 2, p.59-61]
Of course, LRT combine flexibility, modest cost, and low environmental impact, but during the planning, design, specification writing, engineering, or construction phases of a project the "lightness" can be lost. And to pursue new projects in Russia it is necessary to go through all government institutions such as the Transport Ministry and Ministry of Transport Network (railways), the Ministry of Finance, and the Transportation Department of Municipality. Needed for this project are investments by attracting private companies, and finding research organizations to develop it. Estimates of a broad range of impacts, such as construction and operating costs, energy consumption, air quality, noise level, and accident rates, and estimates of required energy, labor, land, and materials consumed in providing and operating a particular transportation system are also necessary.

Information systems

The Canadian transportation system also has a well developed communications and orientation systems, which provide high a level of service for customers. Customer communication systems include advertising media and publications, on street and terminal signs and information systems, automated telephone information systems, and on vehicle information systems. The automated telephone information systems like "TeleRider" are now installed in Mississauga, Saskatoon, Winnipeg, Calgary, Ottawa, Kitchener, Brantford and Guelph. Victoria has the interactive voice response (IVR) system called BusLine, which handles telephone calls, provides a variety of information to callers, creates and manages manus and digitized speech, interrogates a computerized scheduling database, and provides statistical reports. In Vancouver the system HandyLine allows users to not only obtain information, but to cancel trip reservations and check the status of trip reservations. The Visual Communication Network (VCN) system in Montreal would be useful for the Moscow transit. This system provides real-time information inside transit vehicles; it can display and orally communicate instructions regarding emergency procedures, information concerning schedules or system delays, the name of the next station on

the line, and campaigns to promote use of the transit system and security messages. The information may be news headlines, weather information, information on local events, and advertising. Such systems can increase attractiveness of different types of transit, increase ridership, and help people with visual or hearing impairments. [5, p.8-14 - 8-22] The 1990s in Canada are characterized by the growth of Intelligent Transportation Systems (ITS), which are the application of electronic, computer and communications technology to vehicles and roadways to increase safety, energy efficiency, reduce congestion, improve mobility, minimize environmental impact, and promote economic productivity for a healthier economy. ITS is developed by the 3M group, which does research in electronic technology, software, hardware and firmware development. But all these systems require significant investments and can not be implemented in Russia before stabilization of the national economy.

Conclusion

Canadian LRT systems, communication transit systems are new ideas, new models, which could be implemented in Russian urban transportation in 20-30 years at least. And this implementation we can call "transition". However, any modal or idea taken from another country should be changed and adopted for the concrete situation and according to existing conditions.

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Notes

All Russian transportation statistics are based on unpublished and made up of odd parts materials due to the economic and finance situation. Three dots or dash in the tables means the lack of data.

Synopsis
Sustainability in Urban Transportation

by
Richard M. Soberman
Department of Civil Engineering, University of Toronto

Much of the current concern with sustainable transportation focuses on the alleged ills of the automotive industry. In simple terms, global warming and a range of detrimental impacts are attributed to increased atmospheric concentrations of CO_2, a significant proportion of which derive from automotive emissions. Whereas the strongest advocates of sustainability view the problem to be sufficiently serious as to justify draconian measures (including 'full cost pricing' and various licensing schemes) as well as greater support for public transportation, those less committed to concepts of sustainability question the real impact that such measures will have and even suggest that policies in support of sustainable transportation run counter to policies intended to stimulate economic recovery.

Within Canada, various groups such as the *Transportation Association of Canada* in its highly regarded vision statement for urban transportation, as well as the *Ontario Transportation and Climate Collaborative*, have attempted to achieve consensus on a variety of policies and measures intended to reduce automobile dependence. However, even among those committed to this principle, there is some question as to the effectiveness that such policies will really have in the face of logical reasons why many urban travellers and shippers increasingly rely on less sustainable forms of transportation.

For urban travel, for example, emerging patterns of land use development simply cannot be served effectively by public transportation, as we *now* know it. Moreover, achieving more transit oriented, compact development, is difficult because 'infilling' and intensification within existing urbanized areas are typically opposed by local residents, and because a combination of preferred lifestyles and property taxes favour the proliferation of low density development well beyond traditional city centres.

This paper is based on the premise that, from the standpoint of sustainability, the key goals for urban transportation involve first, reducing

total vehicle-km of travel by altering both average trip lengths and modal split and, second, improving fuel efficiency by technological means. After examining the range of policy instruments available to achieve these goals, the highest priority policies are identified in terms of their likelihood of moving Canadian cities to more sustainable forms of land use and transportation development.

Preliminary results of a sensitivity analysis of the effects of 'full cost' pricing and land use change on modal split, vehicle-km of travel, and CO_2 emissions are presented based on modelling for the Greater Toronto Area for a range of fuel price increases and redistribution of population.

Transportation Control Measures and the Urban Environment: A Comparative Review

William P. Anderson
McMaster Institute for Energy Studies[1]

and

Clarence Woudsma[2]
University of Calgary

1. Introduction

Urban transportation accounts for a large share of the total consumption of fossil fuels and the total generation of atmospheric pollution in both the United States and Canada. Technological progress in both engine and pollution abatement technologies have reduced per-kilometre emissions and fuel consumption. Still, this progress may eventually be swamped by the rapid growth in the number and length of trips, especially trips by private automobiles. If growth in emissions and fuel use is to be controlled, policies to reduce the rate of tripmaking, to discourage single-occupant vehicle travel, and to improve the flow of urban traffic are needed.

This paper has two objectives. The first is to review the general category of policies known as *transportation control measures* (TCMs) as they apply in urban areas, and the second is to examine and compare progress that has been made toward the implementation of these measures in the United States and Canada. As we will explain, differences in the structure of federal/state as opposed to federal/provincial relations have led to different frameworks for the implementation of TCMs in the U.S. and Canada.

The remainder of the paper is organised as follows. Section 2 establishes a background for the paper while Section 3 provides a general overview of TCMs and their effectiveness. Section 4 reviews and compares the policy frameworks within which TCMs are being applied in the U.S. and Canada, and Section 5 briefly looks at implementations in both countries.

2. Background

The link between urban air quality and transportation has been the focus of both much debate and research activity. While it is not possible to delve into all facets of this topic, it is necessary to establish a basis from which to explore the specific focus of this paper, the implementation ofTCMs. The following facts provide this basis:

- growth in vehicle kilometres travelled (VKT) in both Canada and the U.S. suggests that urbanites are travelling more than ever by auto
- transit usage has remained relatively stagnant in recent years, although slightly higher in Canada than the U.S.
- emissions per VKT have declined rapidly due to improvements in vehicle technology
- congestion problems may offset the gains related to technological improvements
- climatic conditions and high emissions cause episodes of poor air quality in numerous U.S. and Canadian cities
- while overall emissions have declined, VKT growth rates of 2% per year would be sufficient to cause increases in major pollutants by the year 2005 (TRB, 1995)

These facts suggest, among other things, that technology alone may not be enough to address urban air quality problems. It would appear that the only alternative is to reduce aggregate driving activity, or at least slow its growth. Given the current trends of declining transitridership, increasing car ownership, and falling real gasoline prices, it is unlikely that this will occur without some form of market intervention by various levels of government. A class of policy instruments called*transportation control measures*(TCMs) includes a variety of measures aimed at reducing trips and VKT, diverting traffic to off-peak periods, or improving traffic flow during the most congested periods. ThusTCMs are important not only for reducing energy consumption and emissions, but also for reducing the time lost due to road congestion.

A useful parallel may be drawn betweenTCMs and demand side management (DSM) of electric utilities. DSM has been introduced as a planning principle because it may be cheaper to reduce the rate of electricity consumption through conservation measures than it is to install new generation capacity to meet ever

increasing demand, especially if externalities are counted in the cost of generation (Nadel, Reid, and Walcott, 1992). One of the main ideas behind DSM is that an equivalent amount of energy *services*, defined as light, heat, motive power, etc., can often be delivered with a reduced amount of energy input, defined in kilowatt hours, if some form of conservation is practised. In a similar way, the goal of TCMs is to deliver an equivalent level of transportation services, defined in terms of the movement of goods and people, with a reduced amount of VKT or time spent in vehicles, and with a corresponding reduction in energy consumption and emissions. Implementations of TCMs may also be cheaper than construction of new transportation infrastructure to accommodate uncontrolled demand.

3.0 Conventional TCMs

Most TCMs may be assigned to one of four categories: mode shifting, trip scheduling, flow improvements, and vehicle stock improvements. Since the first two categories affect the level and pattern of the demand for trips, they are sometimes referred to as *transportation demand measures* (TDMs.) The other two categories attempt to improve system performance for a given pattern of demand.

Measures to promote mode shifting primarily encourage travellers to switch from the dominant single occupant vehicle (SOV) mode to transit, some high occupant vehicle (HOV) mode such as carpooling or vanpooling, or non-motorised travel such as biking or walking. This may be achieved either through changes to the design and operation of the transportation system or by means of incentives or rules that use employers as intermediaries. System changes include reductions in transit fares, improvement in transit service, establishment of park-and-ride lots, designation of special lanes allowing transit vehicles and HOVs to bypass traffic, and establishment of bicycle and pedestrian lanes. Employer based measures include incentives for employers to promote and organise carpools and vanpools or to subsidise transit use. They may also require that employers charge the full cost of parking, or alternatively offer the cash equivalent of the parking subsidy to those that don't use a parking space, thus providing a financial incentive to avoid driving alone.

Measures that affect trip scheduling do not necessarily reduce VKT, but they spread trips away from peak periods in order to reduce congestion. These measures reduce energy use and

emissions only to the extent that energy and emissions per VKT are higher in congested driving. The main way to achieve trip scheduling measures is again through employers, who are encouraged to introduce flexible or staggered working hours. Transportation system changes can also promote off-peak travel. For example, signalised on ramps can limit the rate at which cars can enter commuter roads, creating an incentive to avoid peak periods, and tolls may be set at higher levels at peak periods than at off-peak periods.

Flow improvement measures seek to improve the efficiency with which a given volume of traffic moves over the road network during a given period of time. These include improvements to standard traffic management elements such as signal timing and incident management. It may also include the application of new technologies to provide motorist with information on traffic conditions and best available route while they are driving. A new class of technologies known collectively as *intelligent transportation systems* (ITS) which can automatically transfer traffic information to drivers or adjust signal timing to current traffic conditions should enhance the effectiveness of this class of TCMs. (Office of Technology Assessment, 1995: 178-181.) Again, these measures reduce energy use and emissions only to the extent that performance is improved by reduced congestion. NO_x emissions tend to increase with vehicle speeds, however, so flow improvement measures may actually increase the rate of emission for that major ozone precursor. A further consideration is that flow improvement measures – and all measures that reduce congestion – may actually promote growth in VKT by making driving less onerous.

The final category of TCMs involves changes to the stock and performance of private vehicles. These measures do not change traffic volume or flow, and thus do not reduce the time costs of transportation. However, by changing the characteristics of the vehicle stock they reduce energy use and emissions per VKT. Due to ongoing technological progress, newer cars are generally more energy efficient and less polluting than older ones. Thus, accelerating the rate of vehicle turnover can significantly improve overall fleet performance. One way to achieve this is for some government agency to purchase old cars at prices above their market values and then scrap them. Another way is through inspection and maintenance programs, which can identify "gross polluters" – a small proportion of vehicles that account for a much larger proportion of emissions.

The four categories of TCMs are not mutually exclusive. For

example *road pricing*, which is one of the most studied but least implemented of the TCMs, serves several functions. Under road pricing, vehicles are charged a fee which increases with the level of congestion on the routes that they use. Road pricing can discourage SOV commuting since the cost can be shared among carpoolers, encourage commuting off-peak when road prices are set lower, and divert traffic to less congested roads, thereby improving traffic flow -- so it fits into each of the first three categories.

There is a great deal of controversy over how effective TCMs are in reducing energy use and emissions, and whether they can be justified in economic terms. Some critics argue that the benefits of TCMs in those places where they have been implemented are overstated (Giuliano, 1992). Because U.S. environmental regulations have mandated the application of TCMs in some metropolitan areas (see section 4.1), it is gradually becoming possible to make *ex post* assessments of their effectiveness. Table 1 presents a set of estimates by a U.S. consulting firm (Apogee, 1994) of how full implementation of various types of TCMs would affect transportation demand and VOC emissions in a typical metropolitan area.

They indicate that very few TCMs can by themselves effect major reductions in VKT, trips, or VOC emissions. They also indicate wide variability in their cost effectiveness. Some TCMs, such as area-wide ridesharing programs and buy-back of older cars are quite cost effective, but have relatively small impacts. The two TCMs that have high estimated impacts at relatively low estimated costs are programs requiring employers to charge the full cost of parking and congestion-based road pricing.[3] Perhaps most striking is that by these estimates, some of the most frequently promoted TCMs -- employer trip reduction, rail transit, and bicycle/pedestrian facilities -- produce modest impacts at high costs.

It should be stressed that methods for assessing the impacts of TCMs are imperfect (Crawford and Krammes, 1995) so estimates of this type are subject to substantial error. Also, these estimates are based exclusively on American experience. Measures promoting transit and non-motorised options may be more successful in Canadian cities, where transit shares are already higher and where relatively compact urban form is more conducive to transit and non-motorised options.

Table 1: Assessment ofTCMs for a Typical Metro Area (Based on Apogee Research, 1994)

TCM	% VKT Reduced	% Trip Reduced	% VOC Reduced	Cost of VOC Reduction*
Employer trip reduction program	1	0.8	0.9	281000
Area-wide ridesharing program	0.4	0.3	0.4	16000
Major Rail Transit Improvement	1	0.8	0.9	272000
Establishment of HOV Lanes	1.4	0.5	1.1	109000
Park and Ride Lots	0.5	0	0.3	146000
Bicycle/Pedestrian Facilities	<0.1	<0.1	<0.1	289000
Parking Pricing (at work)	3	2.5	2.8	47000
Congestion-based Road Pricing	5	3.8	8.2	66000
Buy-Back of Older Cars	na	na	0.4	3000
Improved Signal Timing	<0.1	<0.1	0.4	23000
Improved Incident Management	-1	-1	0.8	83000

* US$ per ton of emissions reduction

The relatively modest impact ofTCMs found in the Apogee study may be attributed to a number of factors. One is that most TCMs are directed exclusively to journey-to-work travel, and thus do not affect non-work travel, which makes up one half or more of trips and VKT in many metro areas. A second is the high premium that

commuters place on the SOV travel mode, which again may be somewhat different in Canada. Of course, if the impacts of all the TCMs in table 2 were summed, the overall effect would be quite substantial. It is unclear, however, how these TCMs interact. Such a summing up may overestimate the total effect due to double counting, or it may underestimate it by excluding synergies that occur when TCMs are implemented simultaneously.

4. U. S. and Canada Policy Frameworks

Differences in the traditional and constitutional roles of the federal, state/provincial, and municipal governments in urban transportation policy provide very different environments for the implementation of TCMs in Canada and the U.S. This section provides overviews of the policy frameworks in the two countries.

4.1 The U.S Policy Framework

The U.S. federal government has always been very active in the transportation policy and planning arena. Historical reasons for this include the responsibility assigned the federal government for interstate commerce in the U.S. constitution and the military importance of the interstate highway system. But federal involvement is not limited to the interstates. Major infrastructure for urban transportation, including both transit and road infrastructure, almost always depends on some level of federal support.

Up until the late 1980s, distribution of federal funds was project-oriented and thus largely driven by the state or municipal agencies that sponsored projects. In this system the federal government was not well placed to pursue its own planning goals (Howe and Brail, 1993.) The policy environment has recently shifted due to two critical pieces of federal legislation: the Clean Air Act Amendments of 1990 (CAAA) and the Intermodal Surface Transportation Efficiency Act of 1991 (ISTEA.) CAAA is a broad-based update of earlier legislation designed to reduce air pollution from all sources. Its provisions that relate to transportation include more stringent vehicle emissions standards, use of reformulated fuels, programs to accelerate market penetration by alternative vehicles, and other technology-based measures. It differs from earlier legislation in its provisions imposing TCMs in areas where emissions standards might not be adequate to address air quality problems.

Air quality monitoring is carried out in all U.S. metropolitan

areas for six critical air pollutants: CO, Pb (lead), NO_2, O_3, PM-2 and SO_2. Those cities in which federal concentration standards for one or more of these pollutants are regularly exceeded are designated as *nonattainment* areas. A nonattainment area is classified as moderate, serious, severe, or extreme depending upon the amount by which the concentration standards are exceeded and the number of days on which they are exceeded. In each non-attainment area a *metropolitan planning organisation* (MPO) made up of representatives of local governments, is charged with providing a conformity plan that identifies steps to bring air quality in line with federal standards within a prescribed time interval. Since transportation sources (especially cars) contribute a significant proportion of CO and the precursor pollutants for O_3 (NO_x and VOC), the conformity plans for CO and O_3 nonattainment areas often include implementation of some TCMs. For example, severe or worse nonattainment areas for O_3 must include TCMs in their conformity plans.[4] CO nonattainment areas are not always required to implement TCMs, but may be required to do so if they exceed approved forecasts for VKT growth.

A further stipulation of CAAA is that for a nonattainment area, no major infrastructure project may receive federal approval unless it can be demonstrated that it will not result in an increase in total transportation emissions.[5] This applies a much more stringent environmental test than was previously required, forcing state and local authorities to consider environmental impacts of all projects in a comprehensive way. CAAA has another, equally important impact on the federal-state process of infrastructure development. One of the sanctions for metropolitan areas that fail to achieve federal air quality standards is the withholding of federal transportation funds. Thus, the federal government's role in funding transportation infrastructure gives it a powerful lever with which to enforce its environmental regulations.

ISTEA, the second critical piece of federal legislation, is an omnibus bill covering all aspects of the surface transportation system. Among its provisions are the establishment of guidelines for metropolitan and state transportation plans. Under ISTEA, plans are required to address different modes in an integrated way, take account of environmental impacts, and stress the provision of transportation services over the provision of transportation capacity (Gifford et al, 1993; Lyons, 1993.) Thus, ISTEA represents an attempt to shift away from the project-oriented approach to one that stresses broad planning objectives (Howe and Brail, 1993.)

An important aspect of ISTEA is the increased importance it places on metropolitan areas as planning units, and the increased requirements it places onMPOs, which must provide both long-term plans and shorter term implementation plans in order to qualify for federal funds. The plans must meet the legislation's objectives of "intermodalism" and concern for environmental issues, and must also be consistent with corresponding state plans. (This is complicated by the fact that many metropolitan areas straddle two or more states.) However, the amount of funds available directly to metropolitan areas is tripled under ISTEA.

4.2 Canadian Policy Framework

In Canada the federal government plays a lesser role in urban transportation and air quality. This does not imply that the Canadian government is less concerned about the environment than its U.S. counterpart. Rather, it reflects the nature of power sharing between federal, provincial, and municipal governments in Canada.

Transport Canada is the federal ministry with primary jurisdiction of water, rail, and air transportation. In stark contrast to the U.S. case, Transport Canada has relatively little involvement in the construction of highways. Historically, the provinces have built and maintained control over highways and Canada lacks a nation-wide inter-regional road system (with the exception of the Trans-Canada Highway). Additionally, Transport Canada has not played a substantial policy role in urban transportation, which is primarily an area of provincial responsibility[6]. Until quite recently, its policy emphasis was on two factors: safety and economic competitiveness (Transport Canada, p.1 1995) but it is currently integrating environmental objectives more fully into its plans and policies (Resource Futures International, 1996.) For now its principal contribution to controlling automotive emissions is its responsibility to monitor and enforce national new car emissions standards.

Environment Canada monitors concentrations for the same pollutants as the U.S. EPA, and identifies maximum desirable and maximum tolerable levels. Unlike in the U.S. however, no enforcement mechanisms are triggered when the standards are violated. Natural Resources Canada (NRCan) also plays a role in controlling automobile emissions through a variety of programs to encourage energy conservation.

Given the relatively weak position of the federal government, achievement of national environmental goals can only be achieved by voluntary federal-provincial co-operation. The Canadian Council

of Ministers of the Environment (CCME) is made up of representatives from both the provinces and the federal government. It defines principals and sets targets, but has little if any power of enforcement.

The provincial Ministries of Transportation carry the bulk of the responsibility for the construction, maintenance, and operation of highways in Canada. They also advise local municipalities on their transportation plans. Environment ministries in most provinces conduct air quality monitoring in co-operation with Environment Canada, and some even have their air quality criteria (Ontario Ministry of Environment and Energy, 1995.) Most provinces also have Departments of Municipal Affairs which are important because of their influence on zoning, finances, and planning within municipalities.

Municipal governments have the most direct control over urban transportation since they manage most public transit systems and all roads except the provincial highways. Thus it is at the municipal level that mostTCMs must be implemented. A large proportion of the funding for municipal transportation comes down from the provincial level in the form of block grants based on population. Municipalities generally have broad discretion over how these funds are spent, and we know of no situation in which provincial grants have been withheld because of the failure of municipalities to meet environmental targets. Infrastructure related expenditures have tended to dominate municipal transportation budgets, possibly because of their political visibility.

Each of Canada's three dominant metropolitan areas, Toronto, Montreal, and Vancouver, has an additional layer of regional government which has been established to control areas of shared interest such as transportation. In a sense, therefore, government institutions comparable to the U.S.MPOs have developed without federal legislation to mandate them. However, the ability of regional governments to institute policies such as integrated public transit has been hampered by conflicting interests and power struggles at the municipal level (Perl and Pucher, 1995). This is especially true in the case of Metropolitan Toronto, long held up as a model for metropolitan government but currently under critical review. The recent Golden Report (GTA Task Force, 1996) concludes that a strong regional government is needed for a Greater Toronto Area (GTA) encompassing a larger group of municipalities to ensure, among other things, an integrated approach to transportation management and provision.

In Montreal, a new agency responsible for metropolitan issues including transportation (Ministere d'Etat a la Metropole) has been created by the Quebec government. Instituting region-wide demand management programs and directing capital investment are two major activities of the new agency. The Greater Vancouver Regional District (GVRD) has been given the power to work towards a more integrated transportation system and address air quality issues within the region under enabling legislation by the Province of British Columbia. Control of transportation emissions from the GVRD is a critical element of the province's Greenhouse Gas Action Plan (Province of British Columbia, 1995.)

5. Implementations

The discussion above indicates that the U.S. policy environment provides a clearer structure for the implementation of TCMs. This does not mean, however, that their adoption is universal or that implementation is without problems and controversy. In this section, we look at a few U.S. metropolitan areas to see how implementation has proceeded and what further measures are planned. For the purpose of comparison, we also review implementations of TCMs in Canada.

5.1 U.S. Implementations

Los Angeles has the most serious air quality problem of any of the major U.S. metropolitan areas. Los Angeles' MPO, known as the South Coast Air Quality Management District (AQMD), is responsible for meeting state and federal air quality standards in an area of over 12,000 square miles with the second largest urban population in America. Its responsibilities include the implementation of TCMs as required under federal legislation.

AQMD has introduced a novel approach to demand management. Buildings that attract large numbers of vehicles, most notably major employers, are designated as *indirect sources* of emissions. Just as industrial operations are held responsible for the emissions that they produce directly, these operations are responsible for the emissions they produce indirectly through vehicle emissions. Thus AQMD has designed and implemented programs and regulations that operate through the employer rather than the individual driver.

Review of planning documents from a number of metropolitan areas reveals that where TCMs have been included as

part of regional transportation plans, they have been quite limited and their contributions to total emissions reductions have been relatively small. Plans of the National Capital Region Transportation Planning Board (TPB), which serves as MPO for the Washington DC area, provide a case in point. As a "serious" nonattainment area for O_3, TPB is encouraged, but not required to include TCMs in its plan to conform with federal air quality standards. After analysing the cost effectiveness of over 50 TCMs (Metropolitan Washington COG, 1994), TPB included only three in its plan: adjustment of traffic rules to permit right turns on red, expansion of a government sponsored ridesharing program, and establishment of a program to promote telecommuting.[7] TCMs are expected to account for only 2.2% of planned reduction in VOC and 4.2% of planned reductions in CO (TPB, 1995).

One reason for the relatively conservative attitude of most MPOs is the expectation that reductions in emissions per VKT mandated under federal legislation will be sufficient to meet emissions reductions targets. There is increasing evidence to suggest, however, that in-service emissions performance of vehicles is not as good as assumed in most emissions projections. Degradation of emissions control equipment with age, inconsistency between government test procedures and real world driving cycles, and slower turnover of the vehicle fleet are all factors that may result in worse than expected emissions performance (Ross, et al, 1995). If emissions estimates are revised upwards MPOs will have to depend on TCMs for a greater proportion of emissions reductions.

5.2 Canadian Implementations

In Canada, there is no federal mandate for the development of integrated plans for emissions reduction at the metropolitan area level. As a result we find a more piecemeal application of programs comprising one or more TCMs that are generally initiated at either the federal or provincial level and implemented at either the provincial or municipal level or by some supra-municipal body.

They are profiled in Table 2 and can be categorised in to four policy areas: 1) education and information programs that promote all types of TCMs; 2) technological programs that are primarily aimed at vehicle stock improvement and traffic flow improvement 3) demand management measures to promote mode shifting and trip scheduling through transportation system changes and employer based programs, and 4) financial programs that provide economic incentives for mode shifting and trip scheduling.

TABLE 2: Examples of Current Policies and Programs in Canada related to Urban Transportation Energy and Emissions

	Government Level	Description
GO GREEN	multi-level	raise public awareness of auto emissions as an environmental problem educate workers on alternatives to auto based commuting
AirCare	municipal-federal	mandatory vehicle emissions testing tied to annual license renewal restricted geographic coverage
Employer-based	provincial-municipal co-ordination	educate employees on alternatives, carpooling, flexible work scheduling, transit subsidy, parking restrictions and employee administration of TDM plan
Local User Fees	municipal	30.00 annual fixed cost associated with vehicles registered within metropolitan areas 1.5 cent/litre fuel tax within metropolitan region money used for all facets of regional transportation system

Notes: 1) Does not imply Canada wide, merely selected from Canadian jurisdictions
Sources: Collette (1996), Ontario Round Table (1995), Province of British Columbia (1995), MacRae (1994)

Table 2 does not do justice to the spectrum of policy options that are either being explored or implemented throughout Canadian urban areas. The focus for existing or proposed programs has been in major metropolitan areas such as Vancouver Montreal and Toronto, but Province-wide initiatives exist as well.

6.0 Concluding Remarks

Improvements in vehicle technology have significantly reduced emissions and energy use per VKT. However rapid growth in driving and the persistence of air quality problems in U.S. and Canadian cities will probably lead to a need to supplement progress in vehicle technology with policies to change levels and patterns of urban transportation demand. Transportation control measures, therefore, are likely to remain on the policy agenda for the foreseeable future.

Differences in the role that their federal governments play in road transportation have produced very different policy environments for the implementation ofTCMs in the U.S. and Canada. The central role of the U.S. federal government in road transportation, and recent environmental and transportation legislation, have created a framework whereby Washington can pursue its environmental agenda by requiring the implementation ofTCMs at the metropolitan level. At the present time, Ottawa has no such power.

Despite this, it is not clear that the U.S. policy environment has led to more rapid implementation. In most metropolitan areas, TCMs make relatively small contributions to total planned emission reductions necessary to meet federal standards. In the case of Washington DC, only a modest TCM program was adopted because no more was needed to meet federal requirements. Thus it is at least possible that whenTCMs are implemented for the expressed purpose of meeting emissions targets, local policy makers may be less likely to pursue more aggressive programs that exceed those targets. Also, the rigid conformity deadlines in CAAA favour measures that produce results quickly. This may actually work against land use planning measures that have significant potential only in the long run.

In Canada, despite theabsence of a federal mandate, significant implementation ofTCMs has occurred. Furthermore, in the three largest cities new layers of metropolitan government have emerged to help integrate transportation and environmental policy over broad urban regions. Perhaps the historical role of metropolitan government, which has been largely absent in U.S. cities, makes it more likely that these agencies will be created from the bottom up rather than mandated from the top down. Still, the fact remains that in the absence of federal legislation with significant sanctions metropolitan areas can refrain from implementing any policy to mitigate the impacts of transportation on the environment if they choose. This makes it difficult for the federal government to enforce common Canadian standards of urban air quality and also restricts it ability to meet its greenhouse gas emissions targets.

Finally, neither U.S. nor Canadian metropolitan areas have made great strides in integrating transportation and land use planning. There is reason to speculate, however, that this may become a more important tool for achieving environmental objectives in Canada than in the United States. There is a stronger tradition of land use planning in Canada and there is generally more oversight by provinces than there is by states. Also, Canadian cities

are already more compact and transit-supportive that their American counterparts, which suggests that Canadians may be more willing to accept the kind of changes to land use practice that are necessary to reduce levels of driving, energy use, and emissions.

ENDNOTES

[1] The authors acknowledge the support of Natural Resources Canada through the Energy Policy Research Program of the McMaster Institute for Energy Studies

[2] Due to space limitations, references were not included. They can be obtained by sending a request to cwoudsma@acs.ucalgary.ca .

[3] It should be noted that estimates for both of these TCMs were based on very limited information, so these estimates should be regarded with caution.

[4] For moderate or serious O3 nonattainment areas, expected reductions in emissions due to turnover of the vehicle stock is often sufficient to meet air quality standards.

[5] A recent study by the Transportation Research Board (1995) questions the ability of current analytical methods to make such an assessment accurately.

[6] The federal government does influence transportation infrastructure financially through the occasional provision of specific infrastructure funds. A recent federal job creation initiative included the funding of numerous transportation infrastructure projects across Canada. However, this was basically a jobs creation rather than transportation improvement program.

[7] Right turns on red were implemented immediately in 1993 while the others were funded as part of a 1996-2001 Transportation Improvement Plan.

LA NOUVELLE LOI SUR LES TRANSPORTS : SES CONSÉQUENCES SUR LES CHEMINS DE FER D'INTÉRÊT LOCAL ET SUR LA SOCIÉTÉ VIA RAIL

Louis Doyle
Analyste en transport
Ministère des Transports du Québec

1. INTRODUCTION

La *Loi sur les transports*, sanctionnée en mai 1996, est en vigueur depuis le 1er juillet de la même année. Cette nouvelle loi, comprenant 278 dispositions, constitue en fait la consolidation de nombreuses lois (la *Loi de 1987 sur les transports nationaux*, la *Loi sur les chemins de fer*, ainsi que la *Loi sur les chemins de fer de l'État*). Deux éléments s'en dégagent : la création d'un nouvel organisme de réglementation ferroviaire, l'Office des transports du Canada, ainsi que l'établissement d'un nouveau mécanisme de transfert et de cessation d'exploitation de lignes.

Le premier élément, soit la création de l'Office des transports du Canada, mérite notre attention en raison du fait que le nouvel organisme remplace l'actuel Office national des transports et surtout que son rôle est plus limité. À titre d'exemple, certains champs de compétence, dont les fusions et les acquisitions, ont été confiés au Bureau canadien de la concurrence. Le second élément fondamental, relatif à l'établissement d'un nouveau mécanisme de transfert et de cessation d'exploitation de lignes fait l'objet, en raison de ses nombreuses implications, d'une étude spécifique dans ce texte.

2. NOUVEL ENVIRONNEMENT ÉCONOMIQUE

Depuis l'introduction de la *Loi de 1987 sur les transports nationaux*, il y a 10 ans, le secteur ferroviaire est en pleine mutation. En effet, les compagnies de chemin de fer ont dû s'adapter à une déréglementation partielle de la tarification par l'introduction, entre autres, des prix de ligne concurrentiels et des contrats confidentiels. Rappelons que les contrats confidentiels constituent plus de 80 % des contrats de transport ferroviaire au Canada. Ces

nouvelles dispositions ont favorisé dans une certaine mesure les expéditeurs.

D'autres facteurs importants comme la surcapacité du réseau ferroviaire de l'est du Canada, impliquant un déficit pour CN et CP de 1.5 milliard de dollars pour les deux compagnies, la concurrence des chemins de fer américains et la compétition vive du camionnage constituent des exemples frappants de cette mutation. M. Doug Young, du temps où il était ministre des Transports, percevait ainsi la mutation du secteur ferroviaire : «L'avenir de l'industrie du rail est incertain. Il est entravé par des problèmes de surréglementation, de mauvaise administration, de surcapacité, de pertes financières, de pratiques archaïques de travail et de réglementation désuète[1]».

La croissance marquée du commerce dans l'axe nord-sud, accentuée par l'accord de libre-échange avec les États-Unis et l'ALENA, constitue un autre élément fondamental de cette mutation. La situation décrite précédemment explique en partie la tentative de fusion de CN et de CP suivie de la privatisation de CN en 1995. De plus, elle explique la décision de CP de former un chemin de fer régional, le Chemin de fer St-Laurent et Hudson, comprenant le réseau du Québec, de l'Ontario ainsi que celui de l'est des États-Unis. D'autre part, les syndicats lancent un cri d'alarme : 2000 postes auraient disparu en 1996 au Québec, soit des pertes de plus de 10 000 emplois depuis 10 ans. En effet, les effectifs ferroviaires au Québec sont passés de 20 293 travailleurs en 1987, à 11 949 à la fin de 1995, soit une baisse de 41,1 %. Durant cette même période, ceux-là diminuaient de 35,7 % dans l'ensemble du pays à 50 900 personnes[2].

Il va de soi que cette mutation affecte non seulement les principaux chemins de fer mais aussi les chemins de fer d'intérêt local (C.F.I.L.) car leur existence est liée à ceux-là.

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1 Allocution du ministre des Transports, M. Doug Young, au dîner de la Journée nationale des Transports, Thunder Bay, 3 juin 1994, p. 2.

2 Richard DUPAUL. «Rail : cri d'alarme des syndicats», *La Presse*, 25 octobre 1996, p. C-16.

3. LE NOUVEAU MÉCANISME DE TRANSFERT ET DE CESSATION D'EXPLOITATION DE LIGNES

Le nouveau mécanisme de transfert et de cessation de l'exploitation de lignes est prévu aux articles 140 à 146 de la *Loi sur les transports au Canada*.

La première étape de ce nouveau mécanisme est l'obligation pour chaque compagnie de chemin de fer de publier un plan triennal de rationalisation de son réseau. Il y a une procédure différente pour les cas de transfert et ceux de cessation de l'exploitation de lignes.

3.1 Procédure de transfert de lignes

Pour les cas de transfert de lignes, il n'est prévu aucun délai précis. La compagnie de chemin de fer peut négocier avec tout acquéreur en toute liberté. Si les négociations échouent, la compagnie de chemin de fer peut alors mettre en branle la procédure de cessation d'exploitation de lignes.

3.2 Procédure de cessation de l'exploitation de lignes

Pour les cas de cessation de l'exploitation de lignes, la publication du plan triennal de rationalisation constitue la première étape du processus de vente des lignes (article 141). Un délai de 60 jours est prévu pour cette étape (article 142). Après le délai de 60 jours prévu pour la publication «nationale» du plan triennal du réseau, la compagnie de chemin de fer doit produire une annonce publique «régionale» de la cessation de l'exploitation de la ligne visée. Cette annonce publique «régionale» précise les paramètres de la vente de cette ligne (article 143).

Les personnes physiques ou morales intéressées ont un délai de 60 jours à partir de l'annonce publique «régionale» pour communiquer leur offre d'acquisition à la compagnie de chemin de fer.

- Dans l'éventualité de l'absence de propositions de personnes intéressées dans le délai prescrit de 60 jours, la compagnie de chemin de fer doit offrir successivement au gouvernement de la province concernée et aux municipalités touchées les droits de propriété ou d'exploitation de la ligne à la valeur nette de récupération (article 145). À cette étape, l'acheteur peut l'acquérir pour d'autres fins (piste

cyclable, etc.) que la vocation ferroviaire.

- Le gouvernement de la province concernée ainsi que les administrations municipales ont chacun un délai de 30 jours pour manifester leur intention d'acquérir ou non la ligne.

- Cependant, si la ligne franchit les limites d'une province, les frontières du Canada ou une réserve indienne, le gouvernement fédéral (article 145 (2)) peut exercer son option d'acquisition durant les trente premiers jours suivis de l'option du gouvernement d'une province ou celle des administrations municipales touchées.

- En cas de désaccord sur le critère de la valeur nette de récupération (article 145), l'Office des transports du Canada détermine, sur demande des pouvoirs publics intéressés, une valeur pour la ligne visée.

- En l'absence d'intérêt des gouvernements et des administrations municipales, la compagnie de chemin de fer a la liberté complète de disposer de la ligne en procédant au démantèlement de la voie et à la vente des terrains, notamment avec les propriétaires limitrophes.

- Dans l'éventualité d'une proposition d'un acquéreur dans la période de 60 jours suivie de négociations avec la compagnie de chemin de fer, il est prévu un délai de 4 mois pour finaliser une entente (article 144). S'il n'y a pas d'entente dans ce laps de temps, la compagnie de chemin de fer doit l'offrir, selon l'article 145, aux gouvernements ou aux administrations municipales.

En conclusion, nous constatons, sur une période de trente ans, une libéralisation croissante du mécanisme d'abandon et de vente de lignes. En effet, la *Loi nationale sur les transports de 1967* prévoyait le critère de l'intérêt public, la *Loi de 1987 sur les transports nationaux* énonçait le critère de la rentabilité économique, et enfin, la récente *Loi sur les transports au Canada* prévoit le critère de la liberté de disposer des lignes mais dans un cadre déterminé par le législateur.

4. CONSÉQUENCES DE CE NOUVEAU MÉCANISME SUR LES C.F.I.L.

Ce nouveau mécanisme de vente ou d'abandon de voies ferrées a de nombreuses et importantes incidences sur l'avenir des chemins de fer d'intérêt local (C.F.I.L.).

En effet, ce processus accéléré entraîne d'énormes conséquences sur les C.F.I.L. tels le financement et la restauration des voies. Le double défi qui se pose à l'acheteur de ces voies est celui de financer l'acquisition tout en prévoyant, en même temps, des sommes élevées pour leur restauration. Rappelons que le gouvernement fédéral n'a prévu aucune disposition financière dans cette loi, qui permettrait la restauration des voies. Ces voies ferrées régionales n'ont jamais été restaurées par CN ou CP depuis plus de 10 ans. Certaines régions affectées sont donc confrontées à un double fardeau : trouver du financement régional pour l'acquisition (de l'ordre de millions de dollars) et des sources de financement pour restaurer la voie. Le financement de la restauration est d'autant plus difficile que la voie ferrée a généralement servi de garantie hypothécaire pour l'acquisition.

4.1 Conséquences sur les ventes de lignes

4.1.1 Les conséquences au Québec

Tel que prévu, ce nouveau mécanisme de transfert et de cessation d'exploitation a produit une accélération des ventes de lignes comme le démontrent la vente du tronçon CP Lennoxville à St-Jean au chemin de fer Québec-Sud le 26 septembre 1996 ainsi que celle du tronçon CN Matapédia-Chandler à la Société des chemins de fer du Québec le 2 décembre 1996. Ces deux ventes montrent l'intérêt de certaines entreprises et permettent d'envisager une perspective d'avenir intéressante.

4.1.2 Les conséquences dans les autres provinces

Dans les autres provinces, plus particulièrement en Ontario et au Manitoba, on assiste à ce même phénomène d'accélération des ventes de lignes.

En effet, en Ontario, le Chemin de fer St-Laurent et Hudson a procédé à la location d'un tronçon ferroviaire entre Smith Falls et Sudbury (350 milles) à la compagnie de chemin de fer RaiLink Inc., une filiale du chemin de fer

Central Western, précurseur des C.F.I.L. au Canada. Le CP a aussi vendu à un groupe d'employés et de cadres de la compagnie un tronçon de 50 milles entre Havelock et Nephton. Un autre tronçon de CP entre Mississauga et Owen Sound, d'une distance de 108 milles, aurait été vendu au chemin de fer Ontario Midwestern.

Enfin, le CN a vendu un tronçon de quelques dizaines de milles entre Hawksbury et L'Orignal au chemin de fer Ontario L'Orignal Inc., une filiale de Railtex.

En Ontario, nous assistons à un phénomène nouveau : la constitution de C.F.I.L. par les municipalités.

Au Manitoba, le CN a vendu trois lignes d'un total 810 milles entre The Pas et le port de Churchill, sur la Baie d'Hudson, à la compagnie de chemin de fer américaine OmniTRAX.

En Saskatchewan et en Colombie-Britannique, les droits de succession semblent un obstacle majeur à la constitution de C.F.I.L. De plus, pour la province de Saskatchewan, le CN prévoit, dans son plan triennal, seulement 36 milles de tronçons à transférer pour un total de 170 milles de lignes sujettes à abandon.

4.1.3 Conclusions relatives à ces ventes de lignes

Une première conclusion se dégage. On constate à l'évidence que ces ventes de lignes au Canada, qui ont eu lieu rapidement après l'entrée en vigueur de la loi fédérale, ont toutes été réalisées par des acheteurs qui ont une grande compétence en matière ferroviaire.

Deuxième conclusion : il est très rare que les employés touchés par ces ventes de tronçon constituent des groupes pour acquérir ces mêmes tronçons.

Troisième conclusion : en raison de la complexité technique liée à l'acquisition et à l'exploitation d'un C.F.I.L., nous constatons qu'il est très difficile pour un groupe régional qui veut acquérir ces tronçons de négocier leur acquisition sans l'appui d'interlocuteurs détenant une compétence dans le secteur ferroviaire.

4.2 Conséquences sur les demandes d'abandon

Ce nouveau mécanisme a produit une accélération à la fois des ventes des lignes ferroviaires et des demandes d'abandon. En effet, le CN a mis en branle, dès le lendemain de la sanction de la loi, des projets d'abandon pour les tronçons Sorel-Tracy, Québec-Shannon, La Sarre-Cochrane ainsi que Chandler-Gaspé. Un élément porteur d'avenir est la création d'un groupe régional pour acquérir la ligne; citons le cas de la région de Gaspé qui veut acquérir la ligne entre Chandler et Gaspé pour protéger l'avenir économique de la région ainsi que de son port.

Ces projets d'abandon auront pour conséquence certaine une accélération du démantèlement des lignes en raison du caractère impératif des délais qui, dans certains cas, ne permettent pas aux parties, dans la région, de trouver le financement dans le temps imparti. Citons à cet égard, M. Janvier Cliche, président du Conseil québécois pour le transport ferroviaire (CQTF) : *I am disappointed by the proposed federal transportation legislation, since it does not provide for more time before a line abandonment can proceed. We need the time for the forces within the region to organize a short line operator. That's very hard to do in just three months![3]*»

4.3 Enjeu de l'ensemble de ces ventes

L'enjeu fondamental au Québec reste, dans ce contexte, la vente, par le CP, du tronçon Québec-Montréal. En effet, M. Serge Belzile, porte-parole de la Société des chemins de fer du Québec, affirmait «que l'enjeu majeur pour sa compagnie et pour le secteur ferroviaire en général, tourne autour de la décision que prendra le CP au sujet de son tronçon reliant Québec à Montréal, en passant par Trois-Rivières et incluant l'embranchement vers Shawinigan[4]». Ainsi, ce tronçon ferroviaire constitue la clé de voûte car CN est le véritable maître-d'oeuvre au Québec avec sa ligne principale sur la rive sud du St-Laurent, ses deux C.F.I.L. internes (le C.F.I.L. du Nord du Québec et le futur C.F.I.L. du Moncton à Rivière-du-Loup en passant par Mont-Joli),

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3 Malcolm McLean. «Quebec's new railways», *Montreal Business Magazine*, Spring 1996.

4 Gilles GAGNÉ. «La Caisse de dépôt investit 1 million $ dans Chemins de fer baie des Chaleurs», *Le Soleil*, 31 décembre 1996, p. B-2.

ainsi que ses liens étroits avec la Société des chemins de fer du Québec. L'acheteur du tronçon Québec-Montréal, un C.F.I.L., nous l'espérons, est le seul concurrent possible au CN d'où l'importance stratégique de cette vente qui implique de nombreux intéressés ainsi que des sommes élevées.

5. CONSÉQUENCES SUR LA SOCIÉTÉ VIA RAIL

5.1 Conflit d'objectifs

Ce nouveau mécanisme de vente et d'abandon des voies ferrées n'entraîne pas que des conséquences pour les C.F.I.L., mais aussi pour la survie régionale des services ferroviaires passagers. En effet, les projets d'abandon du CN pour les tronçons Chandler-Gaspé et La Sarre-Cochrane remettent en cause l'existence de certains services ferroviaires passagers dans les régions.

Le législateur fédéral semble avoir ignoré le conflit entre la nouvelle loi sur les transports, qui prévoit le démantèlement de certains tronçons, et l'existence de services ferroviaires voyageurs sur ceux-ci. Au Québec, le problème se pose pour les tronçons Chandler-Gaspé ainsi que La Sarre-Cochrane. Au Manitoba, il y avait un problème identique, mais la vente du réseau ferroviaire à un acheteur américain semble avoir résolu le problème.

Lorsqu'il y a projet d'abandon par la compagnie de chemin de fer, la société Via Rail doit décider si elle acquiert ou non cette ligne. Considérant le budget d'immobilisation modeste et les contraintes budgétaires strictes de Via Rail, il y a peu de chances que celle-ci acquiert ces voies ferrées. Il va de soi que le refus d'acquérir certains tronçons par Via Rail a des conséquences dramatiques sur le public voyageur de régions éloignées et économiquement faibles.

5.2 Absence de mécanisme d'arbitrage

Dans les cas de vente des voies ferrées, le nouveau C.F.I.L. devra s'entendre avec Via Rail pour l'établissement des droits de circulation et autres aspects afférents à la ligne. Cependant, le législateur fédéral n'a pas étendu le droit d'arbitrage au nouvel Office des transports du Canada pour les litiges entre les C.F.I.L. et Via Rail, comme il l'a fait pour les litiges entre les compagnies de chemins de fer, Via Rail et les organismes de transport urbain.

Cependant, il faut souligner que rien n'empêche Via Rail de s'entendre avec les C.F.I.L. dans le cadre volontaire d'une médiation. En ce qui concerne le cas précis de l'absence d'un mécanisme d'arbitrage entre Via Rail et les C.F.I.L., faut-il envisager une modification à la *Loi sur les transports au Canada* ou une modification à la *Loi des chemins de fer* du Québec? En effet, l'Ontario a prévu, à l'article 13 de sa récente loi concernant les chemins de fer d'intérêt local, une disposition spécifique qui permet la résolution de conflits entre un C.F.I.L. et une compagnie de chemin de fer se livrant au transport de passagers par l'application d'un mécanisme d'arbitrage.

Pour notre part, nous estimons qu'il n'y a pas lieu de modifier à court terme la *Loi sur les chemins de fer* pour introduire un mécanisme d'arbitrage en raison du pouvoir économique énorme que détient la société fédérale Via Rail lors de négociations éventuelles avec un chemin de fer d'intérêt local pour la fourniture de services.

5.3 Cas spécifique de l'abandon du tronçon Harlaka

Il faut citer le cas précis de l'abandon du tronçon Harlaka qui remet en cause la survie de la gare intermodale de Lévis. En effet, l'abandon de ce tronçon d'une longueur de 14 kilomètres par le Canadien National, en février 1997, oblige la société Via Rail à considérer l'acquisition ou non de ce tronçon, et ce, en vertu de la *Loi de 1987 sur les transports nationaux*. En janvier 1997, la société Via Rail décide plutôt que d'acquérir la voie ferrée, de procéder à la fermeture de la gare intermodale de Lévis et de faire un arrêt temporaire à la gare de Sainte-Foy.

Cette décision aura des conséquences nombreuses et sérieuses sur la clientèle tant de la région que de l'extérieur. En effet, la gare intermodale de Lévis constitue la principale porte d'entrée ferroviaire de la grande région de Québec pour l'ensemble des voyageurs de la Gaspésie, du Bas-Saint-Laurent ainsi que des provinces maritimes. De plus, rappelons que cette gare a été rénovée au coût de trois millions de dollars en 1996 dont une somme de 1,8 milllion de dollars déboursée par le gouvernement du Québec.

Nous nous interrogeons sur la pertinence de procéder à la fermeture de la gare intermodale de Lévis au moment même où la société Via Rail procède à l'acquisition d'un tronçon de la subdivision Chatham, en Ontario, pour protéger le service ferroviaire voyageur entre Toronto et Windsor.

Pour le cas du tronçon Chandler-Gaspé, où le problème se pose tant pour le

transport des passagers que celui des marchandises, nous sommes en présence d'un élément porteur d'avenir, soit la création d'un groupe régional qui veut acquérir cette ligne (Chandler-Gaspé) et qui prévoit la création d'un C.F.I.L. voyageur.

6. CONCLUSION

Nous avons esquissé dans cette étude les incidences nombreuses et importantes de cette nouvelle procédure de transfert et de cessation d'exploitation, tant sur les C.F.I.L. que pour la société Via Rail.

Un enjeu important peut se dégager pour l'avenir : les droits de circulation. En effet, ceux-ci seront sûrement l'objet de discussions dans l'avenir en raison de la présence de nombreux C.F.I.L.

Le problème fondamental qui se posera dans le futur est la volonté de nombreux C.F.I.L. d'obtenir des droits de circulation sur les autres C.F.I.L. de même que le droit à l'arbitrage.

On peut s'attendre, au cours des prochaines années à ce que les C.F.I.L. forment un groupe de pression avec un mandat de défendre l'ensemble de leurs intérêts et, plus particulièrement, l'octroi de droits de circulation par un mécanisme obligatoire d'arbitrage. Dans un tel contexte, de nombreux C.F.I.L., avec la présence d'un ou deux joueurs principaux au Québec, CN et un autre en devenir (l'acheteur du tronçon Québec-Trois-Rivières-Montréal), exigeront ce mécanisme obligatoire comme condition de leur survie économique.

ANNEXE 1

LISTE DES VENTES DE LIGNES AU QUÉBEC

CN

1. Vente du tronçon Matapédia-Chandler (146 milles) à la Société des chemins de fer du Québec, le 2 décembre 1996.

2. Projet de vente du tronçon Ste-Rosalie-frontière américaine (94 milles). Possibles acheteurs : le chemin de fer américain St-Laurent et Atlantique, la Société des chemins de fer du Québec.

CP (Chemin de fer St-Laurent et Hudson)

1. Vente du tronçon principal Lennoxville-St-Jean et de certains tronçons accessoires (140 milles) au chemin de fer Québec-Sud, le 27 septembre 1996.

2. Projet de vente du tronçon Québec-Montréal (Mascouche) d'une distance de 151 milles. Possibles acheteurs : la Société des chemins de fer du Québec, le chemin de fer Québec-Sud, le syndicat des employés du Chemin de fer St-Laurent et Hudson, partenariat du Chemin de fer St-Laurent et Hudson avec la société américaine de chemin de fer Genesee et Rail-One.

3. Projet de vente du tronçon St-Augustin-Lemieux Island (Ontario) d'une distance de 33 milles.

4. Projet de vente du tronçon Trois-Rivières-Grand-Mère (28 milles).

5. Projet de vente du tronçon Lanoraie-Joliette (7 milles).

ANNEXE 2

LISTE DES PROJETS D'ABANDON AU QUÉBEC

CN

1. Projet d'abandon du tronçon Sorel-Tracy (2 milles). Présence d'un pont exigeant des réparations coûteuses sur ce tronçon.

2. Projet d'abandon du tronçon Québec-Shannon (15 milles). Le principal expéditeur est la base militaire de Valcartier.

3. Projet d'abandon du tronçon La Sarre-Cochrane (Ontario) d'une distance de 82 milles. Il existe un service Via Rail sur ce tronçon.

4. Projet d'abandon du tronçon Chandler-Gaspé (56 milles). Présence d'un service voyageur (Via Rail) sur ce tronçon.

5. Projet d'abandon du tronçon Sainte-Thérèse Ouest-Saint-Augustin (4 milles).

REVENUE MANAGEMENT AT VIA RAIL CANADA

ABSTRACT

The general theme of this forum is "Transportation: Emerging Realities " which allows us to introduce revenue management (also known as yield management) at VIA Rail Canada. Revenue management presents a tremendous opportunity for increasing revenue in capacity-constrained transportation businesses.

VIA operates over 430 train departures per week, serving 3 million passengers in the Québec City-Windsor Corridor in 1996. While the overall average occupancy system-wide is 61%, many departures are in fact sold out.

In the passenger transportation business, it is becoming increasingly important to control and manage reservations inventory in order to maximize revenue. At the same time pricing structures are becoming more varied and complex. The challenge is clear: Fill all available seats with the highest possible value passengers.

Revenue management consists of a series of operations research models such as critical train indicators, overbooking, booking profile, short term and long term forecasts, cycling set indicators, revenue optimization and related reporting facilities. With the implementation of a new reservations system in October 1997, there is the added possibility of controlling reservations by origin and destination to provide the mix of markets that maximizes revenue.

1.0 CONCEPT AND DEFINITION

Revenue management techniques are appropriate when

- ⇒ A firm is operating with relatively fixed capacity
- ⇒ Demand can be segmented into clearly-identified partitions
- ⇒ Inventory is perishable

⇒ The product is sold well in advance
⇒ Demand fluctuates substantially
⇒ Marginal sales costs are low, but capacity change costs are high

Revenue management can be subdivided into 3 categories:

- Seat inventory control
- Overbooking
- Traffic management

Seat inventory control is the process of determining the number of discount fare seats to offer on a train in order to stimulate demand and to fill seats that would otherwise be empty. Overbooking is the practice of intentionally selling more reservations for a train departure than actual seats on the train in order to offset the effects of passenger cancellations and no-shows. Traffic management is the process of controlling reservations by passenger origin and destination to provide the mix of markets that maximizes revenue.

2.0 STRATEGY

2.1 Background

VIA effectively backed into the development of a form of semi-automated revenue management system after *Peak, Off-Peak* pricing was introduced in 1990. The then Canadian Transportation Commission had directed that the off-peak prices be limited in quantity, as well as meeting the VIA-proposed five day advance purchase requirement. Experience soon showed that manual review and control of these limited seats was time consuming and not effective in maximizing revenue. Internal staff reductions made automation absolutely critical.

By mid-1991 VIA took the decision to create a form of yield or revenue management system. Discussions with other carriers and software suppliers showed that purchasing an existing air or hotel system and then modifying it for rail was both time consuming and beyond our budget. We choose to develop in-house on a step by step basis.

The most immediate need was to manage and adjust the balance of full-fare and discount seats. This implies making the correct trade-off

between stimulating traffic volume through discounting and avoiding dilution from existing passengers willing to pay full fare. Sophisticated statistical analyses are required to predict the number of full-fare and various discount fare passengers for each future train departure (since inventory decisions must be made days or usually weeks in advance).

Most reservation and therefore revenue management systems operate with nested inventories. This means that any discount seat is always available for sale at a higher fare. VIA by contrast had, and still has until late 1997, a reservation system with discrete inventories for each booking or fare class. This means that it is possible to be sold out of full-fare seats and still have discount seats available, thus requiring constant review and adjustment. It also makes it impractical to manage more than two booking classes within a class of services. However the revenue management system was designed to anticipated multiple-class nested inventories, while functioning temporarily with the current ReserVIA restrictions.

2.2 Progressive Implementation of Revenue Management

A substantial historical database is a pre-requisite and that work began in November 1991. That database included about 30 snapshots of the advance reservations spread over the 180 days before a train departure (dpd) with greater frequency of viewing closer to departure. Use of that database to make decisions began in Spring 1993 in parallel with the completion of a system of rudimentary statistically-based forecasts and automatic flagging of train instances needing immediate decisions. This was the first step in the incremental process toward a true revenue management system.

The fixed costs of operating passenger trains are relatively high. However the marginal cost to VIA of filling an otherwise empty Economy seat is less than $5 (about 8% of the ticket price), and the remainder is a contribution to fixed costs. Even adding an extra car normally costs around $1.00 per mile, meaning that 10 passengers. even at discount fares, would be required to break even. The forecasts allow decisions to be made about both adding (or cutting) cars and adjusting discount seats.

Train do not operate in isolation, but in cycles over as many as three days. Thus good decisions must look at the economics of a whole cycle, even when total passenger demand varies considerably from one leg of the cycle to another.

These features were put into place gradually during 1994 and 1995.

The second major aspect of revenue management to be implemented was overbooking. Based on statistical results of no-shows and go-shows gathered in 1993, overbooking began in mid 1994 on a limited basis and was finally applied throughout the Ontario-Quebec Corridor in 1996. Although there is generous compensation for inconvenienced passengers, properly chosen overbooking levels result in very few oversold situations on board trains.

The last form of revenue management is origin-destination or traffic management. Due to limitations in ReserVIA, this feature can only be applied in a few of the most obvious situations and in a relatively crude manner at present.

2.3 Practising Revenue Management

At VIA revenue management consists basically of a forecasting system, a prioritizing or flagging system for identifying situations requiring review and decisions, a reporting system for management, and a communication module for interfacing with car control in the operations department.

Since there is only a one-way batch download from the reservation system to revenue management, our system supports rather than makes decisions. Three controllers review all the flagged situations daily and input their decisions into the reservation system.

Almost unexpected side-benefits have occurred from easily customized management reports and the simplified communications interface between seat inventory control and car control.

Immediate future enhancements include extending the time horizon to departures 11 and more months in the future, capturing cancellations as well as reservations, operating up to 8 nested booking levels within a class of service, and adding practical traffic management through two-

dimensional nesting*. Automated decisions fed online into the new reservation system lie a couple of years in the future.

3.0 FORECASTING MODEL

A vital part of every revenue management system is the ability to forecast with precision. The challenge is to predict booking activity of each train departure by class of service, market and fare class based on historical and current reservations data. The forecasting models, based on advanced probabilistic techniques, consider the trend, day-of-week, month-of-year seasonality, bookings on hand and passenger booking behavior.

The Long Term Forecasts (LTF) are done monthly by train departure number, day of the week, class of service and booking class. The model selected generates the monthly average traffic forecasts with a 2 year horizon and doesn't take into consideration the current bookings on hand.

The current bookings are handled by the Short Term Forecasts (STF) based on passengers booking behavior for the bookings-to-come up to the train departure. The STF are recalculated each time we receive a new snapshot from the VIA Reservations system. It is done for each individual train number and departure date by class of service and booking class. The STF is a dynamic process (a daily process for dpd≤16) as opposed to the LTF. The latter is a static process (a monthly process).

These two models (LTF & STF) produce different predictions which must be reconciled to produce final forecasts. These final forecasts provide the most dynamic, robust, and accurate forecasts possible for each individual train number and departure date by class of service and booking class.

3.1 Long Term Forecasts (LTF)

The long term forecasts reflect mainly the basic characteristics of the data such as the level, the trend and the seasonality of the data.

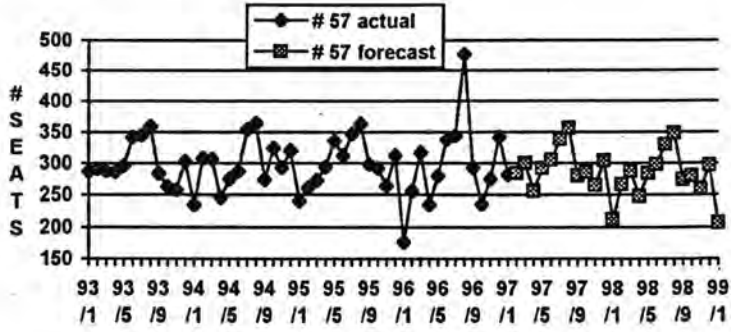
Late in 1994, Marketing department bought a statistical software package to cover the revenue forecasts for the corporation and also for the train departure traffic forecasts. Due to the fact that we have a large number

of train departures by day-of-week, class of service and booking class, the only acceptable solution for providing monthly forecasts in a timely manner is the use of an automated expert system with its advantages and deficiencies.

Each month, over 2,000 different LTF have to be provided. Following is the monthly process done after the end of a month:

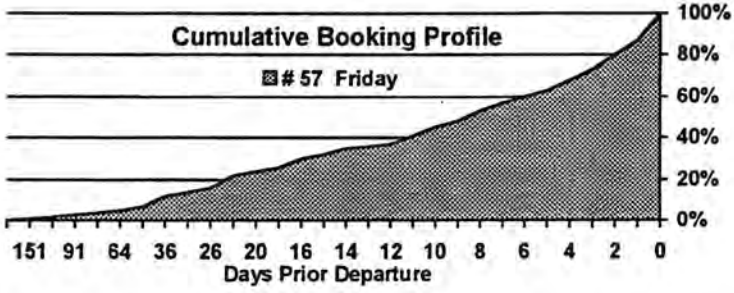
1) Filter each train departure of the previous month and provide the monthly average traffic demand by train number, day-of-week, class of service and booking class.
2) Update the historical monthly average traffic demand database (up to 48 months of historical).
3) Filter data to remove the seasonality via seasonal indices.
4) Use the expert system to fit the best forecasting model. The choice includes single, Holt, exponential, linear and CMFS (combination of Holt & linear) models.
5) Provide 2 years of forecasts (24 monthly forecasts) .
6) Filter the forecast results, if these results do not meet specific criteria, replace them by the monthly historical average traffic demand.

The expert system always fits a model to a given historical data set. It proposes the best one from the above models, but sometimes none of them are plausible forecasts. The result of any automatic process like this one often follows the Pareto paradox: the 80/20 rule (i.e.: 80% of revenue provided by 20% of customers and 80% of customers for 20% of revenue, etc.). In our case, 75-80% (an average) of the LTF are plausible results and 20-25% aren't.



3.2 Passengers Booking Behavior

Passengers booking behavior can be derived from historical patterns of cumulative reservations by days prior departure. For a booking class and/or class of service, booking profiles can be accumulated by train number, day-of-week, travelling season, train service, strategic group and/or a combination of these parameters. The graphical display shows the cumulative booking profile for train #57 on Friday, regular travelling season in Economy class. From that data display, 60% of the expected total reservations are already booked 6 days before the departure.



3.3 Short Term Forecasts (STF)

The approach is based on the idea of using the bookings on hand and the booking behavior of passengers. The short term forecasts reflect mainly the total number of bookings on hand for a specific departure combined with the bookings to come up to the train departure. The bookings to

come are derived from standard cumulative percentage of bookings. The accuracy of this extrapolation model depends upon the extent of pattern stability identified in the past data.

Model without group bookings information (before Dec. 1995)

This was the model used in YLD system before the availability of separate group bookings information from our Reservations system. The cumulative absolute number of the passengers is derived from the standard passengers bookings behavior curve (at dpd and the day of departure) at the class of service and booking class level.

$STD_{bkg\ dpd}$ represents the ratio of cumulative standard booking profile percentage divided by 100

$$STF_{dpd} = \left\{ LTF_{dpd} * \left(1 - STD_{bkg\ dpd} \right) \right\} + Total_{bkg\ dpd}$$

Model with group bookings information (since Dec. 1995)

The cumulative percentage of the standard passenger bookings behavior curve at the class of service and booking class level is used under the following conditions:

- The actual individual bookings on hand is greater than 0
- The actual individual bookings on hand is greater or equal to a ***Baseline number*** of bookings as indicated in the table "Forecast Calibration Parameters table " within the system.
- The cumulative percentage of the standard booking profile is greater or equal to a ***baseline %*** as indicated in the above table.

$$Total_{individual\ bkg\ dpd} = Total_{bkg\ dpd} - Group_{bkg\ dpd}$$

$$A = \left\{ \left(Total_{individual\ bkg\ dpd} \div STD_{bkg\ dpd} \right) + LTF_{dpd} \right\}$$

$$STF_{dpd} = \left\{ A * \left(1 - STD_{bkg\ dpd} \right) \div 2 \right\} + Total_{bkg\ dpd}$$

If the above conditions are not met, then use the previous model.

3.4 Combined Forecasts

This approach is based on the idea of using different forecasting strategies or models depending upon the extent of pattern stability

identified in the past data. Benefits can be derived from using the combined forecasts, while avoiding the problems and limitations of the two forecasting methods mentioned in the previous sections.

The first one is to track the long term trend and seasonality. The second one applies the long term trend to the booking activity over time and adjusts it with the latest actual bookings available.

The two models (LTF & STF) produce different predictions which must be reconciled each time we received a snapshot from our Reservations system to produce final forecasts. The Long Term model (or strategy) is exclusively used until a certain number of days prior to the train departure (in the formula, parameter dpd). When the number of days prior to the train departure is reached, the Long Term and Short Term models are utilized. This reconciliation is done in an exponential fashion, the parameters dpd and α will determine the timing and speed of reconciliation.

To find the right parameters dpd and α, two specific questions must be answered. The first is "After how many forecasts should reconciliation begin?". The second is "What is the appropriate speed of reconciliation?". The closer the α value is to 1 the slower the speed of reconciliation will be. For α=0.9, it will take around 7 periods; for α=0.95 it will take around 30 periods and so on. Empirical analysis on many series has indicated that the best choice is to "turn fast" and "go slow". This philosophy does make sense in our case because groups book early in the process (dpd≥30) and individual bookings occur late in the process (dpd≤22 and it is our main traffic demand). So $\alpha \geq 0.92$ and dpd≤50 should be appropriate parameters in our case.

$$\text{Comb}_{\text{Fcst dpd}} = \begin{cases} \text{LTF}_{\text{dpd}} & \Rightarrow \text{ if dpd} > 50 \\ \left(1-\alpha^{\text{dpd}}\right) * \text{LTF}_{\text{dpd}} + \alpha^{\text{dpd}} * \text{STF}_{\text{ddp}} & \Rightarrow \text{ if dpd} \leq 50 \end{cases}$$

Where $0 < \alpha < 1$

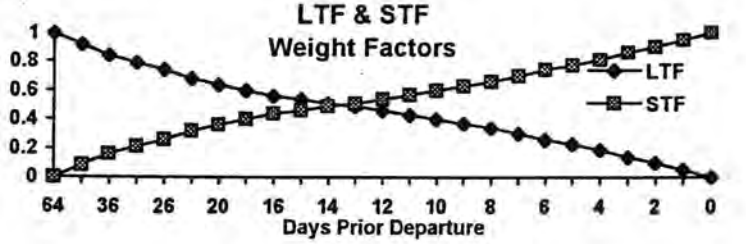
dpd: the number of days prior departure

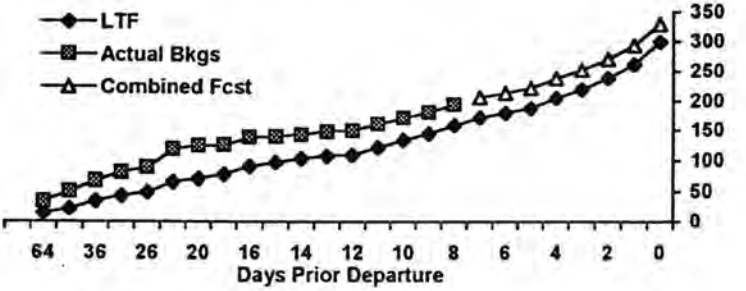
When LTF and STF differ drastically (i.e. LTF less than half of STF), often the combined forecast calculated with above formula is less than the actual reservations on hand at a dpd>>0. This combined forecast is inappropriate in that situation and an adjustment has to be made.

$$\text{If } \text{Comb}_{\text{Fcst dpd}} \leq \text{Total}_{\text{bkg dpd}} + \left\{ 0.10 * \left(\text{STF}_{\text{dpd}} - \text{LTF}_{\text{dpd}} \right) \right\}$$

$$\text{Then } \text{Comb}_{\text{Fcst dpd}} = \left\{ \text{LTF}_{\text{dpd}} * \left(1 - \text{STD}_{\text{bkg dpd}} \right) \right\} + \text{Total}_{\text{bkg dpd}}$$

Here is a graphical example of LTF & STF weight factors with α=0.95 and turning point at 50 days prior departure followed by another representing the combined forecasts & LTF.





3.5 Origin - Destination Market Control

The traffic demand forecasts can then be proportionally distributed to origin-destination markets. Due to the large number of possible origin-destination itineraries on a train, it was decided by VIA to group them in *segment buckets* representing equivalent values. This concept is explained in detail in the CTRF paper "Two-dimensionally Nested Inventory ".

4.0 REVENUE OPTIMIZATION MODEL

4.1 Decision Theory

Decision theory is used to determine optimal strategies when a decision maker is faced with several decisions alternatives and an uncertain or risk-filled pattern of future events. For each individual request by train departure date, class of service, booking class and market, the decision alternatives are to accept or reject the reservation request. Here is a simple example of a Payoff table (class of service Economy and 2 booking classes Y: Full fare & Q: discount fare):

	STATES OF NATURE	
DECISIONS	Request booking in Q ; high probability to sell in Y	Request booking in Q ; low probability to sell in Y
Accept request at Q	$Q - $Y	$Q
Reject request at Q	$Y	- $Q

In many situations good probability estimates can be developed for the states of natures. For each *state of nature / decision* combination, we can weigh the possible payoffs by their chance of occurrence. In practice, the expected monetary value has been the most widely used and accepted criterion for decision making under uncertainty.

In the passenger transportation business, the states of nature were too numerous to be treated as a discrete random variable. The solution procedure in this situation is to treat the state of nature as a continuous random variable. Assume that the reservation requests are normally distributed with a mean and a standard deviation.

4.2 Revenue Optimization Model

The revenue optimization model uses the forecasts and advanced probabilistic techniques to determine the appropriate number of seats for sales in each booking class / segment bucket combination of a train departure date and class of service. This model is designed to make the best use of the inventory controls and nesting structure available in VIA's new reservation system.

The EMSR (Expected Marginal Seat Revenue) model was first introduced by P. Belobaba in 1987. This mathematical model, used by many Revenue management software packages, will be employed at VIA to optimize the seat mix for the greatest potential revenue gain.

The basic notion is to protect seats for higher-fare passengers. In a nested reservations environment, the model must calculate the *protection levels* for higher booking classes and then convert those into *booking limits* on lower booking classes. Protection level is the minimum number of seats that should be retained for a particular booking class. Booking limit is the maximum numbers of seats that may be sold to a booking class (including all nested lower booking classes). For a class of service, the booking limit on the highest booking class is the total physical seats capacity (or the authorized capacity when overbooking).

For each class of service, booking class and segment bucket, EMSR model requires:

A) When a train departure is incorporated in the reservations system for the first time (*Static module*)
   - Total number of expected bookings for a future train departure
   - Standard deviation in total bookings around the expected value

B) Periodical revisions at dpd (*Dynamic module*)
   - Total number of actual bookings already accepted
   - Estimate of partial demand in the form of requests still to come from dpd to train departure date
   - Standard deviation of this partial demand

Each booking, however, will translate into a filled seat that generates revenue for VIA only if the passenger actually purchases a ticket and travelled. This implies that an overbooking component has to be included in the revenue optimization model. VIA's EMSR model will take into consideration the overbooking and passenger shift components.

4.3 Overbooking

The main objective of overbooking is to maximize the net revenue without increasing operating costs (without adding extra cars). Overbooking can generate substantial benefits since the last bookings are generally at full fare.

Probabilistic techniques are used to estimate the "show-up" rates (no-show & go-shows) of similar historical train departures (using sampling results for now and, later on, the new Reservation system) to determine appropriate overbooking levels. With these overbooking levels, an "authorized" capacity is created greater than the physical capacity. The benefits generated by the extra seats sold almost always exceed any compensation costs..

4.4 Passenger Shifts

A refused reservation request for a specific train departure at a class of service & booking class does not always result in a booking loss. Depending on the consumer's choice process, the availability of a desired train departure and booking class can lead to:

- a vertical shift to a higher booking class, same train departure
- a horizontal shift to a different train departure, same booking class
- a booking loss for VIA Rail

Only the probability associated with a vertical shift is associated directly with the purpose of managing the seat inventory. The horizontal shift to a different train departure is captured by the other train departure involved.

4.5 Group Request Evaluation

Isolates the revenue impact related to accepting or rejecting group requests. What is the net revenue generated under the condition of accepting the request and not adding a car versus the net revenue when the group request necessitates adding an extra car to the train. If the net revenues were negative or insignificant under these two situations, find alternatives like other train departures and/or departure dates or split the group. Finally, if no viable alternative exists, the controller has to judge on considerations other than monetary before accepting this group request.

4.6 Cycling Set Indicators

Identifies a planned train cycle requiring review by a controller-analyst and also queues all related train departure details for processing.

Each day, the analyst controllers first review all cycles identified as critical, based on certain criteria, and process them. The next task is then to review the list of all remaining critical train departures. Critical train departures are often part of a critical cycle. When action was taken on a critical cycle, it also affects the related critical train departures by completing them in most circumstances.

4.7 Critical Trains Indicators

Identifies individual train departure requiring review by a controller-analyst and queues those departures for individual processing.

The criticality rules and flagging parameters have to be ranked from the most important to the least by the responsible controller. This is fundamental since the controllers have to review these problems by order of importance within a very limited period of time.

5.0 REVENUE IMPACT, SAVINGS AND BENEFITS

5.1 Revenue Impact

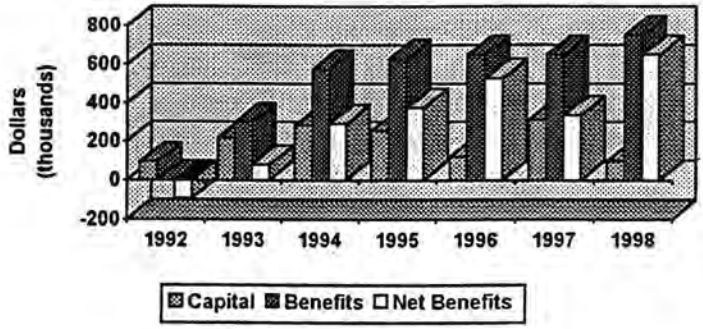
Estimates here are always somewhat speculative since actual results are compared to what might have happened without revenue management. VIA took the conservative approach of estimating incremental revenue from the number of passengers shifting vertically up on sold-out trains.

To that was added the direct gains from progressive overbooking. No specific credit was taken for the limited application of traffic management.

5.2 Cost Savings and Net Benefits

Implementation of revenue management has allowed VIA to operate with 2.5 person-years of inventory controllers versus 4 previously. No specific numbers have been applied to better car management, since other factors such as changes in maintenance and switching operations have occurred simultaneously.

A comparison of the revenue gains and cost savings to development and operating costs is shown below.



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Two-dimensionally Nested Inventory

Introduction

The inventory model presented in this paper has been developed for passenger railways but it could be applicable to any means of passenger transportation such as buses or airlines. Existing inventory models developed for airlines were found inadequate for railways mainly due to the greater number of itinerary legs and segments for an average train compared with an average flight. Another factor is the requirement to limit allocation and therefore availability of the various segments of a train. The idea was not to allow large number of short haul reservations to eat up availability of the long hauls, which are more profitable for the organization.

The model allows to control the allocation and availability of booking classes that belong to a main reservation class for each itinerary segment "bucket". The itinerary segment bucket is a collection of itinerary segments for which inventory - for one reason or the other - could or should be controlled together. Both booking classes and segment buckets are prioritized and nested under each other according to their respective priorities. They are dimensions of a table that describes a train leg inventory.

This inventory design provides yield management with the ability to control supply and demand of inventory during the reservation process. The demand is controlled by allowing multiple booking classes to represent various marketing initiatives and support incentive pricing in order to attract passengers. The supply is controlled by segregating the inventory of various itinerary segments for each of the booking classes into segment buckets.

Terminology and definitions

Trains operate daily and stop at various stations along their routes. Two consecutive stations on a train route constitute a *train leg*. Any two stations on a train route constitute a *train segment*. Any train leg is therefore a train segment as well (see figure 1).

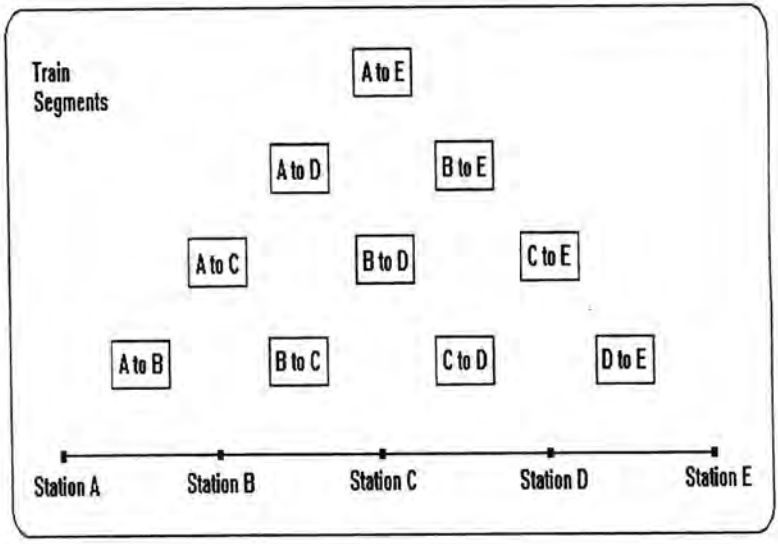
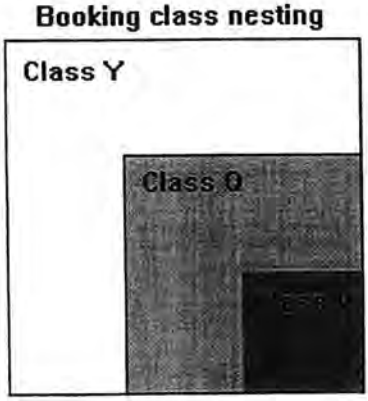
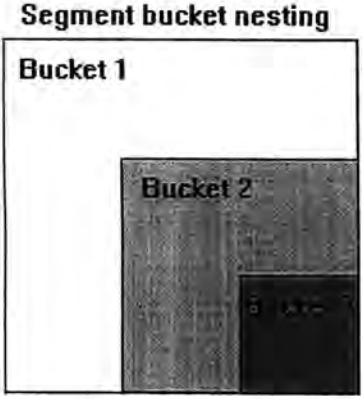


Figure 1.



Trains carry a number of seats or other units such as sleepers which constitute the *train physical inventory*. The physical characteristic of a seat or a unit determines its *main class* such as coach, first class, bedroom, berth etc. So the main class is a collection of seats or accommodation units that are physically similar. For example, in a plane there are usually two main classes: first class and economy class. The seats in first class are

bigger and have much more leg room than seats in economy class. Each main class has its physical inventory - the number of seats of its kind in a plane, train etc. Inventory control may offer for sale a different number of seats/units than is actually allocated in physical inventory. These available inventory numbers are the *authorized inventory levels.* The authorized inventory may be smaller, equal or larger than physical inventory. Any main class can be offered for sale as a set of *booking classes* which differ from each other on the basis of fare level and/or applicability conditions associated with them. For example, economy class is often presented to the market as multiple booking classes distinguished on the basis of fare level - the economy class is being sold as regularly priced economy class (booking class Y) or discounted economy class (booking class Q) or finally deeply discounted economy class (booking class V). Booking classes within a main class are ordered by the ascending price and nested within each other in such a way that the authorized inventory of a higher priced booking class includes the authorized inventory of the lower priced classes. This model is known as *simple nested inventory* (see the chart to the left).



The business reason for booking class nesting is the need to limit the supply of lower priced classes while offering the bigger supply of higher priced classes.

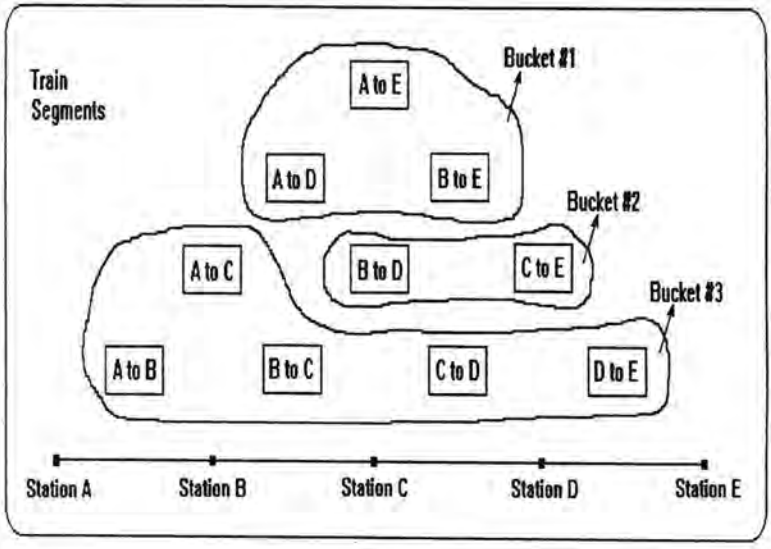
Seats/units/booking classes are reserved and sold over train segments. The fares associated with different segments for travel in the same booking class usually differ as they may depend on distance, market conditions etc.

A *segment bucket* is a collection a train instance's itinerary segments put together for inventory control purposes. Every train segment for every

main class must belong to one and only one bucket. The segments to be bundled can be chosen using various criteria. For example, the similar distance between segment city pairs, similar price range, level of demand, cost, yield, etc. Inventory controllers may pick their own criteria for itinerary segment classification. Once the segments are assigned to the buckets and the buckets are ordered by the established rules, they are nested under each other. This means that the authorized inventory of the lower ranking bucket is included in the authorized inventory of the higher ranking bucket. This is also a simple nesting structure (see the chart to the left)

The business reason for the segment bucket nesting is to have the ability to limit the supply of lower valued itinerary segments in favour of higher valued segments.

Figure 2.



In order to control inventory with revenue maximization in mind, the supply of each main class is offered for sale in a fragmented way. The pieces depend on booking class, segment bucket and train leg. They are also dependent on each other in two-dimensional nesting. For each train leg and each main class carried by a train, a two-dimensional table is stored which contains the authorized inventory levels offered for sale, the availability anda running count of the bookings (see bottom-right part of figure 3).

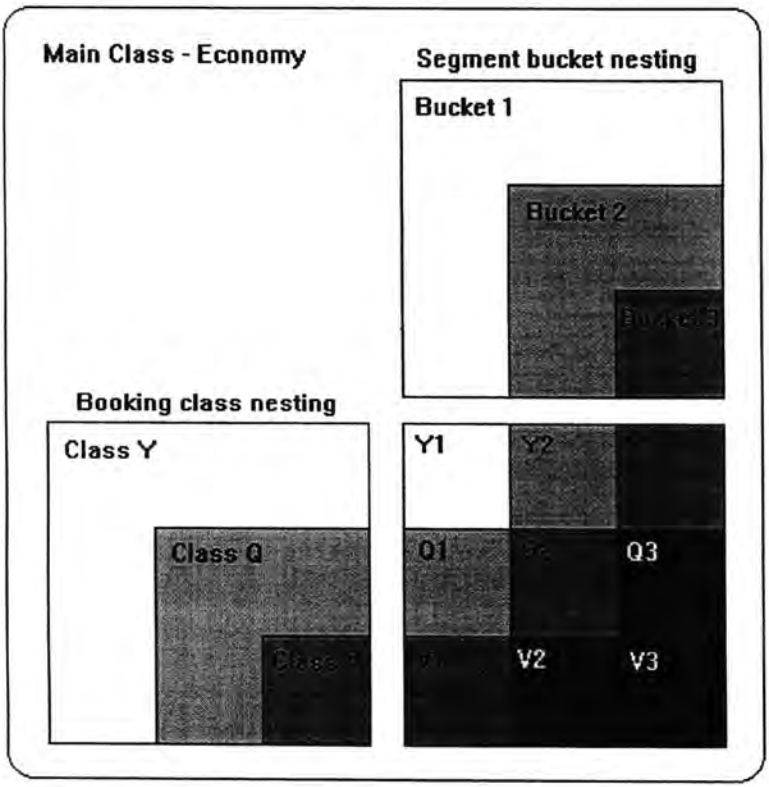


Figure 3.

The cross-section of the booking class nesting and segment bucket nesting

creates a two-dimensional matrix nested simultaneously in both directions. Any cell of the matrix is nested under its adjacent cell directly above or to the left side of it.

Inventory model

Parameters, indices and variable descriptions:

i - booking class nesting indicator
j - segment bucket nesting indicator
k - main class
l - train leg
t - time measured in inventory events - single reservation or cancelation transaction
K - number of main classes for the train instance
L - number of legs for the train instance
M_k - number of segment buckets for a train instance and main class k
N_k - number of booking classes for main class k
S - number of segments of the train instance

A_{ijkl} - inventory allocation for the leg l, main class k, segment bucket j and booking class I
a_{ijkl} (t) - number of seats available for the leg l, main class k, segment bucket j and booking class I after transaction t
b_{ijkl} (t) - number of seats booked up to date for the leg l, main class k, segment bucket j and booking class I after transaction t
c_{ijkl} (t) - number of seats reserved (+) or cancelled (-) by the transaction t for the leg l, main class k, segment bucket j and booking class I

The initial allocation, availability and bookings are shown for t = 0 (that means that no reservation/cancellation event has been recorded up to date)

There are two nesting orders: booking class order and segment bucket order. Both are ascending orders. The lower booking class is nested under the higher booking class. The lower booking class has a higher nesting indicator. The same is applicable to the segment buckets nesting.

Conditions and limitations:

1) The booking count changes for all higher level booking classes and higher level segment buckets when reservation or cancelation happens for booking class q and segment bucket p

$$b_{ijkl}(t+1) = b_{ijkl}(t) + c_{qpkl}(t+1) \quad \text{for } i=1,q \quad j=1,p \quad l=1,L \quad k=1,K$$

2) After the event t, the availability of the booking class I and segment bucket j for the leg l and main class k, is a minimum of the difference between allocation and booking count, availability of the booking class I-1 (higher level booking class) and segment bucket j-1 (higher level segment bucket).

$$a_{ijkl}(t) = \min \{ A_{ijkl} - b_{ijkl}(t),\ a_{i-1jkl}(t),\ a_{ij-1kl}(t) \} \quad \text{for } i=2,N_k \quad j=2,M_k \quad l=1,L \quad k=1,K$$

$$a_{1jkl}(t) = \min \{ A_{1jkl} - b_{1jkl}(t),\ a_{1j-1kl}(t) \} \quad \text{for } i=1 \quad j=2,M_k \quad l=1,L \quad k=1,K$$

$$a_{i1kl}(t) = \min \{ A_{i1kl} - b_{i1kl}(t),\ a_{i-11kl}(t) \} \quad \text{for } i=2,N_k \quad j=1 \quad l=1,L \quad k=1,K$$

$$a_{11kl}(t) = A_{11kl} - b_{11kl}(t) \quad \text{for } i=1 \quad j=1 \quad l=1,L \quad k=1,K$$

3) The number of seats reserved in one transaction cannot exceed availability

$$+c_{ijkl}(t+1) =< a_{ijkl}(t) \quad \text{for } i=1,N_k \quad j=1,M_k \quad l=1,L \quad k=1,K$$

4) The number of seats cancelled in one transaction cannot exceed booking count

$$-c_{ijkl}(t+1) =< b_{ijkl}(t) \quad \text{for } i=1,N_k \quad j=1,M_k \quad l=1,L \quad k=1,K$$

5) At any given event measured time t, the booking count cannot exceed

allocation

$$A_{ijkl} >= b_{ijkl}(t) \quad \text{for } i=1,N_k \; j=1,M_k \; l=1,L \; k=1,K$$

6) At any given event measured time t, the availability count cannot exceed allocation

$$A_{ijkl} >= a_{ijkl}(t) \quad \text{for } i=1,N_k \; j=1,M_k \; l=1,L \; k=1,K$$

7) Inventory allocation of the lower booking class cannot be higher than higher booking class.

$$A_{ijkl} >= A_{i+1jkl} \quad \text{for } i=1,N_k\text{-}1 \; j=1,M_k \; l=1,L \; k=1,K$$

8) Inventory allocation of the lower segment bucket cannot be higher than a higher segment bucket.

$$A_{ijkl} >= A_{ij+1kl} \quad \text{for } i=1,N_k \; j=1,M_k\text{-}1 \; l=1,L \; k=1,K$$

9) The number of segment buckets cannot exceed the number of segments.

$$M_k =< S \quad \text{for } k=1,K$$

10) Initial set up constrains

$$A_{ijkl} = a_{ijkl}(0) >= 0 \quad \text{for } i=1,N_k \; j=1,M_k \; l=1,L \; k=1,K$$

$$b_{ijkl}(0) = 0 \quad \text{for } i=1,N_k \; j=1,M_k \; l=1,L \; k=1,K$$

Graphical representation:

The figure 4 below shows inventory of one main class (k) for one train instance. Rows represent booking classes available on that train instance. Columns represent segment buckets that have been created by inventory control for that train instance. For each leg (from 1 to L) along the route of the train a separate allocation table exists and has to be maintained. The inventory table, in each of its cells, contains the following data: A for allocation, a for availability and b for bookings count. The upper-right corner of a cell has an index (ijkl) describing the booking class I (from 1 to N_k), the segment bucket j (from 1 to M), main class k and legs l (from 1 to L). For each main class k (from 1 to K), being carried by the train instance, similar inventory table sets must exist.

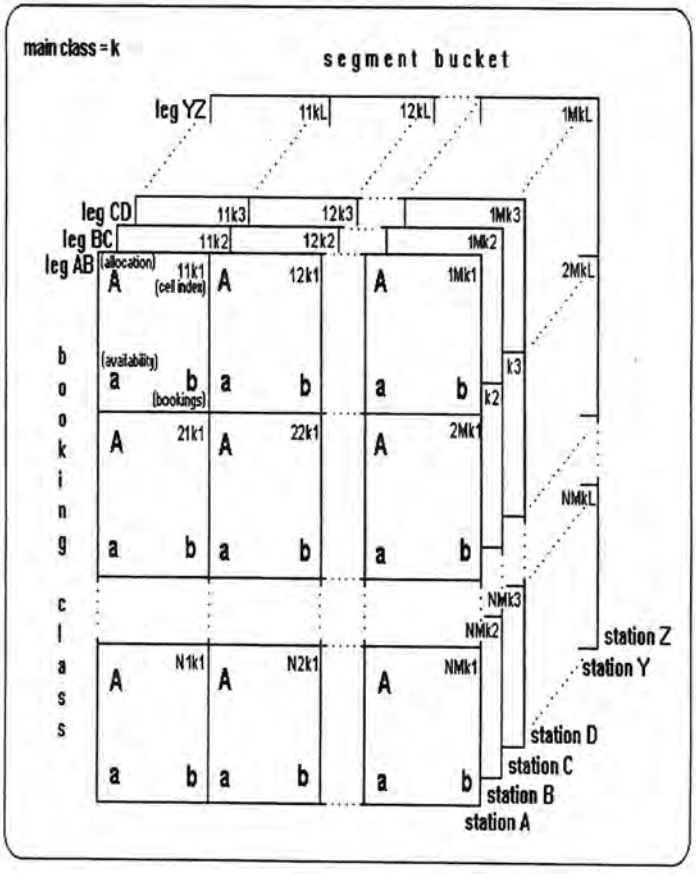

main class = k
segment bucket
leg YZ
11kL
12kL
1MkL
leg CD
11k3
12k3
1Mk3
leg BC
11k2
12k2
1Mk2
leg AB
(allocation)
11k1
(cell index)
12k1
1Mk1
2MkL
booking class
(availability)
(bookings)
k3
k2
21k1
22k1
2Mk1
NMkL
NMk3
NMk2
N1k1
N2k1
NMk1
station Z
station Y
station D
station C
station B
station A
A
a
b

Figure 4

Example

The train is travelling from Montreal to Toronto with two intermediate stops at Cornwall and Belleville. The train therefore has 3 legs and 6 segments. The train carries only coach space (main class - coach) that has been organized into 3 booking classes: Y, Q and V. The segments have been distributed into 3 segment buckets: #1, #2 and #3:

bucket #1 (long) - segment Montreal-Toronto

bucket #2 (medium) - segments Montreal-Belleville and Cornwall-Toronto

bucket #3 (short) - segments Montreal-Cornwall, Cornwall-Belleville and Belleville-Toronto.

There are four figures that illustrate the example. Each figure represents one reservation event (in the examples all events are new bookings). Each figure contains the description of the reservation event, inventory status before the event took place, and then inventory after the event has been recorded in the data base.

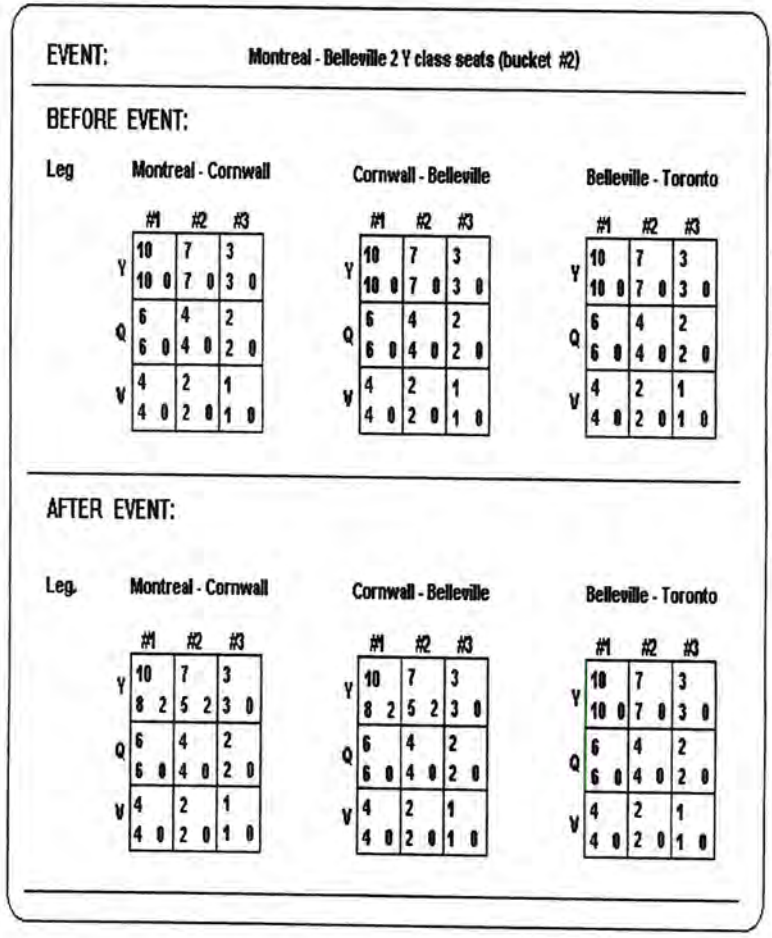

EVENT:
Montreal - Belleville 2 Y class seats (bucket #2)
BEFORE EVENT:
Leg
Montreal - Cornwall
Cornwall - Belleville
Belleville - Toronto
#1 #2 #3
Y
10 10 0
7 7 0
3 3 0
Q
6 6 0
4 4 0
2 2 0
V
4 4 0
2 2 0
1 1 0
AFTER EVENT:
Leg.
Montreal - Cornwall
Cornwall - Belleville
Belleville - Toronto
#1 #2 #3
Y
10 8 2
7 5 2
3 3 0
Q
6 6 0
4 4 0
2 2 0
V
4 4 0
2 2 0
1 1 0

Figure 5

EVENT: Montreal - Toronto 3 Q class seats (bucket #1)

BEFORE EVENT:

Leg	Montreal - Cornwall			Cornwall - Belleville			Belleville - Toronto		
	#1	#2	#3	#1	#2	#3	#1	#2	#3
Y	10 8 2	7 5 2	3 3 0	10 8 2	7 5 2	3 3 0	10 10 0	7 7 0	3 3 0
Q	6 6 0	4 4 0	2 2 0	6 6 0	4 4 0	2 2 0	6 6 0	4 4 0	2 2 0
V	4 4 0	2 2 0	1 1 0	4 4 0	2 2 0	1 1 0	4 4 0	2 2 0	1 1 0

AFTER EVENT:

Leg	Montreal - Cornwall			Cornwall - Belleville			Belleville - Toronto		
	#1	#2	#3	#1	#2	#3	#1	#2	#3
Y	10 5 5	7 5 2	3 3 0	10 5 5	7 5 2	3 3 0	10 7 3	7 7 0	3 3 0
Q	6 3 3	4 3 0	2 2 0	6 3 3	4 3 0	2 2 0	6 3 3	4 3 0	2 2 0
V	4 3 0	2 2 0	1 1 0	4 3 0	2 2 0	1 1 0	4 3 0	2 2 0	1 1 0

Figure 6

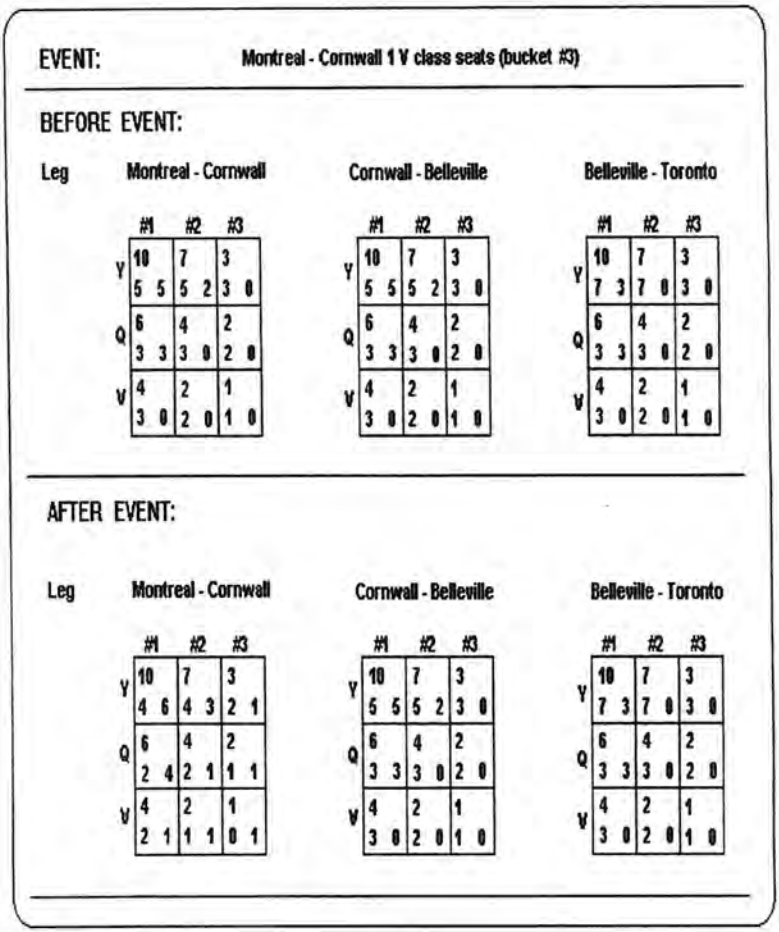

EVENT:
Montreal - Cornwall 1 V class seats (bucket #3)
BEFORE EVENT:
Leg
Montreal - Cornwall
Cornwall - Belleville
Belleville - Toronto
#1 #2 #3
Y 10 5 5 | 7 5 2 | 3 3 0
Q 6 3 3 | 4 3 0 | 2 2 0
V 4 3 0 | 2 2 0 | 1 1 0
Y 10 5 5 | 7 5 2 | 3 3 0
Q 6 3 3 | 4 3 0 | 2 2 0
V 4 3 0 | 2 2 0 | 1 1 0
Y 10 7 3 | 7 7 0 | 3 3 0
Q 6 3 3 | 4 3 0 | 2 2 0
V 4 3 0 | 2 2 0 | 1 1 0
AFTER EVENT:
Leg
Montreal - Cornwall
Cornwall - Belleville
Belleville - Toronto
#1 #2 #3
Y 10 4 6 | 7 4 3 | 3 2 1
Q 6 2 4 | 4 2 1 | 2 1 1
V 4 2 1 | 2 1 1 | 1 0 1
Y 10 5 5 | 7 5 2 | 3 3 0
Q 6 3 3 | 4 3 0 | 2 2 0
V 4 3 0 | 2 2 0 | 1 1 0
Y 10 7 3 | 7 7 0 | 3 3 0
Q 6 3 3 | 4 3 0 | 2 2 0
V 4 3 0 | 2 2 0 | 1 1 0

Figure 7

EVENT: Cornwall - Toronto 3 Q class seats (bucket #2)

BEFORE EVENT:

Leg

Montreal - Cornwall

	#1	#2	#3
Y	10 4 6	7 4 3	3 2 1
Q	6 2 4	4 2 1	2 1 1
V	4 2 1	2 1 1	1 0 1

Cornwall - Belleville

	#1	#2	#3
Y	10 5 5	7 5 2	3 3 0
Q	6 3 3	4 3 0	2 2 0
V	4 3 0	2 2 0	1 1 0

Belleville - Toronto

	#1	#2	#3
Y	10 7 3	7 7 0	3 3 0
Q	6 3 3	4 3 0	2 2 0
V	4 3 0	2 2 0	1 1 0

AFTER EVENT:

Leg

Montreal - Cornwall

	#1	#2	#3
Y	10 4 6	7 4 3	3 2 1
Q	6 2 4	4 2 1	2 1 1
V	4 2 1	2 1 1	1 0 1

Cornwall - Belleville

	#1	#2	#3
Y	10 2 8	7 2 5	3 2 0
Q	6 0 6	4 0 3	2 0 0
V	4 0 0	2 0 0	1 0 0

Belleville - Toronto

	#1	#2	#3
Y	10 4 6	7 4 3	3 3 0
Q	6 0 6	4 0 3	2 0 0
V	4 0 0	2 0 0	1 0 0

Figure 8

Model discussion

The two-dimensionally nested inventory model allows two-fold market segmentation: one based on pricing strategy (booking classes), the other based on itinerary segmentation (segment buckets). The effect is the creation of multiple market segments (the number of market segments is a Cartesian product of the number of booking classes and number of segment buckets) that in turn creates the basis for an effective yield management control.

The two-dimensionally nested inventory model can be reduced in one or both of its dimensions. The reduction of both dimensions leaves one booking class and one segment bucket - i.e. effectively creating the simple inventory model. The reduction of the number of segment buckets to one produces the simple nested inventory model. The reduction of the number of booking classes to one creates a model with a simple nested structure of itinerary segments.

The following extensions or changes of the model can be considered:

- Adding new dimensions to increase the granularity of the market segmentation. For example, one of the new dimensions could be passenger type. Passenger types are usually not included in the booking class concept but have great influence on the yield since in many cases seniors, students, children, etc. are entitled to special discounts.

- Replacement of simple nesting along the dimensional axis by the discrete nesting of booking classes and segment buckets.

- The model can be expanded to provide O/D (origin-destination) inventory for connecting trains. This would enable O/D yield management.

- Waitlisting limits can be handled by this model as well with separate allocations, bookings and availability. The waitlist limits (allocation) could be set as a fraction of reservation allocation. That mechanism and an identical inventory structure for the reservations and waitlists would allow control of both with just reservation allocations.

- Condition 5 (see page 6) of the inventory model could be waived for the following practical reason: when the inventory control or yield management decides to lower the allocation below the current booking level, excess bookings do not have to be cancelled at that moment. They may remain at the current level - higher than new allocation - and assume that the natural cancellations and "no shows" will take care of the excess bookings over time until the train departs.

- Condition 2 (see page 6) of the inventory model could be changed in order to preserve the proportions expressed by the authorized inventory levels (A). Availability counts would change as a result of in-coming bookings preserving, however, the authorized level proportions instead of the current disproportionate approach. The approach chosen depends on company objectives respecting inventory control and the peculiarities of the market the company is servicing.

- Inventory inhibits could be applied on various levels: train, main class, booking class, itinerary leg, itinerary segment, bucket or any of their combinations (e.g. itinerary segment-booking class-bucket). Those inhibits being temporary by nature would not change any allocations, availability or bookings counts. However, setting an inhibit on would mean showing the availability as zero.

Focusing Public Consultation in Urban Transportation Planning: Winnipeg's TransPlan 2010 Process

David Hicks, DS-Lea Consultants Ltd.
Richard S. Tebinka, DS-Lea Consultants Ltd.
Dr. Barry E. Prentice, Transport Institute, University of Manitoba

Introduction

The shape of urban structures can be traced to the designs promulgated in transportation and land use plans commissioned periodically in every major jurisdiction. Until recently, outside engineering consultants developed these plans with minimal *ex ante* public consultation. The implementation of these transportation plans met with mixed success. Aspects of each plan were never implemented because popular support was lacking. This political experience is not unique to Winnipeg; most urban centres have experienced similar frustrations.

Greater *ex ante* public consultation has been seized upon as the method of getting the plan right, the first time. Recent transportation plans for Vancouver, Calgary, Edmonton, and now Winnipeg have embraced extensive public consultation.

Using extensive public consultation as the guiding force to develop a new urban transportation plan, is easier said than done. First, it is necessary to get the public involved. Second, the process must give the public a framework to express their ideas, without leading them to a preordained solution. Finally, the process must be able to synthesize the multitude of ideas and conflicting opinions into a workable plan. This paper outlines the public consultation process employed by TransPlan 2010, and presents the *Transplanning Model* developed to focus public ideas. The "emerging" scenario identified in the consultation process is described. The paper concludes with a discussion of the economic tradeoffs inherent in the *TransPlanning Model.*

TransPlan 2010

The City of Winnipeg made two significant changes in updating the transportation component of its long term development plan, *Plan Winnipeg - Towards 2010*. The study would include the urban-centred region (the "Capital Region"), and it would be guided by public consultation. Lack of public acceptance was a significant factor in shelving recommendations contained in earlier plans. The 1966 *Winnipeg Area Transportation Study* recommended an extensive system of freeways. Negative public reaction to this recommendation led Winnipeg City Council to adopt a series of interim development policies in 1973. Freeways were effectively excluded as an option for new street construction.

Plan Winnipeg . . . Toward 2010 required a comprehensive transportation study "be prepared utilizing an interdisciplinary approach." TransPlan 2010 was structured and funded jointly by the City of Winnipeg and the Province of Manitoba in 1994. An independent Steering Committee consisting of five private citizens[1] was appointed to direct the technical and public involvement activities and file a final report with recommendations. To broaden the technical resource and consultation basis available to the Steering Committee, two further communities were formed - a City/Province Management Team and an Advisory Committee. The Advisory Committee represents a broad cross-section of stakeholder groups and organizations, and the community at large. Further assistance was provided by staff resources from the City of Winnipeg, Streets and Transportation Department, consultants (Transportation Planning Team, Community Involvement Team and TransPlan Writer)and other personnel from Provincial and Civic Administrations.

TransPlan 2010 has involved four Phases:

Phase I- Issues and Themes (February to September 1995)
Phase IIA - Development of Scenarios (October 1995 to January 1996)
Phase IIB - Scenario Evaluation and Refinement (February to May 1996)
Phase 111 - Development of Recommendations (June 1996 to May 1997)

TransPlan 2010 has featured extensive, broad-based community consultation and involvement including:

Community Workshops
Public Presentations
Newsletters
Public Opinion Survey
Community Cable Television Programs
Public Open House
Focus Group
Media Coverage
Radio Talk Shows/Interviews
Telephone Hotline

No objective measure of public consultation exists. More community involvement is always desirable, but time and funding define the limits. Community involvement at Winnipeg compares favourably with the results of similar cities (e.g., Calgary and Edmonton). The results of the TransPlan 2010 consultations are documented in the reports filed at the completion of each phase.

What the Public Thought

The goal of Phases I and II was to determine what people liked or disliked about the current transportation system. These issues include land use, funding, decision making, maintenance, the environment, etc. The community s views were plumed respecting needs and priorities for the future.

Phase I input was received from approximately 400 interested citizens and groups. Table 1 summarizes the 12 specific issue areas and seven general themes identified. Safety, efficiency, sustainability and assessibility are strongly desired. Common sense is also wanted: integration and inclusion in planning, prudence in spending, and wise utilization of existing infrastructure.

The Phase IIA round of workshops was designed to elicit Images of th e Future. Participants were asked to identify transportation system characteristics that should be kept/improved or added/reduced/deleted, keeping in mind the issues and themes. Participants were asked to visualize

a future scenario and identify its "pros and cons. This public input was employed to develop the *TransPlanning Model* to assist the refinement of scenarios in Phase IIB.

Table 1 TransPlan 2010 Phase I Issues and Themes

Issues	Themes
demographics land use & urban form funding community involvement land use conflict/compatibility decision making & management sustainable development & the environment people movement traffic operations goods movement transportation infrastructure travel behaviour	provide a safe, convenient and accessible transportation system provide safe, effective and efficient movement of goods and services in support of economic development provide an inclusive and integrated decision making process for land use and transportation planning, implementation and evaluation maintain the existing transportation infrastructure in a safe, effective and efficient manner better utilize the existing transportation system develop funding alternatives for transportation system maintenance, improvements and additions provide a sustainable transportation system that is environmentally friendly

The TransPlanning Model

The problem of comparing apples and oranges is basic to any plannin g exercise. A myriad of ways exist to deal with transportation concerns.

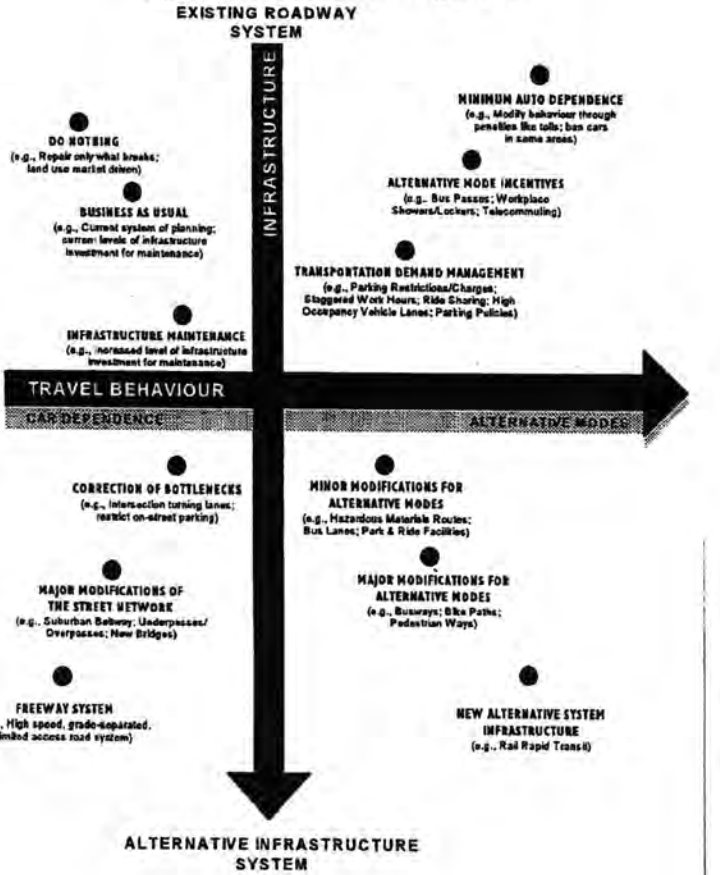
Comparing system proposals that have different cost-effective responses for a broad range of socioeconomic and environmental concerns is difficult. Throughout Phase I and IIA community involvement workshops, the transportation planning team worked to categorize the issues and concerns being raised by the public and by different interest groups.

All twelve issue groupings were seen as important, but two stood out as directly applicable to the definition and description of alternative system scenarios - travel behaviour and transportation infrastructure. They were frequently identified as significant issues by participants in the community involvement process. Both issues are subject to a broad spectrum of opinion respecting their treatment in planning the future transportation system. They have been the focus of transportation planning measures implemented in other jurisdictions and should be feasible to carry out in Winnipeg and the Capital Region. Accordingly, these two issues were selected as the axes for graphic representation of options that might be used to define alternative system scenarios. The *TransPlanning Model* is reproduced in Figure 1.

The *TransPlanning Model* begins as a simple arrangement of two issue groupings as the horizontal and vertical axes of a two dimensional graph. The existing roadway system is at the top of the *"infrastructure"* axis and car dependence is at the left of the *"travel behaviour"* axis. The *"travel behaviour"* axis is best described as the reliance of transportation system users place on particular modes of travel. At one end of the spectrum is total dependence on the private automobile, specifically on the car driver mode. At the other is accessibility to and service by a variety of alternative modes (e.g., auto passenger, pedestrian, cyclist, transit rider, etc.).

The intersection of the infrastructure and travel behaviour axes creates four quadrants. Alternative approaches were identified in each quadrant as examples of where particular transportation system solutions would fit. The twelve examples represent ideas or suggestions made in Phase I and IIA consultations. The more extreme solutions fall toward the outer edges of the quadrants. These locations involve higher cost solutions and/or require more substantial intervention and political commitment by the implementing authorities.

Figure 1: The TransPlanning Model



Sources: Transplan 2010, Phase II Report: Images of the Future . Winnipeg, MB, June, 1996.

The upper left quadrant describes alternative scenarios involving almost no action relative to the status quo. Infrastructure adjustments are minimal as are corresponding capital cost

implications. Travel behaviour continues to be characterized by dependence on the car driver mode. At the extreme, this quadrant houses the "Do Nothing" option. In a more moderate interpretation, it provides for a "Business As Usual" approach for ongoing maintenance of existing infrastructure. In many respects, Winnipeg's current approach to the transportation system is characterized by measures that fall within this quadrant.

The upper right quadrant houses a variety of measures that is analogous to "demand-side management. These are sometime s characterized as relatively low cost measures that rely on modification of travel behaviour to improve the performance of existing infrastructure systems. In the extreme case, such measures emphasize regulatory approaches like banning automobiles from specific precincts within the city. More moderate measures emphasize incentives (e.g., bus passes, high occupancy vehicle lanes, etc.) rather than disincentives or regulations (e.g., parking restrictions/charges). Measures of this type have been carried out elsewhere but, for the most part, have seen only limited application in Winnipeg.

The lower right quadrant provides alternative scenarios that would promote a shift away from auto dependence in favour of other modes of travel. Implementation would involve significant investment in new infrastructure to support alternative modes. Other alternative modes might entail development of improved pedestrian and cycling facilities, or even designation and/or development of dedicated truck routes. In the extreme case, such measures would mean development of alternative infrastructure systems like rail rapid transit. A more moderate measure, for public transit, would be the development of dedicated bus guide ways. Even more moderate transit improvement measures would include bus priority lanes or development of park and ride facilities. Many related measures cited during the community involvement workshops emphasized greater commitment to use of public transit.

The lower left quadrant provides for alternative scenarios that might improve system performance but would continue to emphasize dependence on the private auto and improvement of

related roadway infrastructure. Extreme versions of this approach include development of a freeway system. A more moderate interpretation might see completion of a "suburban beltway" to facilitate cross-town travel. Minimal use in this approach might mean an infrastructure improvement program limited to correction of existing bottlenecks in the system (e.g., provision of intersection improvements or grade separations at critical locations).

Winnipeg's present streets and transportation program includes elements from at least three of the quadrants (i.e., maintenance of existing infrastructure, modification of existing infrastructure to facilitate bus transit, and improvement of the existing roadway infrastructure to alleviate traffic congestion). Focus group testing confirmed that use of the model would facilitate debate of the options and that combinations of measures would be identified in describing a preferred system scenario.

The Model As A Consensus Building Tool

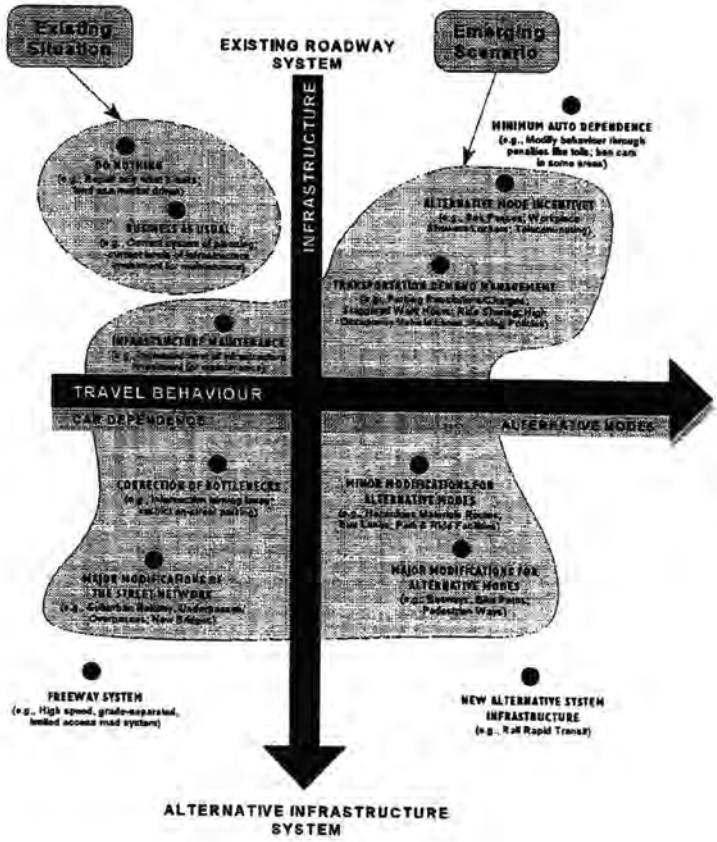
Participants in the Phase IIB round of TransPlan community involvement workshops were asked to use the *TransPlanning Model* as a basis for describing their preferred scenario for future development of Winnipeg's transportation system. A total of 24 such scenarios were identified (including trial runs and focus group testing of the model). As expected, the selected scenarios were generally combinations of elements from several quadrants of the model.

Upon reaching a consensus within each workshop group, scenarios were posted on a display area. Participants discussed similarities and differences between their scenarios and why they selected a particular scenario. After discussion, some groups were able to reach a consensus among themselves on a revised, combined scenario. The eight to ten scenarios per workshop were grouped into three to five combined scenarios.

A substantial degree of consensus apparent in the alternative scenarios developed at the workshops. The workshop format cannot sustain statistically valid conclusions as to the extent that this consensus might be shared by the general public. The workshop consensus is a baseline scenario for further evaluation and development of more specific recommendations. The baseline or "emerging" scenario is illustrated in Figure 2. The emerging scenario starts with elimination of the extreme

positions within three of the four quadrants of the *TransPlanning Model.* This excludes the *"Do Nothing"* option from the upper left quadrant; the *"Minimum Auto Dependence" or "Ban the Car"* option from the upper right quadrant; and the *"Freeway System"* option from the lower left quadrant.

Figure 2: The Emerging Scenario



Source: TransPlan 2010, Phase II Report: Images of the Future Winnipeg, MB, June, 1996.

These options received almost no support.

The situation is different with respect to the lower right quadrant. Although a substantial majority of the workshop scenarios rejected the *"New Alternative System Infrastructure"* option, a few were reluctant to rule out the potential benefits of a rail rapid transit system. This view seemed in several cases to reflect a belief that rapid transit could be a cost-effective means of reducing auto dependence and of generally improving the quality and performance of the transportation system. The question is balance. The capacity and cost of a rapid transit system must be assessed in terms of the relatively limited growth and resultant increase in traffic congestion expected over the TransPlan 2010 time horizon. One possible response would be to protect the rapid transit option against the contingency of higher than expected growth in the longer term. The baseline scenario tentatively excludes the rapid transit option. Its evaluation is extended in a discussion paper on the rapid transit option - with specific attention to system cost and capacity in relation to probable travel demand.

Some confusion was evident among workshop participants with respect to the *"Infrastructure Maintenance"* option identified in the upper left quadrant. Most participants saw infrastructure maintenance as one point along a spectrum extending from *"Do Nothing"* to more substantial improvement and extension of the existing infrastructure system. However, a few people saw maintenance as an independent option. They proposed more intensive roadway improvements as an alternative and preferred strategy.

The relative lack of local experience with respect to demand-side management measures (i.e., those in the upper right quadrant) required further clarification before the baseline scenario could be precisely identified in this area. What was clear from the workshops was a preference for measures involving incentives as opposed to regulations or disincentives.

Refinement of the baseline scenario in the two quadrants below the horizontal axis included supplementary modelling - in particular to identify the extent to which road network and busway improvements might be incorporated. These two categories of improvement relate specifically to *the "Major Modification of the Street Network" and "Major Modification for Alternative Modes"* options identified in the *TransPlanning Model.* The lower right quadrant of the model refers to pedestrian ways and bike paths,

in addition to busways.

TransPlanning Model Limitations

No model can represent all aspects of a problem as complicated as urban transportation. The *TransPlanning Model* implies some average form of travel behaviour. In reality, each mode of transport has a discrete market share. Some proportion of the traveling public may shift from one mode of transport to another if their cost/travel time options change. Segments of the population however, are either absolutely car dependent, or ca n never hope to operate a car. Recommendations must address population groupings[2], as much as transport modes.

The *TransPlanning Model* does not give much guidance regarding to how changes in monetary and time-related costs will affect travel behaviour. Polices that encourage change in travel behaviour are likely to have an asymmetric impact. A change that makes non automobile users better off may also make the car dependent users better off because congestion is reduced. Changes that make auto use better however, are more likely to make alternative modes of transport less viable and the users worse off. The *TransPlanning Model* is static, has no units of measure and is not drawn to scale. The impact of any change, or combination of recommendations, is not explicit.

The market for urban transportation services is distorted. In normal markets, prices play a critical role in guiding consumption behaviour. Urban transportation behaviour is influenced by political decisions and private tradeoffs. Government fiscal and regulatory policies modify travel behaviour by altering the relationship between the monetary costs and the time-related costs of travel. Individuals choose their mode of transport based on out-of-pocket costs and travel times that best suits their needs. The *TransPlanning Model* is helpful in gleaning ideas through the public consultation process, but does not lead directly to recommendations. The demand and supply factors that influence consumer choices in the urban transportation market need to be considered.

Travel Demand Considerations

Relative prices of different modes of transport are the most important determinates of travel demand[3]. A key problem is the difficulty of making

realistic price comparisons between the different forms of urban transport. The cost of a transit bus ticket may be known with certainty, but most people have only a vague idea of the equivalent taxi fare, or the cost of using a private automobile. From society s perspective, the decisions of such consumers are likely to be economically inefficient. This is made worse if direct and indirect subsidies distort the prices paid by individuals. If prices are not visible, or do not reflect true economic costs, individuals will consume too much of what is actually scarce, and too little of what is abundant.

The demand for travel is further complicated by the joint consumption of some transportation services (e.g., road ways). Joint consumption of the street network is supported by a pooled contribution of revenues from fuel taxes and other levies. Through the purchase of fuel, the car owners gain unlimited access to the entire network of a public infrastructure. The direct cost of using any street is the same, regardless of whether it is a main arterial road or quiet residential street. The higher demand for strategic routes is rationed through congestion costs. Congestion of traffic increases travel time as user numbers climb. Time represents the indirect price " that influences consumer decisions on route choice and means of transport. In the case of transportation the expression, *Time is money* can be applied directly.

The degree of comfort and security provided to the passenger are generally related to cost. Individuals are more willing to tradeoff monetary costs for improvements in comfort and security attributes of travel as income rise. Higher income consumers are likely to choose more expensive means of transport, because of comfort and security attributes, even if time is not a constraint. Low income consumers have little choice but to accept the comfort/security that is available with the more time-consuming means of transport.

Travel Supply Considerations

Governments have an active role in the supply of transportation services. This can be explained by the desire to use transportation as an instrument of social policy and the public good nature of infrastructure. Urban transportation supply combines public and private investment. The public sector provides the long-lived infrastructure (e.g., streets), while the vehicles are provided by private individuals or corporations.

Regulations and subsidies influence the supply of transportation services. The supply of taxi services is determined by licencing arrangements that limit the number of cars and maximum fares. Regulating supply helps maintain the incomes of taxi owners, and in theory improves the quality of the cars and guarantees service. If regulators are careless however, taxi fares can make the service a luxury that discourages use.

Transit bus services are an example of direct government intervention. Most transit services were converted to public monopolies, after regulatory authorities drove them into bankruptcy. The sources of the private operators problems were route and fare regulations. A private transit service cannot survive when the operations of unprofitable routes are mandated by government fiat.

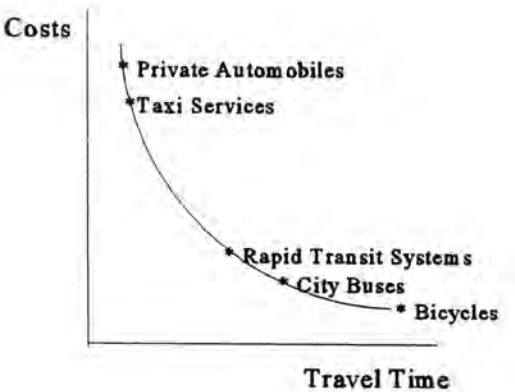
Governments have used subsidies to provide uneconomic services when they could not achieve their social goals through regulation. In general, urban transportation regulations narrow the range of choices available to consumers, while subsidies provide levels of service that would not otherwise be provided.

Consumer Choice

The choice of urban transportation services can be presented as a function of price (fares, or private costs), and a bundle of quality attributes that represent speed of travel, comfort, convenience and security. The bundles of quality attributes tend to decline as the travel time increases. Rather than a smooth supply curve of transportation options, individuals have t o choose between discrete alternatives. The primary tradeoff is between the monetary cost of the trip and the time involved in making the trip. If money is scarce, consumers are willing to take a more time-consuming, but less expensive mode of transportation. If time is limited, the consumer is more likely to opt for a more expensive, faster means of automobile transport.

Figure 3 presents this tradeoff and lists the alternatives available to the consumer. At one extreme is the fast, but expensive car, at the other is the slow, but inexpensive bicycle.

Figure 3 Monetary Cost - Travel Time Trade-off



Any conceptual model suffers when confronted with the reality of application. In the case of travel times the generalization depicted in the model will depend on the three factors: length of trip, route, and time of day. For very short trips city buses and bicycles can experience the travel times of private automobiles (if one includes the time required for locating a parking spot). As the length of the trip increases, the general model is more likely to apply. On main corridor routes, the travel time of city buses is likely to be closer to the private automobile. Congestion will also affect travel time on main corridor routes, especially the relative performance of rapid transit systems compared to automobiles. Off the main corridors, the general model is more likely to be accurate. Time of day exaggerates these relationships because of congestion. During peak travel periods, rapid transit systems are likely to perform better than the private automobile or city buses.

The costs of travel are also subject to some generalization in the model. The conceptual model reflects the full costs to society, rather than the private costs to individuals. The effects of direct and indirect subsidies will shift

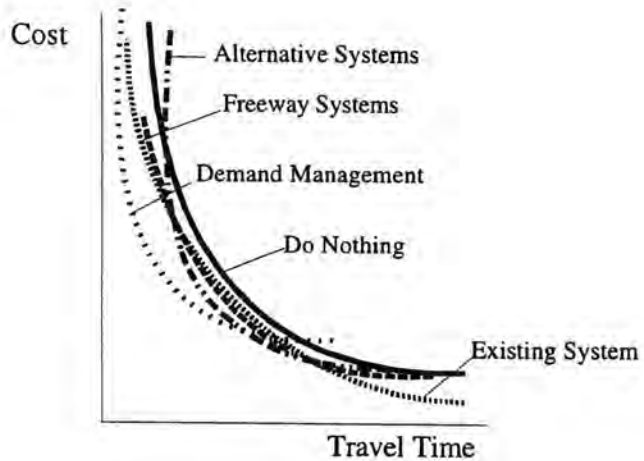
the shape of the tradeoff curve with respect to the consumer. Costs will also vary with the utilization of the system. Rapid transit systems and city buses enjoy economies of scale because they have relatively high fixed costs associated with their use. The higher the utilization, the more the tradeoff curve will bend toward the origin.

The tradeoff curve does not consider the externalities associated with the provision of transportation services. The impact of transport on air/water pollution, the city land use or medical/insurance costs are not included. If they were, the cost curves would tend to rise and bend to the left, on the basis that single-occupancy vehicles tend to cause a greater proportion of the externalities.

TransPlanning Economics

Each quadrant of the *TransPlanning Model* represents different monetary cost and travel time tradeoffs. Figure 4 illustrates the impact of policy direction on the location/shape of the tradeoff curve. The *Do Nothing* quadrant presents the future costs and travel times of the present system. If the infrastructure is not improved and the traffic increases, the curve could be expected to shift up and to the right.

Figure 4 Impacts of Policy on Monetary Cost - Travel Time Trade-off



The *Demand Management* quadrant suggests higher costs for the automobile, but somewhat improved speeds overall because more passengers take the alterative modes. Over time, this curve will tend to rise and rotate to the left as traffic increases, if no further infrastructure is provided.

The *Alternative Systems* quadrant improves travel times for all participants, but with higher minimum costs to the riders of public transit system who have to bear the burden of the additional infrastructure costs. Overtime, the curve should stay relatively stable, or could shift to the left as greater utilization helped to spread the fixed costs.

The *Freeway Systems* quadrant reduces the travel time for automobile users and increases the cost and travel time for the alternative modes. In part this is a reflection of falling utilization of the public transit system. Overtime, this curve will shift to the right as increased traffic causes more congestion.

Concluding Comments

The *TransPlanning Model* offers a method of translating the results of public consultation into the formulation of a new transportation plan. Greater *ex ante* input from the public is hoped to improve the acceptability of theTransPlan 2010 recommendations. Whether this approach is more successful remains an open question. The lack of efficient markets fo r urban transportation services plagues the development of comprehensive transportation plans. Consumers are unaccustomed to paying directly for the use of the transportation system. In the absence of explicit prices, consumers rely on the prices implicit in the costs (monetary and time) they experience, to guide their choices. Extensive public consultation may lead to a plan that better fits the needs/desires of the community, but success is not guaranteed. As long as the economic conflicts that are inherent in urban transportation remain unresolved, no plan is immune to rejection by some organizations and stakeholder groups.

As of this writing, the TransPlan 2010 Steering Committee has reviewed the results of the community involvement process, technical papers prepared by the transportation planning consultants and other relevant information. Development of recommendations is underway and a final report to the Province of Manitoba and the City of Winnipeg is to be submitted in mid-1997.

1. The TransPlan 2010 steering committee is comprised of: Robert Gabor, Q.C. of the law firm of Taylor, McCaffrey, as Chair and members Susan Lewis, Executive Director of the United Way of Winnipeg; Dr. Barry Prentice, University of Manitoba; Mary Dixon, owner of Peguis Publishers and AI Cerilli, retired Regional Vice-President of the Canadian Brotherhood of Railway Transport and General Workers.

2. This includes income separations, as well as demographic classifications.

3. The absolute price of any good or service is often less important than the difference between its price and the price of a close substitute.

THE CALGARY DIESEL LRT/COMMUTER RAIL EXPERIMENT

Kells Boland
PROLOG Canada Inc.
Calgary, Alberta

INTRODUCTION

The purpose of this paper is to look at some of the more subtle issues confronting potential opportunities and risks for commuter rail applications in smaller cities, like Calgary, not normally considered commuter rail candidates. The paper will also highlight the hybrid of Diesel Light Rail Transit and Commuter Rail operations which showed special potential in Calgary (i.e., as an LRT prebuild/feeder and as a regional rail link with downtown LRT access).

The discussion in this paper derives directly from a 5 month commuter rail demonstration project which was conducted in Calgary during the spring and summer of 1996. The demonstration was operated on Canadian Pacific Railway tracks with a new generation of diesel light rail vehicle, the Siemens RegioSprinter.

Peak period commuter service every 20 minutes over a 6.5 km segment of CPR freight rail track was integrated with Calgary Transit LRT service at the outskirts of the city using an across-the-platform transfer. Ridership response dramatically exceeded expectations and the combination of light rail technology operating on freight rail tracks attracted attention from public transit planners across North America.

The Calgary Commuter Rail Project provided actual experience in a distinct departure from conventional commuter rail operations. It was a unique experiment that:

Introduced Diesel Light Rail Transit in North America,
As a potential pre-build/extension of full Electric Light Rail Transit,
Sharing existing tracks with Freight Railway Operations.

The novelty of this project raised new questions (and provided some possible answers) for urban and regional transportation planners - especially in smaller cities seeking public transit improvements under stringent capital constraints:

When can Diesel LRT substitute for Electric LRT?
(for initial peak hour service)
How can Diesel LRT operate on Freight Rail Tracks?
(with exclusive occupancy of a track/time block)
Where can Diesel LRT and Freight Rail best share existing tracks?
(off high density main line railways)

This paper seeks a pragmatic, balanced perspective among the issues confronting freight railways, transit planners and politicians. The focus is on basic cost and capacity concepts which are at the core of the opportunities - and risks - from applying Diesel LRT in a freight rail context as a public transit solution.

THE CALGARY EXPERIENCE

For 5 months during 1996, Calgary was arguably one of the smallest cities on the continent to have a commuter train. The tracks were provided by the Canadian Pacific Railway; the train was provided by Siemens Electric Limited; and they were both integrated with Calgary Transit Service.

Some very creative partnering achieved a financially and operationally acceptable 3 way agreement - and each partner deserves a lot of credit for making it work so well. As a compact city, with a unique project partnership, Calgary defied the conventional wisdom of commuter rail service, which is typically operated only in much larger metropolitan areas.

The conventional wisdom says that commuter rail is long trains going longer distances all the way downtown in the morning and back in the evening; but the Calgary commuter train was a single car shuttling over a relatively short track segment between outlying suburbs and an LRT terminus.

The conventional wisdom says that commuter rail can't be as attractive as a good bus feeder if an additional transfer to LRT is required to get downtown; but the Calgary commuter train attracted an average of 700 passengers per day, almost a quarter (22 percent) new to transit, despite requiring a transfer at the LRT terminus after boarding the commuter train further out.

The conventional wisdom says that commuter rail will have trouble sharing a single track with freight traffic unless additional capacity is provided; but the Calgary commuter train got along quite well operating during the morning and evening rush hours with exclusive occupancy of a block of track for a block of time on a relatively lightly used freight rail line.

So Calgary defied the conventional wisdom of commuter rail service, but what was so successfully demonstrated? Maybe it was the start of a regional rail link feeding LRT; or maybe it was an instant - interim - peak period LRT extension.

Whichever it was, what was really demonstrated was the opportunity, and the risk, of using the freight railway's capital investment to reduce the requirement for public transit investment.

Just as highway sharing makes bus service relatively less capital intensive, freight railway sharing can make commuter rail less capital intensive - and that's the opportunity. However, just as future highway congestion can require dedicated bus only lanes, future freight rail congestion can require separate investment in dedicated transit tracks - and that is the risk.

So the trick is to find a complementary mix of commuter rail demand and underused freight rail capacity. For five months during 1996, the Calgary Commuter Rail Demonstration seemed to find that magic mix - with by all accounts, little interference to current freight rail service.

However, this is a bit like trying to insert a few sets of tennis between periods in a basketball game - with the host railway controlling access to the court. Whether both games can continue successfully, alternating use of the same court, remains to be seen. And, since the court belongs to the freight railway, public transit could have to find a new place to play ball.

Such extended ramifications of the Calgary experience are the subject of the balance of this paper from the author's armchair analysis of both a freight railway perspective and a public transit perspective.

THE FREIGHT RAILWAY PERSPECTIVE

Freight railways are in business to make a profit for their shareholders. These days that is generally viewed as maximizing the return on assets employed - specifically right-of-way, track, cars and locomotives. In looking at any commuter rail proposal, freight railways must consider the alternative cost of FOREGONE OPPORTUNITIES from not employing right-of-way and track for the more PROFITABLE OPERATION of freight cars and locomotives.

Two points here require closer consideration:

1) FOREGONE OPPORTUNITIES - implies that commuter rail service will disrupt freight service: To the extent it does, investment in additional train capacity will be required for commuter and freight rail service to co-exist. To the extent it doesn't, and commuter service can share existing tracks with freight trains, incremental return on railway assets will increase while investment required for public transit is minimized.

2) PROFITABLE OPERATIONS - implies that freight train service over the track in question fully covers operating costs and provides an acceptable return on railway investment: To the extent it does, there is a true opportunity cost from potentially disrupted freight service. To the extent it doesn't, commuter rail may provide the incremental revenue source to keep the track economically viable for freight service.

Key, then, to lowering the investment cost threshold for commuter rail, is finding underused railway tracks with marginal freight operations (i.e., low opportunity costs). A subjective search for low opportunity cost commuter rail prospects suggests the best chances of successful coexistence on freight rail lines as characterized below:

Mutually Beneficial Freight and Commuter Rail Service
most likely on marginal branchlines;
probably on low density secondary mains;
maybe on line abandonment candidates;
BUT NOT ON HIGH DENSITY MAINLINES
- OR ABANDONED LINES.

Note that the best prospects for low cost commuter rail success are not attributed to either high performance freight rail assets or to disinvestment in freight rail assets. It is between these two positions, with ongoing operation of underperforming freight rail assets not yet abandoned, that the prospect of commuter rail should achieve the greatest mutual economic benefit.

For the ongoing freight rail operation, that economic benefit is in terms of commuter rail service fees that provide an incremental return on track assets without jeopardizing existing freight revenues - or that may justify retention of marginal freight service which otherwise would warrant abandonment.

For the public transit prospect, that economic benefit is a lowered capital cost threshold with shared use of existing freight railway investment (in track, tunnels, bridges, trestles, train control and protection as well as right-of-way land) to avoid incurring the capital cost of constructing parallel capacity for rail transit alone.

Conceptually it seems reasonable to expect that these mutual benefits might flow from commuter rail prospects characterized by the range of freight rail lines broadly identified above. However, to generalize a low opportunity cost to specific rail routes fails to recognize the complexity of railway operations under varying circumstances.

A more objective search might screen alternative routes through a conceptual model like the following for a Calgary style commuter train shuttle on a single, unsignaled, freight rail track.

A COMMUTER/FREIGHT RAIL OPPORTUNITY COST INDEX MODEL

PRE-REQUISITES

Local switching is (or can be) effected mid-day or at night.
Through trains are (or can be) dispatched outside of peak periods.

SCREENING CRITERIA	***Calgary***
Distance of proposed service (1 to 10 or more kms.)	***6***
Local switching jobs (how many: 0 to 10 or more jobs)	***1***
Through trains per day each way (how many: 0 to 10 or more trains)	***4***
Annual traffic percent decrease/increase (-10 or more to +10 or more)	***-1***
Conflicting train movements at any junctions (0 to 10 or more per day)	***0***
TOTAL OPPORTUNITY COST INDEX (max. = 50)	***10***

This is a QUICK (easily completed from readily available information) and DIRTY (requires extensive "clean-up" before acting on conclusions) screening model which nevertheless applies a set of purely objective criteria to specific areas creating capacity constraints (opportunity costs). It is at least a preliminary process that both the existing rail track owner and the potential commuter train operator should go through to get a pragmatic sense of where there may be a window for shared track operations.

This also starts a rational calculation of the contingency cost that can be associated with the probability of any freight service disruptions from shared track operations. Such a contingency allowance should become the marginal cost floor for commercially attractive commuter rail pricing that will maximize railway stockholders return on track assets.

The extent of that return will be the subject of negotiations. Railways may perceive negotiating leverage where there are no apparent alternatives (e.g., as in Edmonton with the CPR High Level Bridge before a new low level LRT bridge was built). Public transit agencies may gain negotiating leverage where there is the prospect of outright abandonment (i.e., with the new Canada Transportation Act requiring right-of-way sale at salvage value to any public agency).

In a variation on potential abandonments, the increasing role of short line railways as purchasers of underperforming rail track assets, may also change the weighing of opportunity costs. While the transcontinental railways tend to be concerned with a network approach and worry about precedents that may not work everywhere, the short lines are typically much more flexible in seeking to accommodate any new revenue potential.

As in buying and selling anything, there is a range between the cost floor and "all the traffic will bear" within which negotiations will take place. Knowledgeable negotiators on both sides will recognize that the opportunity costs for contingency capacity discussed here are not to be confused with operating costs regardless of how pricing of the two might ultimately be combined in a contract fee for providing commuter service.

THE PUBLIC TRANSIT PERSPECTIVE

Smaller cities the size of Calgary (approx. 750,000 population) do not normally consider commuter rail as a public transit option. However, the Calgary commuter rail experiment demonstrated that where there is sufficient commuter demand along existing freight railway routes this option may be economically viable. The critical caveat is that careful consideration must be given to the freight railway perspective on the relative opportunity cost of commuter versus freight trains for a range of different rail lines with different operating characteristics.

Subject to full understanding and consideration of this caveat, commuter rail generally, and Diesel LRT specifically, can become a valid part of the transit planning process - even for smaller Calgary size cities. In essence, Diesel LRT/Commuter Rail service extends further downward a cost continuum of new rail transit technologies that can achieve financial viability at increasingly lower investment thresholds:

LOWERING THE RAIL TRANSIT INVESTMENT THRESHOLD

1) ***From Heavy Rail Transit to Light Rail Transit***
2) ***From Electric Light Rail Transit to Diesel Light Rail Transit***
3) ***From Dedicated Transit Tracks to Shared Freight Rail Tracks***

At the bottom of this continuum, and assuming that a rail route with an acknowledged "low opportunity cost index" can be found, something like the Calgary experiment can provide a peak period alternative for traffic currently moving on highways. However, while Calgary Diesel LRT peak hour service on CPR tracks - with freight trains operated the rest of the day - is a step up from prevailing bus feeder service, it cannot be compared with full Electric LRT service operated all day.

It is the am/pm peak service characteristic of commuter rail which minimizes the opportunity cost of accessing freight rail tracks. However, it is the new European Diesel LRT technology that pushes service and performance toward Electric LRT levels while holding down equipment and operating costs. In particular, the Calgary Commuter Rail Project demonstrated the feasibility of one-man crew passenger operations on freight railway tracks that would otherwise have been double the Electric LRT operating costs.

So, operating Diesel LRT on shared freight rail tracks appears to be an incrementally attractive first step back up the continuum toward full Electric LRT. Given an estimated $90 million investment planned for Calgary to extend full Electric LRT over a parallel route (including the construction of a new bridge), it seems to offer a much greater degree of flexibility for rational capital allocation when financial resources are constrained - and where competing LRT route proposals may not have the alternative of accessing existing freight rail tracks.

This is not a perfect picture, though. From the following comparison with Electric LRT, the capital cost of Diesel LRT investment appears incredibly attractive for infrastructure and to a somewhat lesser extent for equipment. For operating costs, on the other hand, a premium is exacted compared to Electric LRT.

RELATIVE COST OF DIESEL LRT
COMPARED TO ELECTRIC LRT*

OPERATING COST	*about 25% More*
CAPITAL COST	
EQUIPMENT COST	*about 15% Less*
INFRASTRUCTURE	*up to 90% Less*

* Approximate values based on Siemens RegioSprinter and U2 LRVs as used in Calgary, and infrastructure investment as discussed in this paper.

The cost trade-off, then, is between lower operating costs for Electric LRT and lower capital costs for Diesel LRT - slightly lower for equipment investment and drastically lower for infrastructure. Since infrastructure is where the greatest expenditure is required for Electric LRT, and correspondingly the greatest potential saving from Diesel LRT, it is important from the public transit planning perspective to fully understand what you get for what you pay.

A PHASED LRT INFRASTRUCTURE SCENARIO

	WHAT YOU GET	*WHAT YOU PAY**
A) DIESEL LRT		
Freight Rail	***AM/PM Peak Ops***	***$10MM***
Shared Track	***20 minute freq***	***(11% of C)***
B) DIESEL LRT		
Dedicated	***Full Day Ops***	***$25MM***
Single Track	***10 minute freq***	***(28% of C)***
C) ELECTRIC LRT		
Dedicated	***Full Day Ops***	***$90MM***
Double Track	***5 minute freq***	***(100% of C)***

* 1996 order-of-magnitude estimates believed to reasonably reflect relative infrastructure costs based on the experimental 6.5 km Calgary Diesel LRT/Commuter Rail route and construction of the full Electric LRT extension as planned on a parallel route.

In the scenario above, Phase (A) assumes interim use of freight rail tracks, leading to Phase (B) investment in a single dedicated track that becomes a "prebuild" for dedicated double track electric LRT in Phase (C). The interim Diesel LRT Phase (A) assumes a contingency capacity charge which might be annualized at say $1 million/year operating fee for between 5 and 10 years with the balance allocated toward station, parking and maintenance facilities designed for ultimate inclusion in the full LRT investment. The intermediate Diesel LRT Phase (B) assumes "prebuild" investment in a dedicated single track with an intermediate station and extended passing siding "pre-build" for ultimate inclusion in the full LRT investment. The final Electric LRT Phase (C) investment would then be the balance of dedicated double track installation and electrification costs.

With this sort of investment strategy the "risk" of sharing freight rail tracks can be minimized by close coordination with the freight railway's long range capacity planning. Phase B and C investment in dedicated LRT tracks can be advanced or postponed to mutual advantage: The railway continues to realize an incremental revenue stream against on an otherwise underused asset and a heavy public investment can be postponed until there is no alternative.

Another "risk" which can be mitigated within this strategy is the investment in Diesel LRT equipment - which without the intermediate Phase (B) operation on a non-electrified dedicated LRT track might otherwise be made obsolete with transition to full Electric LRT. (Other solutions to this "risk" including re-cycling Diesel LRT equipment to other Electric LRT extensions or to regional rail links.)

The Calgary Commuter Rail Project provided a unique planning and operations testbed for practical application of some obvious yet often overlooked synergies from integration with existing transit services. These were far ranging and included the following:

REMOTE PARK AND RIDE SHUTTLE - The project proved an unanticipated double role, not only attracting new transit customers with a direct commuter rail link that was also twice as fast as LRT bus feeders along the same route, but also providing current park and ride customers with an alternative to overcrowded parking (and a long walk) at the LRT terminus.

SINGLE TRACK LRT EXTENSION - Instant start-up and dramatic system utilization was proven possible without investment in sophisticated train control, double track or electrification: Over a relatively short 6.5 km single track segment, 17 trains each way per day ran on a 20 minute frequency during peak hours *

LRT/FREIGHT RAIL ACCESS - The feasibility of contracting a block of track/time for peak period commuter rail service was proven successful and provided ample protection for light rail equipment separation from freight rail operations on the same line.

REGIONAL TRANSIT INTEGRATION - The potential for seamless projection of urban light rail transit into a regional rail context was tested with an exceptionally well orchestrated combination of LRT equipment, marketing, fares, bus feeders and an across-the-platform transfer that prompted unexpected customer acceptance for a commuter rail interface with urban transit outside the downtown.

COMPLEMENTARY RAIL CAPACITY USE - The ability to avoid or postpone heavy capital expenditures for both outlying LRT extensions and regional rail downtown access was proven: Diesel LRT extended transit service around a congested highway segment over an existing freight rail line where expensive bridge construction for a parallel LRT route would be required; and the LRT transfer allowed commuter rail to avoid busy freight operations at a major rail yard and mainline junction near the downtown.

Despite the potential operating synergies and cost saving opportunities, Diesel LRT in a commuter rail context carries both the risk of less direct control over public transit service and of less flexibility for freight rail operations. The perception of these risks is real - whether an objective evaluation of their full consequences would support that perception remains to be seen.

* By extension a longer 10 km segment should support up to approximately 30 minute frequencies; and approximately 1 hour frequencies with a 20 km segment.

In reality, there are only limited situations where shared access to freight rail tracks will provide a feasible alternative for transit planning. However, where those situations do exist, preconceived notions of commuter rail and urban transit incompatibility should not be allowed to cloud the evaluation process.

THE POLITICAL/CULTURE CLASH

The Commuter Rail/LRT evaluation process can be clouded by conflicting cultures, objectives and political agendas having little to do with public transit innovation to achieve higher quality at lower cost - or with increased freight railway return on assets. The common perception that freight rail and public transit are at odds, may be perpetuated from both perspectives for counter-productive purposes. This situation has a tendency to reinforce itself as a convenient fig leaf to cover up at least the following political/cultural issues:

Freight Railway - The potential for public transit to push more productivity from railway assets reduces the margin of flexibility for freight service management and imposes tighter criteria for total rail plant operations and maintenance scheduling in line with greater use of existing track capacity.

Public Transit - The potential for virtual "contracting-out" to a freight railway of public transit operations reduces the purview of transit management in terms of both large project capital and ongoing operating budgets; and of transit labour in terms of possibly losing jurisdiction to railway employees.

Politics - The potential for interim substitution of lower capital cost Diesel LRT on freight rail tracks in one political jurisdiction means that some other political jurisdiction without a freight rail option may get the grander investment in full Electric LRT.

CONCLUSIONS

From the freight railway perspective, where there is a low "opportunity cost index" for freight rail lines that are <u>not</u> to be abandoned, the incremental return on assets which public transit may provide should be revisited. Service specific pricing could consider a block of track/time - regardless of how many commuter trains operate within it - for a fixed capacity charge contributing to railway overhead and profit; as well as the uniquely lower direct costs of new Diesel Light Rail equipment operations and associated track maintenance.

From a public transit perspective, Diesel LRT/Commuter Rail service operated on freight railway tracks could offer Calgary size cities a cheap, quick fix in the short run. There are no long term guarantees that money saved now will not have to be spent latter; but from the financial perspective that is, at the least, a lot of interest available from postponed investment.

The Changing Relative Importance of International and Interprovincial Merchandise Trade in Canada with Particular Reference to Ontario

Frank Sinanan
Kevin Junor
Ministry of Transportation Ontario
April, 1997

Source of Data: Statistics Canada

1. Summary of Recent Trends and Historical Perspective

Traditionally, it appears that Canada has tended to view closer economic ties with the U.S.A. with a certain degree of unease. Despite the fact that the "natural" flow of trade is North - South rather than East-West in North America, Canada has been somehow suspicious that fostering closer economic ties with the U.S. will somehow erode national integrity. This seems evident whether in the trade in goods, or services especially regarding culture, or even in the use of U.S. capital markets long after the U.S. had established itself as a major creditor nation.

In recent years, the globalization of the world's economy, the formation of important trading blocks, and continued growth in importance of the U.S. market to Canada in spite of the efforts of various Canadian governments to reduce dependence on the U.S. by seeking new export markets in Asia and reviving old ones in Europe, underlined the acceptance of the U.S.A. as a vital economic partner. This acceptance is largely embodied in the Canada - U.S.A. Free Trade Agreement of 1987, later expanded into the North American Free Trade Agreement to include Mexico.

According to trade theory, international trade would encourage national specialization and international exchange. Liberalized trade should lead to intensified national specialization and international exchange.

It is not surprising therefore that the relative importance of international merchandise trade in terms of provincial Gross Domestic Product (GDP) in Ontario has steadily increased in recent years. International merchandise exports as a proportion of Ontario's GDP has risen from over 25% in 1988 to almost 40% today (Chart 1).

At the same time, merchandise exports to the U.S.A. have increased both in absolute value as well as in terms relative to provincial GDP. Of particular significance, has been the growth in the value of goods destined for Michigan, New York, Ohio and Illinois (Chart 1). Also worth noting is the fact that trade between Ontario and these states is decidedly two-way
(Charts 3 & 15).

Conversely, the relative importance of merchandise "exports" sent to the rest of Canada has declined both in absolute value as well as in terms relative to Ontario's GDP. Consequently, merchandise "exports" to Quebec which is estimated to make up about one-third of all goods by value sent from Ontario to the rest of Canada have also declined in significance (Chart 1). This is merely a reflection of the stagnating values of merchandise "exports" to the rest

of Canada and the continuing growth of the value of Ontario's GDP.

The dependence on the road mode has also increased in importance in the movement of merchandise exports out of Ontario as well as in the movement of merchandise imports into Ontario (Charts 2 and 3).

It is estimated that 50% of the goods sourced by Ontario from the rest of Canada originates in Quebec. However, merchandise "imports" from the rest of Canada have stagnated around $25 billion a year despite steady growth in Ontario's GDP (Charts 1 and 4).

Merchandise exports make up a large portion of provincial GDP in other provinces (Chart 5). At the same time Ontario is an important gateway for Canada's exports. 58% of Canada's exports are cleared in Ontario while 37% of Quebec's exports are cleared in Ontario. Less that 8% of Ontario's exports are cleared elsewhere in Canada.

2. Trends in Ontario's Merchandise Trade 1988 - 1995 (Charts 2 & 3)

The value of Ontario's international exports of goods has almost doubled (x 1.9) over the last eight years, rising from $65.3 billion in 1988 to $124.1 billion in 1995. At the same time Ontario's GDP at market prices has grown steadily from $253.1 billion in 1988 to $315.1 billion in 1995.

In other words, Ontario's exports of goods now constitutes an increasingly important proportion of Ontario's output, rising from just over 25% in 1988 to almost 40% in 1995. Perhaps, this spectacular growth in the proportion of Ontario's GDP represented by merchandise exports is somewhat exaggerated by the stagnation of domestic consumption in recent years. Still, the trend remains unmistakable, the export of goods is an increasingly important component of Ontario's output and therefore vital to the utilization of labour resources, especially when the multiplier effect is taken into account.

3. Importance of the United States, Particularly the Border States (Charts 4, 5, 6 & 7)

Merchandise exports from Ontario to the United States represented 89% of the value of all Ontario international merchandise exports in 1995. This proportion of exports going to the U.S.A. has grown steadily from 86% in 1988. As a percentage of Ontario's GDP, the value of these exports to the U.S. have assumed greater significance accounting for 22% of GDP in 1988 and 35% of

GDP in 1995.

Looking more closely at the destination of Ontario's exports to the U.S.A., merchandise exports from Ontario to the contiguous states of Michigan, New York, Ohio and Illinois were 64% of the value of Ontario's exports to the U.S. or 57% of all Ontario's exports. In 1988, these four states received 67% of Ontario's U.S. exports or 58% of all Ontario's exports. As a proportion of GDP, Ontario's exports to these four states were 22.4% in 1995 and 15% in 1988. It should be noted that the destinations of Ontario's exports as reported to Customs may not be their final destination, but merely points for further redistribution. Nevertheless, it could safely be assumed that significant amounts of Ontario's exports end up in these four states and certainly, whether this is so or not, the transportation links with these four states remain of vital importance to Ontario.

4. **Importance of the Auto Trade** (Chart 18)

As would be expected, the export of automotive products, machinery and equipment and industrial goods dominate Ontario's exports to the U.S.. In 1995, automotive products were almost one half (49.3%) of the value of all exports from Ontario to the U.S. Machinery and equipment, and industrial goods accounted for 21.5% and 15.8% respectively.

This is hardly surprising, considering the relative maturity of the secondary sector in southern Ontario.

5. **Importance of Transportation Modes** (Chart 12 & Table 2)

Road transport continues to be the most important mode used to move exports from Ontario. In 1995, $74.7 billion worth of exports left Ontario by road or 60% of all goods exports equivalent to 24% of Ontario's GDP. At the same time, $32.3 billion left by rail or 26% of all goods exports representing 10% of provincial GDP.

In terms of the broad commodity classification of exports to the U.S., road transportation was significant in every important category. $29.5 billion or 54% of automotive products sent to the U.S. moved by truck. Likewise, $18.9 billion or 79% of machinery and equipment destined for the U.S. moved by truck. $13.6 billion or 78% of industrial goods left Ontario by road.

Rail also played a significant role in the movement of Ontario's exports. $24.1

billion or 42% of automotive products sent to the U.S. in 1995 moved by rail. $2.6 billion or 40% of all forest products bound for the U.S. moved by rail, while $2.7 billion or 15% of industrial goods were moved to the U.S. by rail.

6. **The Gateways** (Charts 13, 14 & Table 1)

Windsor, Fort Erie and Sarnia account for over 81% of the value of exports cleared in Ontario and 43% of all Canada's merchandise trade (imports plus exports). Since the road mode is important in the movement of exports to, and imports from these points, the importance of Highways 401, 402 and the Queen Elizabeth Way is underlined.

It is worth noting too that Ontario's ports of exit are an important gateway for the exports of other provinces, particularly Quebec. In 1995, $16.5 billion or 37% of Quebec's exports were cleared in Ontario. $6.6 billion or 24% of Alberta's exports left Canada at Ontario. $2.7 billion or 10% of British Columbia's exports passed through Ontario in 1995.

7. **The Import Picture** (Charts 14, 15, 16 & 17)

Merchandise imports into Ontario in 1995 were valued at $144 billion. Of these $108 billion or 75% came from the U.S. $90 billion or 85% of all imports from the U.S. arrived by road while $10 billion or 9% were moved by rail. At the same time, $47.6 billion or 44% of all imports from the U.S. originated in four states -Michigan, New York, Ontario and Illinois.

Since 1988, imports the U.S. have grown from $63 billion to $108 billion in 1995. At the same time, imports from the four states have risen from $31 billion to $47.6 billion in 1995.

Again the importance of the four states as trading partners of Ontario is underlined. At the same time, the growth in imports suggests that the trade is two-way. Also worth nothing is the fact that imports into Ontario are higher in value than exports, suggesting that Ontario may be a significant redistribution point for imports to the rest of Canada.

8. The Decline of Interprovincial Trade (Charts 8, 9, 10 & 11)

The importance of interprovincial trade, the cornerstone of the old national policy forcing trade East - West, has eroded steadily in recent years. From Ontario's view point, interprovincial "exports" which represented 16.7% of Ontario's GDP in 1988 or $42.3 billion, in 1995 was worth only $34.1 billion or 11.2% of provincial GDP.

The relative and absolute decline in interprovincial "exports" is emphasized in Ontario's "trade" with Quebec which accounts for roughly one third of Ontario's interprovincial "exports". "Exports" to Quebec in 1988 were worth $14 billion or 5.6% of Ontario's GDP. In 1995, "exports" to Quebec were worth $11 billion or 3.8% of Ontario's GDP.

This steady erosion of the importance of interprovincial trade to Ontario appears likely to continue at least in relative terms if not in absolute terms.

9. Transportation Policy Implications

The foregoing analysis suggests that as international trade is becoming more important to Ontario, interprovincial trade is declining both in absolute and relative terms. The growth in international trade for Ontario is concentrated in the United States. The significant states are Michigan, New York, Ohio and Illinois. With the export of goods to the U.S. representing over 35% of Ontario's GDP, it is imperative for Ontario's economic well-being and performance that transportation policy enhances rather that impedes opportunities in the U.S. export market. Transportation policy could affect physical infrastructure, ports and gateways, regulatory regimes, warehousing locations and business travel which must be an important component of trade.

Investment in physical infrastructure to support and promote trade has been the subject of debate recently particularly in the Federal Commons Transportation Committee. There should be no doubt, if the analysis above is valid, that such expenditure should take place in Ontario, relieving the gateway of congestion and easing the flow of traffic on the highways providing access to these gateways. Specifically, if resources are to be committed to highway infrastructure to promote trade, there are no better candidates in this regard than highways 401, 402 and the Queen Elizabeth Way. Port or gateway development should centre on Windsor's Ambassador Bridge, Fort Erie and Sarnia.

Since road transport is so vital to export movements, the development of an

appropriate truck regulatory infrastructure is essential. Harmonization in regulation (of vehicle weight and dimensions, safety matters etc) must recognize the economic opportunities and developments in the United States in particular the four states bordering Ontario. From Ontario's viewpoint, any conflict with the rest of Canada and the four border states should be resolved in a way that will not jeopardize Ontario's trade opportunities, employment and economic well-being.

Finally, there are ancillary services needed to support trade. Ontario's air travel links should be strengthened and made more convenient for business travellers particularly to points within the four border states, namely Michigan, New York, Ohio and Illinois.

Disclaimer

The views expressed in the paper are those of the authors and not necessarily those of the Ontario Ministry of Transportation, nor their colleagues, whose constructive criticism is gratefully acknowledged.

Biographical Notes:

Frank Sinanan was educated at Queen's Royal College, Trinidad and Oxford University. Having served at the Bank of England, London, England, the Bank of Nova Scotia, the Toronto Stock Exchange and Imperial Oil Ltd, Frank has worked in the policy issues at the Ontario Ministry of Transportation for the last twenty years.

Kevin Junor holds the diploma in Civil Engineering from Seneca College, Toronto. He has worked at the Ontario Ministry of Transportation for the past twelve years serving as a Research Technician and more recently as a Policy Advisor. Kevin also serves as a Company Sergeant Major with the Canadian Armed Forces (Reserves).

The Changing Relative Importance of International and Interprovincial Merchandise Trade in Canada with Particular Reference to Ontario

Frank Sinanan
Kevin Junor
Ministry of Transportation
April, 1997

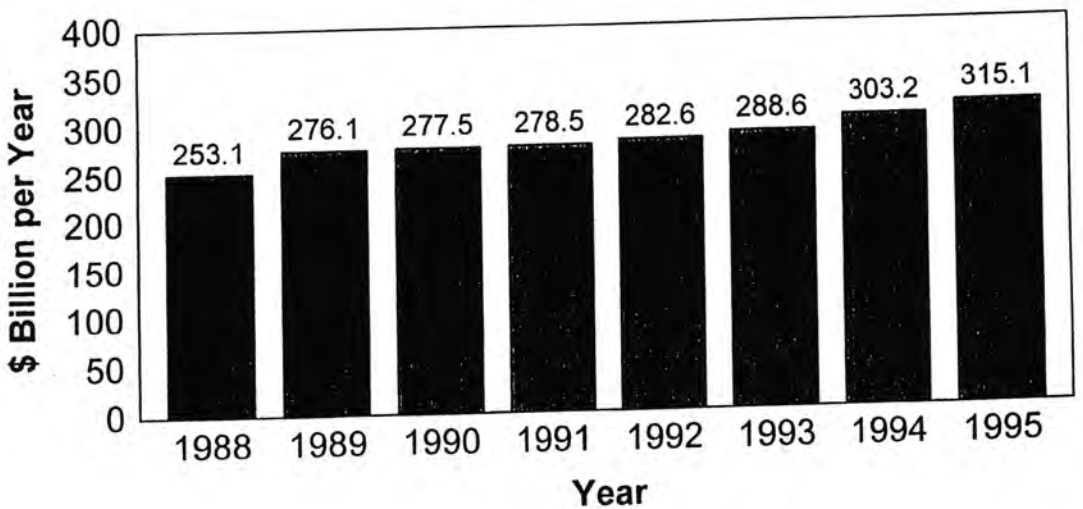
Source of Data: Statistics Canada

1. Ontario's Output (GDP) has grown steadily over the past eight years.

Chart 1

Ontario GDP

(market prices)

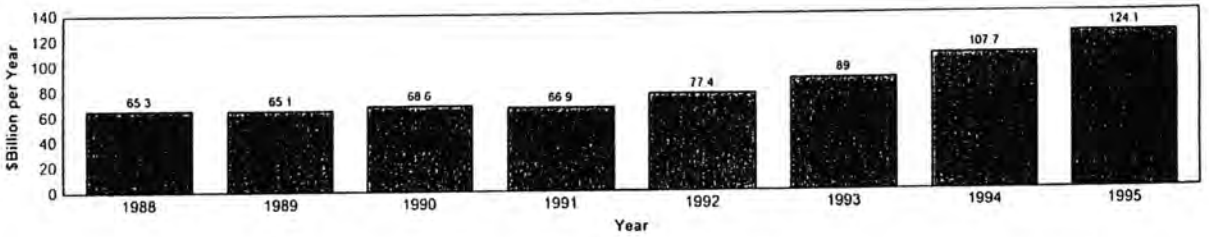


2. The value of Ontario's international exports of goods has almost doubled (x 1.9) over the last eight years.

Chart 2

Ontario's Merchandise Exports

(International)

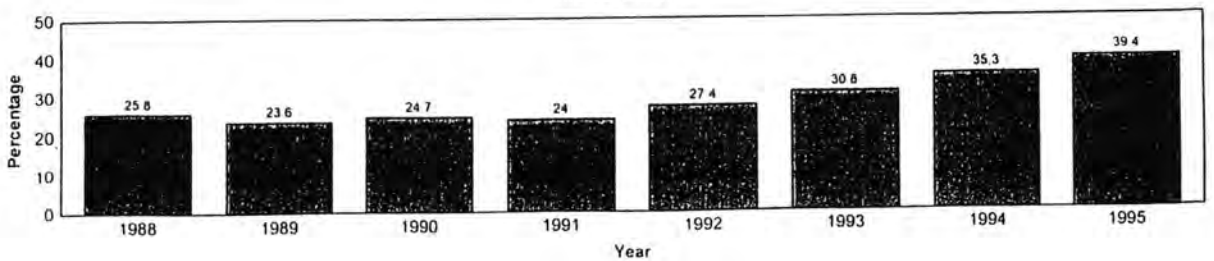


3. ... and now constitutes an increasingly important proportion of Ontario's output (GDP)

Chart 3

Percentage of Ontario's GDP

(market prices)

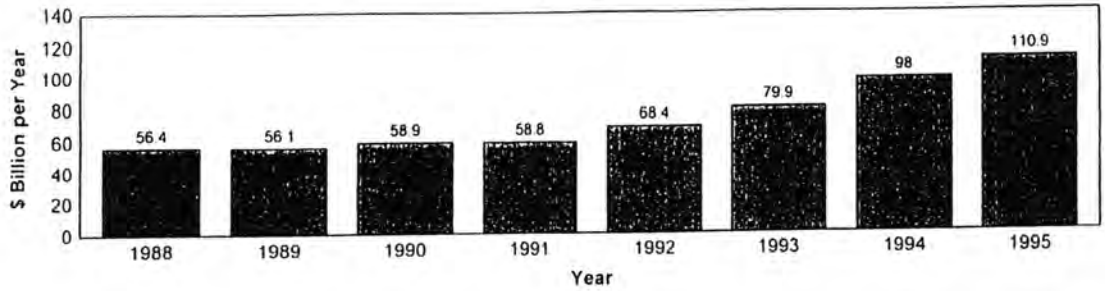


4. The value of Ontario's exports to the U.S.A., now 89% of all Ontario's exports, has increased even more remarkably (x 1.97).

Chart 4

Ontario's Merchandise Exports

(U.S.A.)

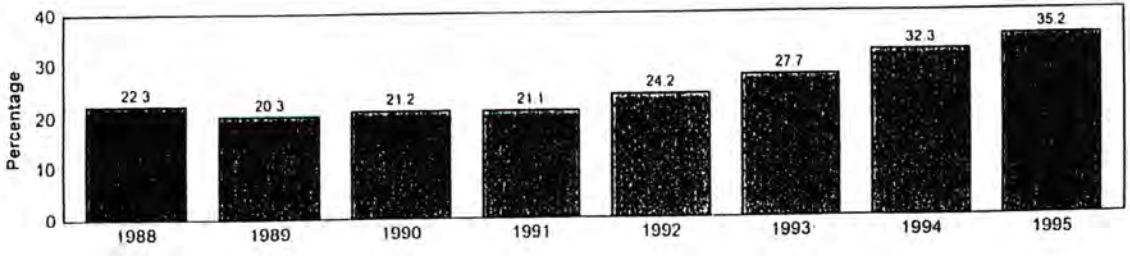


5. ... and therefore as a proportion of Ontario's Output (GDP) has become more significant

Chart 5

Percentage of Ontario's GDP

(at market prices)

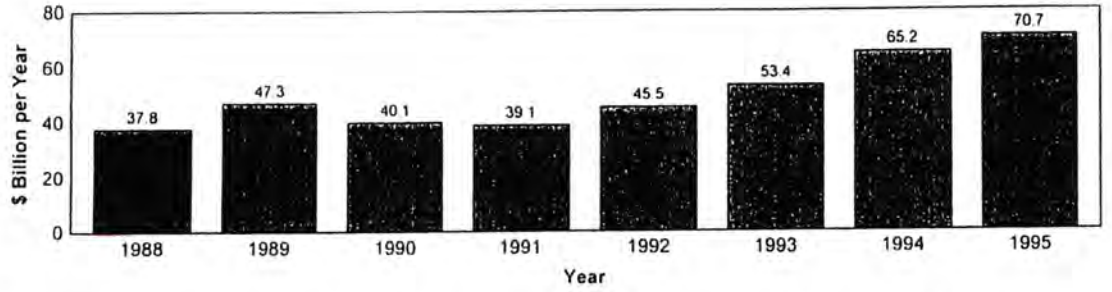


6. Almost 64% of the value of Ontario's exports to the U.S.A. now go to four U.S. states - Michigan, New York, Ohio and Illinois.

Chart 6

Ontario's Merchandise Exports

(Michigan, New York, Ohio, Illinois)

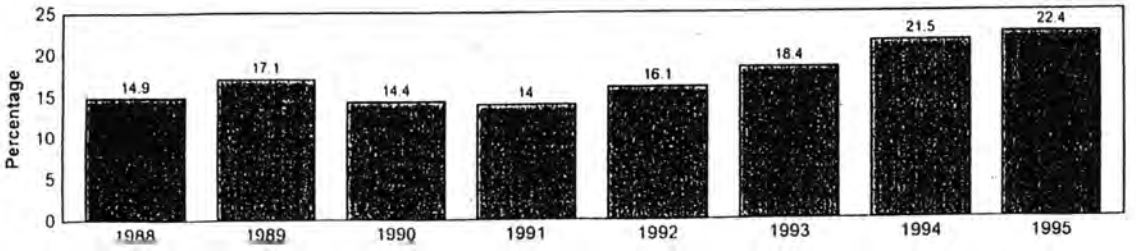


7. ... and these exports account for almost a quarter of Ontario's Output (GDP)

Chart 7

Percentage of Ontario's GDP

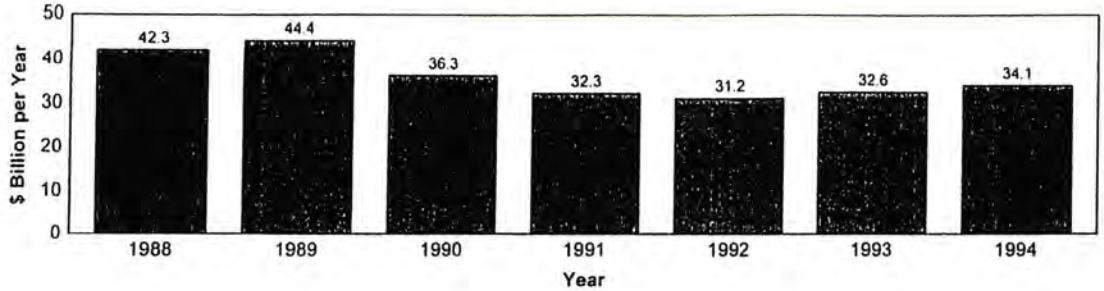
(at market prices)



8. Meanwhile, the value of interprovincial "exports" has declined and stagnated.

Chart 8

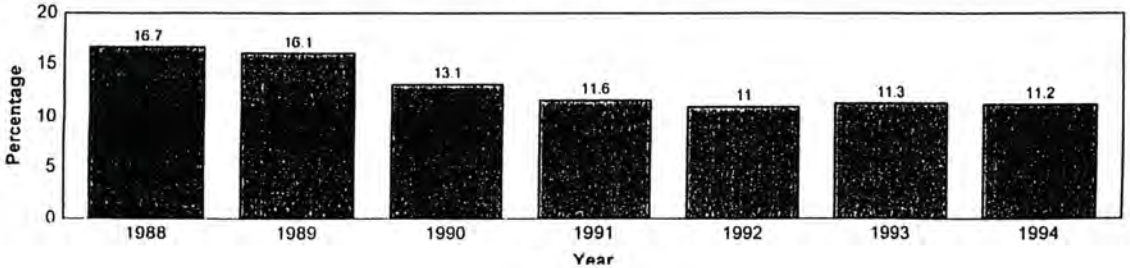
Ontario's Merchandise "Exports"
(Interprovincial)



9. ... and therefore constitute a steadily decreasing proportion of Ontario's Output (GDP)

Chart 9

Percentage of Ontario's GDP
(at market prices)

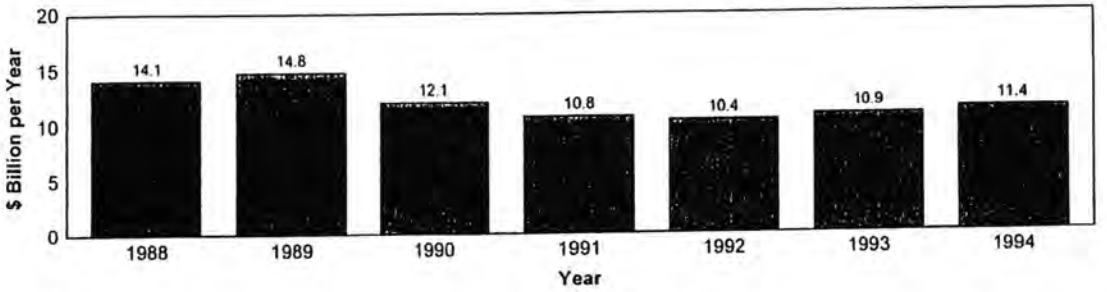


10. The value of exports to Quebec, estimated at one third of interprovincial "exports" has likewise declined and stagnated.

Chart 10

Ontario's Merchandise "Exports"

(Quebec)

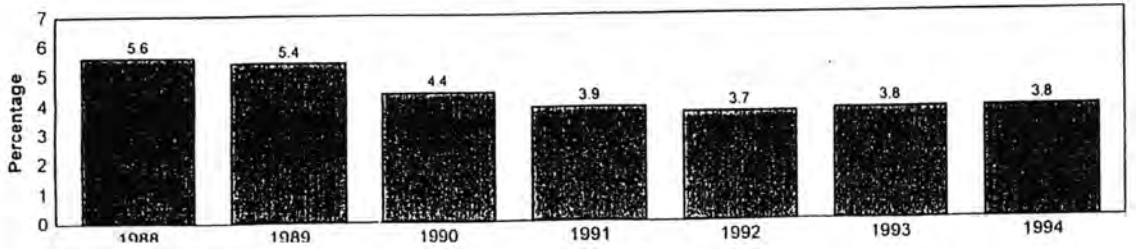


11. ... and thus, as with all interprovincial "exports" constitutes a less important proportion of Ontario's Output (GDP).

Chart 11

Percentage of Ontario's GDP

(at market prices)

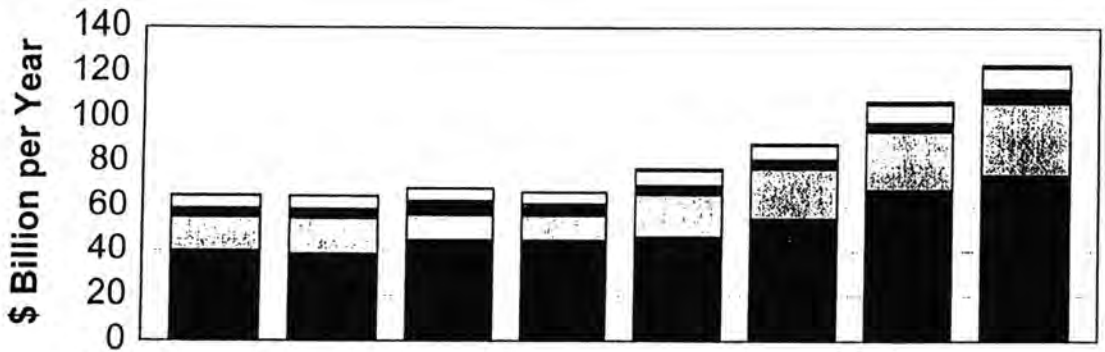


12. Road transport continues to be the most important mode used to move exports.

Chart 12

Merchandise Exports (International) from Ontario

($ Billion)



Year	1988	1989	1990	1991	1992	1993	1994	1995
Road	40.0	38.6	45.0	45.0	46.7	55.1	68.1	74.7
Rail	15.3	16.2	11.4	11.3	19.1	22.4	26.3	32.3
Wate	4.4	4.5	6.7	5.5	4.4	4.4	4.2	6.3
Air	5.2	5.6	5.3	4.9	6.3	6.1	7.6	9.2
Othe	0.4	0.2	0.2	0.2	0.9	1.0	1.5	1.6
Total	65.3	65.1	68.6	66.9	77.4	89.0	107.7	124.1

13. Ontario's ports of exit are an important gateway for the exports of other provinces, particularly Quebec.

Chart 13

Ontario as Gateway for Canada's Exports 1995

International Merchandise Exports Cleared in Ontario

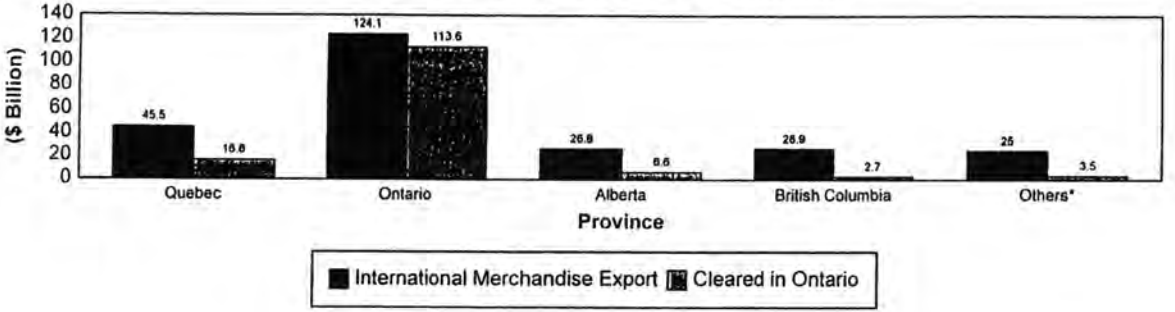
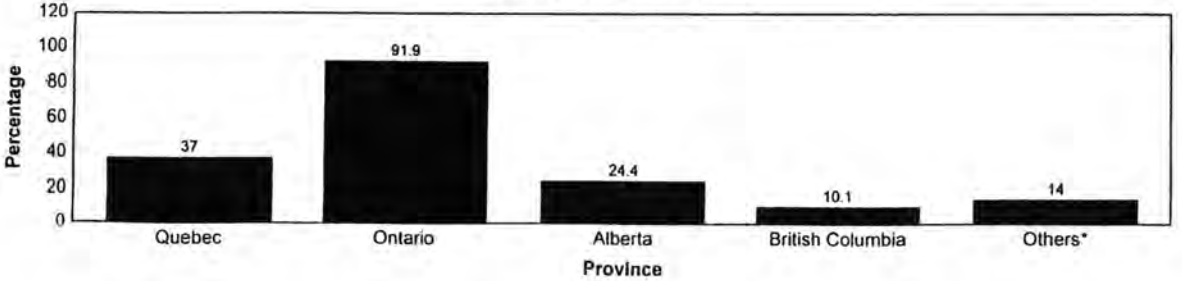


Chart 13A

Ontario as Gateway for Canada's Exports 1995

(% of Provincial Exports)



*Others - Manitoba, New Brunswick, Newfoundland, Nova Scotia, Prince Edward Island and Saskatchewan

14. Windsor's Ambassador Bridge, Fort Erie and Sarnia account for over 81% of the value of exports cleared in Ontario.

Table 1

Port Data 1995
($ Billion)

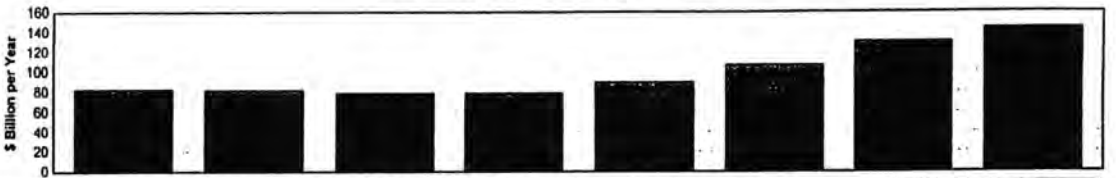
Ports of Entry/Exit Access Highways	Exports (% of total)	Road Mode (% of Port)	Imports (% of total)	Road Mode (% of Port)	Trade (% of total)	Road Mode (% of Port)
Windsor Ambassador Bridge (Hwy 401 & Hwy 3)	54.4 (36.4%)	37.3 (68.6%)	45.6 (31.5%)	42.5 (93.2%)	100.0 (33.9%)	79.8 (79.8%)
Fort Erie (QEW)	37.7 (25.2%)	25.4 (67.3%)	15.9 (11.0%)	15.7 (98.7%)	53.6 (18.2%)	41.1 (76.7%)
Sarnia (Hwys 402 & 401)	29.2 (19.5%)	16.4 (56.2%)	19.1 (13.2%)	16.2 (84.8%)	48.3 (16.4%)	32.6 (67.5%)
Toronto Perarson Int'l Airport (Hwys 427, 409 & 401)	9.9 (6.6%)	-	14.4 (9.9%)	1.0 (6.9%)	24.3 (8.3%)	1.0 (4.1%)
Other Ontario Ports	18.4 (12.3%)	9.4 (51.0%)	49.9 (34.4%)	27.5 (55.1%)	68.3 (23.2%)	36.9 (54.0%)
Total Ontario Ports	149.6	88.5 (59.2%)	144.9	102.9 (71.0%)	294.5	191.4 (65.0%)

15. ... and since road transport is the most important mode used at these points of exit/entry, the significance of Highways 401, 402 and the Queen Elizabeth Way is underlined.

16. Merchandise imports entering Ontario originate largely in the USA

Chart 14

Merchandise Imports Entering Ontario

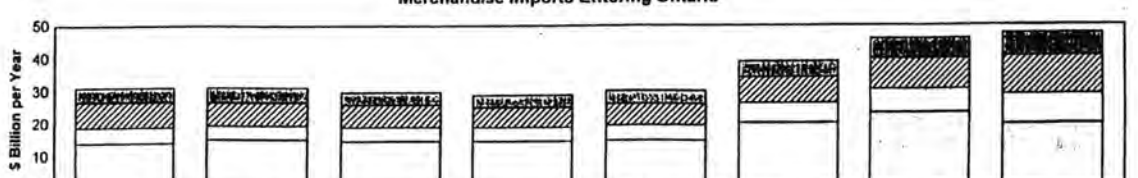


	1988	1989	1990	1991	1992	1993	1994	1995
USA	62.9	62.4	60.4	59.6	68.0	81.2	98.7	108.1
Others	19.9	19.7	18.8	19.6	21.7	25.5	32.3	35.9

17. While 44% of imports from the USA are laded in the four states

Chart 15

Merchandise Imports Entering Ontario

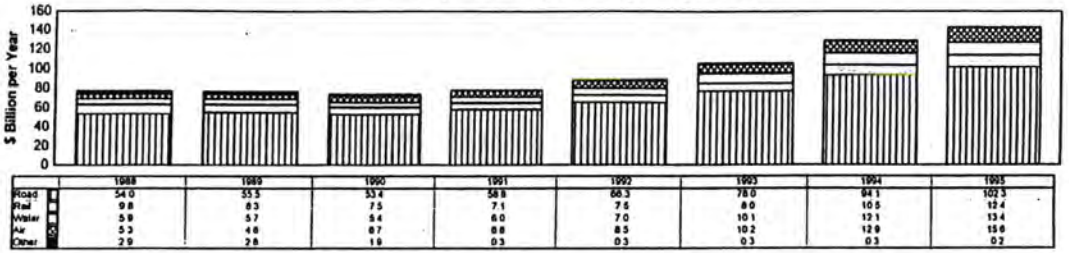


	1988	1989	1990	1991	1992	1993	1994	1995
Michigan	14.3	15.4	14.8	14.7	14.6	20.3	23.3	19.7
New York	4.8	4.3	4.3	4.3	4.8	6.2	7.4	9.3
Ohio	7.9	7.2	6.9	6.2	6.6	8.0	9.3	11.7
Illinois	4.4	4.5	3.9	3.8	4.0	4.7	6.1	6.9

18. Road transport is the most important mode moving imports

Chart 16

Merchandise Imports Entering Ontario by Transport Mode

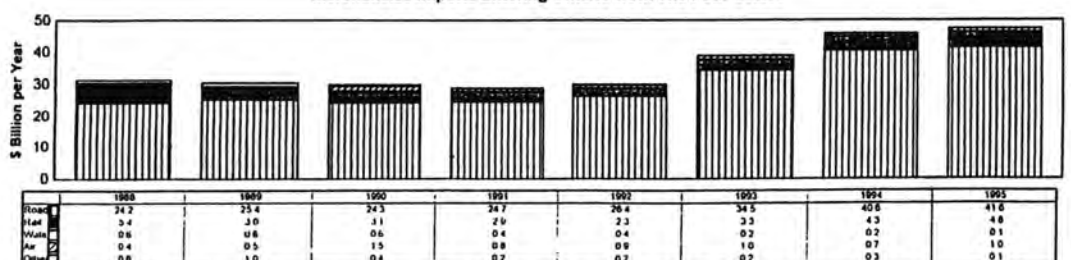


	1988	1989	1990	1991	1992	1993	1994	1995
Road	54 0	55 5	53 4	58 8	66 3	78 0	94 1	102 3
Rail	9 8	8 3	7 5	7 1	7 6	8 0	10 5	12 4
Water	5 9	5 7	5 4	6 0	7 0	10 1	12 1	13 4
Air	5 3	4 8	8 7	8 8	8 5	10 2	12 9	15 6
Other	2 9	2 8	1 9	0 3	0 3	0 3	0 3	0 2

19. and certainly almost exclusively from the four states

Chart 17

Merchandise Imports Entering Ontario from The Four States



	1988	1989	1990	1991	1992	1993	1994	1995
Road	24 2	25 4	24 3	24 7	26 4	34 5	40 6	41 6
Rail	3 4	3 0	3 1	2 9	2 3	3 3	4 3	4 8
Wate	0 6	0 6	0 6	0 4	0 4	0 2	0 2	0 1
Air	0 4	0 5	1 5	0 8	0 9	1 0	0 7	1 0
Othe	0 8	1 0	0 4	0 2	0 2	0 2	0 3	0 1

20. Not surprisingly, Ontario's merchandise exports to the USA are dominated by manufactured good and the road mode is significant in every important category.

Table 2

1995 Exports
($ Billion)

	Agriculture & Fishing	Energy Products	Forest Products	Industrial Goods	Machinery & Equipment	Automotive Products	Consumer Goods	Special Transactions	Total
Road	2.9	0.3	3.8	13.6	18.9	29.5	2.8	0.2	72.0
Rail	0.3	0.1	2.7	2.7	1.3	25.2	-	-	32.3
Water	-	0.1	-	0.2	0.3	-	-	-	0.6
Air	-	-	-	1.0	3.3	-	0.1	0.1	4.5
Other	-	0.3	-	-	-	-	-	1.2	1.5
Total	3.2	0.8	6.5	17.5	23.8	54.7	2.9	1.5	110.9

21. To summarize:

- International exports now make up almost 40% of Ontario's Output (GDP)

- The U.S.A. remains Ontario's most important international customer, with Michigan, New York, Ohio and Illinois being the most significant destinations

- Interprovincial "exports" have declined in value as well as a proportion of Ontario's Output

- Road transport continues to be the most important mode for moving exports from Ontario

- Ontario's ports of entry/exit are important to other provinces particularly Quebec, 37% of whose exports are cleared in Ontario

- Windsor's Ambassador Bridge, Fort Erie and Sarnia account for over 81% of exports cleared in Ontario and 43% of all Canada's merchandise trade (imports plus exports)

- Since the road mode is important in the movement of exports at these points, the importance of Highways 401, 402 and the Queen Elizabeth Way is underlined

Truck Traffic Between Canada and the United States

Fred P. Nix[1], John R. Billing[1], Michèle Delaquis[1]

Recent work related to NAFTA negotiations for Transport Canada described the weight and dimension regulations of the provinces and territories and the neighbouring states in detail.[2] New information on truck flows and new surveys have become available which allow this paper to relate cross-border truck traffic to the governing sets of regulations.

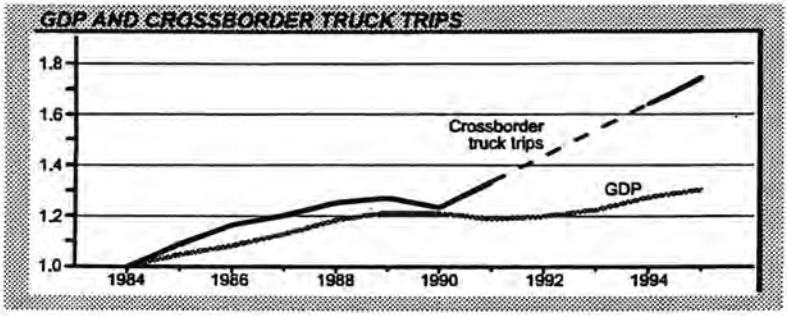
There has always been a large flow of trucks between Canada and the United States. Prior to de-regulation of trucking in the 1980's, much freight was interlined at points close to the border. Today, carriers operate their trucks freely throughout the territory of the neighbouring country. The 1989 Free Trade Agreement and NAFTA in 1992 have had a significant impact on the growth and patterns of Canada-US trade. Truck traffic has increased dramatically against a backdrop of an enormous array of arrangements and institutions that facilitate this flow. Compatible truck weight and dimension regulations, however, are not one of these facilitating factors.

NAFTA established a process to work on common weight and dimension limits, but there has been little progress to date—mainly because of the complexity and diversity of the regulations. This paper outlines existing regulations and describes how cross-border trucking has accommodated itself to the diversity of weight and dimension regulations.

Importance of cross-border truck flows

Regulations controlling trucks operating across the border also control a major part of Canada's economy. In 1995, three-quarters of Canada's total trade, valued at $360.8 billion, was with the United States. Trucks carried two-thirds of this. Since 1991, trade between the two countries, and the amount carried by trucks, have both increased rapidly. Further, the share carried by trucks has grown, from about 60-62% in the mid 1980's to about 66% today, so that the value of trade carried by truck between Canada and the United States is now almost half Canada's total imports and exports.[3]

This is reflected in trucking industry revenues. In the early 1980's for-hire carriers in Canada earned 9-10% of their revenues from cross-border traffic. This has grown steadily, to 20.6% in 1994. This is $2.7 billion in trucking revenues on cross-border traffic for Canadian domiciled carriers alone.[4]



The figure above illustrates the importance of this issue. The lower curve shows the growth in the Canadian economy, averaging 2.4% per year, with real GDP indexed to one in 1984.[5] The upper curve shows the number of trucks crossing the Canada-United States border, also indexed to one in 1984.[6] Cross-border truck traffic has been increasing at an annual rate of 5.2% since 1984, more than twice the rate of increase in the economy.

Weight and dimension regulations

Many commentators assume cross-border trucking is governed by US federal weight and dimension regulations, represented by the 5-axle tractor-semitrailer grossing 80,000 lb. This assumption captures a majority of cross-border traffic, but misses trucks making use of local provincial and state regulations, mostly to carry bulk and heavy commodities.

"National" regulations in Canada resulted from an Interprovincial Agreement (MoU) signed in 1988 and since modified. This MoU sets minimum-maximum limits for configurations that all provinces agree can operate on designated highways. "Minimum-maximum" means provinces are free to set higher limits for trucks within their boundaries or even have no such limit. While the MoU was not uniformly implemented, in the (almost) decade since it was signed, regulatory change has tended to shift more limits to those in the MoU. In the balance of this paper, provincial regulations are described in terms of how close they are to the MoU.

The federal government in the United States imposes a few minimum-maximum limits on the states to control weights on Interstate (IS) highways, and dimensions on a National Network (NN) which includes the IS. However, states control limits on other roads. Of great importance, "grandfather rights" allow some states to exceed federal limits on the IS or NN.

Canadian MoU and US federal regulations are quite different. Canadian regulations contain great detail on internal dimensions, such as where axles may be located. They allow relatively high axle and gross vehicle weights (GVW) for specific configurations. They also do not allow lift axles, though provinces may through the permissive nature of the MoU. The common 5-axle tractor-semitrailer is allowed 39,500 kg (87,078 lb), and the heaviest tractor-semitrailer is allowed 46,500 kg (102,509 lb). The provinces are considering increasing these weights. Of more importance, the MoU allows an 8-axle B-train (two trailers) with an overall length of 25 metres and 20 metres of trailer length to operate coast-to-coast at 62,500 kg (137,781 lb).

US federal regulations require states to allow at least 20,000 lb and 34,000 lb on single and tandem axles respectively. A bridge formula controls the distribution of weight to a maximum GVW of 80,000 lb. They also require states to allow on the NN tractor-semitrailers 102 inches wide with a semitrailer of at least 48 ft in length, and a double trailer combination with trailers each at least 28 ft and no overall length limit.

Because US federal weight limits are lower than Canadian limits and because the US bridge formula requires weight to be distributed over a greater length than in Canada, US federal regulations tend to dominate cross-border trucking. Any truck operating widely in the United States has to conform. This "lowest common denominator" truck is the common 5-axle tractor-semitrailer at a maximum weight of 36,288 kg (80,000 lb).

Roads and trucks

Table 1 shows the border crossings between Canada and the US, and the truck volumes using them, by province. Two points stand out. First, Ontario accounts for 62% of all trucks crossing the Canada-US border, though that includes a large number of Québec-based trucks heading to the US midwest, and some east-west Canadian domestic and triangular route traffic moving south of the Great Lakes. Second, over the past decade, truck traffic has grown faster in Western Canada than Eastern Canada.

Table 1: Canada-US Border Crossings and Truck Traffic, 1995[6]

	Border Crossings		Truck Traffic ('000)	Distribution (%)	Annual Growth Rate 1984-95 (%)
	Road	Ferry			
Nova Scotia	0	1	2.7	<0.1	-8.0
New Brunswick	17	0	455.7	4.4	3.4
Québec	32	0	1,365.8	13.2	3.2
Ontario	14	1	6,430.1	62.4	5.3
Manitoba	17	0	399.0	3.9	6.9
Saskatchewan	13	0	177.4	1.7	5.3
Alberta	6	0	173.6	1.7	6.1
British Columbia	16	3	1,285.4	12.5	7.1
Yukon	4	0	22.4	0.2	10.8
Total	119	5	10,312.0	100.0	5.2

Regional perspectives

New Brunswick There are 17 roads between New Brunswick and Maine. Six on the Canadian side are primary highways that allow the heaviest (62,500 kg) and longest (25 m) MoU trucks. Only I-95 on the American side is an Interstate route.

New Brunswick adopted new regulations in 1994 that are much closer to the MoU than what they replaced. While lift axles are still allowed, the tri-axle weight (tandem-plus-lift) was reduced closer to the MoU tridem weight. New Brunswick allows heavier tandem and tridem axles than the MoU and, as a consequence, the GVW for some trucks is also higher.

Only the crossing at Woodstock to I-95 in Maine is governed by US federal regulations. All other routes are governed by Maine regulations that are quite restrictive of length, as doubles are not allowed and the overall length of a tractor-semitrailer is 65 ft (19.8 m). Maine allows higher axle loads—up to 44,000 lb on a tandem—and a higher GVW than federal limits. Six-axle tractor semitrailers are allowed 90,000 lb (40,826 kg) generally and 100,000 lb (45,362 kg) if hauling products from the farm, forest or for construction work, other than on I-95.

Table 2 summarizes cross-border traffic characteristics at the busiest crossings, in percentages for each crossing. 28% of all traffic crosses at Woodstock to I-95, the only one where double-trailers are observed because of the short length limit on Maine's state roads. 91% of the traffic at all eight

crossings is tractor-semitrailers. While five axles are all that is required for trucks to reach the 80,000 lb limit, fully 56% of the trucks have more than five axles, and this is the largest class at all but one crossing. On routes other than I-95, this is evidence that trucks are operating up to 45,000 kg, the maximum common limit between New Brunswick and Maine for 6-axle configurations hauling farm/forest/construction materials. Many trucks observed during the survey at the northern border crossings were associated with the forestry industry.

Table 2: New Brunswick-Maine Truck Traffic[7]

Border Crossing	Configuration			Number of Axles		
	Truck	Tractor-Semi	Other [1]	<5	5	>5
Milltown	3.1	96.9	0.0	3.1	9.3	87.6
St Stephen	8.4	91.0	0.6	9.6	62.7	27.7
Woodstock	3.2	90.3	6.5	12.1	41.1	46.8
Perth-Andover	0.0	100.0	0.0	0.0	30.0	70.0
Centreville	14.3	85.7	0.0	14.3	42.9	42.9
St Leonard	1.1	98.9	0.0	1.1	9.0	89.9
Edmundston	17.3	71.2	11.5	26.9	25.0	48.1
Clair	33.3	55.6	11.1	33.3	16.7	50.0
Total	6.5	90.6	2.9	9.6	34.3	56.1

[1] "Other" consists of 11 bobtail tractors, 4 truck-trailers, and 2 B-trains.

Québec There are 32 roads in Québec to four states, although eight soon will be closed to trucks over 3,000 kg. At least two of these, routes 55 and 15, are potentially primary as a 62,500 kg 25 m B-train can probably be driven to the border. Québec has announced a major expansion of this primary network although, to date, details are unknown. On the US side, three routes are Interstate and all others are under state regulations.

Québec regulations used to be quite different than the MoU, allowing considerably higher axle and gross weights, lift axles, trailers with more than three axles, and considerably more weight per length of truck. Québec has gradually amended its regulations to bring them more in line with the MoU. It has announced plans to reduce 3-axle groups to 26,000 kg, from as much as 30,000 kg, and to standardize tandems at 18,000 kg, bringing these axle loads in line with New Brunswick. However, Québec will continue to allow a 7-axle tractor-semitrailer at 55,500 kg, well above the 46,500 kg for the

heaviest tractor-semitrailer in the MoU. Québec allows long trucks (> 25m) under permit, but not on any routes to the border.

Regulations on state roads in New Hampshire and Vermont are similar to those in Maine, with heavy axles, GVW up to 100,000 lb or, in some cases, higher by permit or for particular commodities, 48 ft semitrailers, and a 65 ft overall length that precludes the use of doubles. The two IS routes in Vermont are under US federal limits, with one minor exception for trucks hauling milk. Regulations on state roads in New York are similar to those in New England. However, there is an extensive permit program allowing trucks to operate state wide, including IS routes, at 102,000 or 107,000 lb (or even heavier in the south). Because equipment eligible for these permits has to be registered in New York, not many of these trucks cross the border.[8]

Table 3: Québec-United States Truck Traffic[9]

Border Crossing, Highway	Maine		Vermont		NY
	Armstrong 173	Woburn 161	Rock Island 55	Phillipsburg 133	Lacolle 15
Truck	0.3	1.1	1.3	6.9	5.2
Tractor-semi	99.1	96.9	97.2	90.0	92.1
B-train	0.0	0.0	0.4	0.8	0.1
Other double	0.0	0.0	0.0	0.5	1.7
Other	0.6	2.1	1.1	1.8	0.9
	Tractor-semitrailer traffic only: axles on trailer				
1	0.0	0.0	1.3	0.9	0.7
2	27.5	11.7	90.6	86.6	93.1
3	59.8	56.4	6.7	12.5	5.4
4	12.7	31.9	1.3	0.0	0.8

Percentage breakdowns of trucks crossing the Québec-US border are shown in Table 3. The three crossings to Vermont and New York are to Interstates and account for 70% of the truck traffic. At least 85% of these trucks are the common 5-axle tractor-semitrailer. Trucks crossing on these three routes with more than two axles on the semitrailer are operating with excess axle capacity, possibly Canadian 6-axle tractor-semitrailers engaged in triangle runs, with the sixth used only on the Canadian leg of the triangle, or US trucks for use on state roads at over 80,000 lb, but used on the Interstates and limited to 80,000 lb. Trucks between Québec and Maine are similar to those on the state roads between New Brunswick and Maine.

Ontario There are 14 roads between Ontario and New York, Michigan and Minnesota. All are primary at a GVW of 63,500 kg , as Ontario designated all highways under the MoU. Six connect to Interstates in the US, three each in New York and Michigan, accounting for 91% of Ontario's cross-border truck traffic. One connects to a US NN route.

Ontario has the most complex regulations in Canada. Axle weights are given in tables that depend on axle spread and axle type, and are generally the highest in North America. There is no restriction on the number or arrangement of axles in vehicles, and no prohibition of lift axles. GVW is determined from a series of tables, depending on some dimensional parameters and front axle weight. However, semitrailers over 14.65 m or doubles over 23 m must comply with regulations similar to the MoU.

New York regulations, and its permit program, have been described. There are two additional points. First, on the Peace Bridge into Buffalo, New York has a permit program that allows trucks up to Ontario's 63,500 kg maximum GVW. Second, long trucks (two 48 ft trailers) are allowed under permit on the New York State Thruway which connects with Ontario at the Niagara Frontier. New York is one of six states bordering Canada that allows long trucks. Michigan regulations are quite different than any other in North America. They only control axle weight, allowing 13,000 lb per axle, or 18,000 lb with 9 ft spacing, and one tandem at 32,000 lb. GVW is the sum of axle weights of up to 11 axles. This can exceed 150,000 lb. Michigan regulations and US federal regulations both apply on IS/NN routes. Minnesota regulations govern three roads in northwestern Ontario, and are considered in the next section on Manitoba.

Ontario's cross-border truck traffic has been obtained from periodic Commercial Vehicle Surveys (CVS) that provide a glimpse of truck characteristics over time. These surveys have been conducted at scales a few kilometres from the border, so may include some domestic traffic.

Ontario-New York truck traffic is summarized in Table 4, with the percentage breakdown by configuration in the upper part and by total number of axles below. The 1990 surveys combine all doubles together. The Ivy Lea bridge is weight-limited, and used by many trucks from Québec, so traffic is similar to the Québec crossings to Vermont and New York. It is clear that heavy trucks with more than five axles are using both Peace and Queenston Bridges, and that the relative importance of these trucks is growing. This is linked to New York's permit program allowing up to

140,000 lb into Buffalo,[10] and the more general permit program (102,000 or 107,000 lb), which began in the mid 1980's.

Table 4: Ontario-New York Truck Traffic[11]

Survey	Ivy Lea	Peace Bridge				Queenston Bridge		
	1997	1988 CVS	1990	1995 CVS	1996	1988 CVS	1990	1996
Truck	0.8	13.8	6.3	7.6	6.1	7.4	4.0	7.1
Tractor-semi	99.2	85.2	87.5	88.6	91.2	92.1	86.9	89.9
B-train	0.0	0.5		0.9	1.3	0.0		0.0
Other double	0.0	0.5	1.7	1.7	0.4	0.0	2.7	1.2
Other	0.0	0.0	4.5	1.2	1.0	0.5	6.4	1.7
< 5 axles	0.0	18.3	12.2	8.9	6.6	12.2	11.1	8.2
5 axles	92.4	74.4	77.5	80.5	80.0	86.7	83.6	82.9
> 5 axles	7.6	7.3	10.3	10.6	13.3	1.1	5.4	8.9

The Ambassador Bridge sees over two million trucks a year. It is not only the busiest international truck crossing in North America, it also sees an incredible diversity of trucks because it lies at the junction of very different regulatory regimes: Québec and Ontario to the east; Michigan to the west; some local permit situations into the midwest, and US federal for all long-distance traffic. The percentage breakdowns in Table 5 mask the real diversity of this traffic. 17-18% of the trucks have six or more axles, and trucks with up to 11 axles are seen. There are a large number of heavy trucks that, with various arrangements of axles can haul payloads close to 45,000 kg between Ontario and Michigan.

The proportion of doubles has not changed much from 1988 to 1996, but there is a trend towards greater use of B-trains over A-trains. This is related to US federal definition of the length of a B-train lead trailer, and the more recent adoption of 53 ft (16.2 m) semitrailers in Ontario reducing the usefulness of the A-train double for low-density freight, though A-trains are still preferred for some commodities into and beyond Michigan.

Table 5: Ambassador Bridge Truck Traffic[11]

Survey	1988 CVS	1992 CVS	1993 CVS	1995 CVS	1996
Truck	10.6	7.1	6.3	9.0	3.9
Tractor-semi	82.4	89.9	88.4	84.6	90.0
B-train	0.7	1.4	1.9	3.6	2.7
Other double	4.6	1.1	2.3	1.4	0.6
Other	1.6	0.7	1.1	1.5	2.9
< 5 axles	12.9	9.7	9.4	11.3	6.8
5 axles	74.2	76.2	77.9	70.8	76.7
> 5 axles	12.9	14.0	13.2	17.9	16.5

Table 6 shows the truck traffic at the Bluewater Bridge at Sarnia. Despite the earlier observation that truck traffic has been growing faster in Western Canada than in Eastern Canada, this is the fastest growing of any of the major crossings, and the bridge is now being twinned. From 1984 to 1995 it experienced an average growth of 11.2% per year in truck traffic, and now has over one million trucks a year crossing. Further, as seen in Table 6, the proportion of trucks with six or more axles is very high (22%) and appears to be growing, even more so than at the Ambassador or the New York bridges. Although the evidence is cloudy, there also appears to be a trend to B-trains among the doubles.

Table 6: Bluewater Bridge Truck Traffic[11]

Survey	1988 CVS	1992 CVS	1993 CVS	1995 CVS	1996
Truck	8.9	4.7	4.9	6.8	2.2
Tractor-semi	84.7	94.3	90.6	89.7	92.7
B-train	1.2	0.0	1.5	0.4	2.4
Other double	2.2	0.0	2.0	2.2	1.6
Other	3.0	1.0	1.0	0.8	1.2
< 5 axles	12.8	6.4	7.1	8.0	4.1
5 axles	70.4	72.5	75.1	79.3	73.9
> 5 axles	16.8	21.1	17.8	12.6	22.0

Manitoba Manitoba has a complex road class system, with GVW limits of 47,600 kg, 56,500 kg and 62,500 kg. There are 17 roads between Manitoba and the United States. On the Canadian side, only three are primary highways, and only trucks qualifying as MoU are allowed to operate to the border at 62,500 kg and 25 m. Manitoba also allows trucks much longer than 25 m to operate by permit on selected routes, and one of these connects to the US border. On the American side, only I-29 in North Dakota is an Interstate, and four, including I-29, are NN highways.

Manitoba's regulations generally reflect MoU limits.

Minnesota regulations are similar to federal regulations. It it is the only border state where weight regulations the same as US federal regulations control all roads reaching the border. There may, however, be some shorter length limits, and there is a winter weight allowance for an 88,000 lb GVW.

North Dakota's regulations are also similar to US federal limits, except that a GVW up to 105,500 lb (47,857 kg) is allowed on state roads, and by permit on the Interstate. North Dakota has an extensive long truck network, and three routes connect to the Manitoba border, though long trucks only cross where Manitoba 75/29 meets I-29.

Table 7 shows the percentage distribution of truck traffic from the principal border crossing, to I-29, which accounts for two-thirds of the trucks between Manitoba and the US. This suggests that the standard US 5-axle tractor-semitrailer at 80,000 lb dominates on this IS route, though there is a small but significant traffic with more than five axles.

Table 7: Manitoba-North Dakota Truck Traffic, 1996[12]

Emerson-Pembina	
Trucks	2.7
Truck-trailers	0.1
Tractor-semitrailers	93.3
A-trains	2.1
B-trains	1.9
<5 axles	3.4
5 axles	90.4
>5 axles	6.2

Saskatchewan There are 13 roads between Saskatchewan and the United States. From a Canadian perspective, four of these are primary roads, and from a US perspective, five are NN, with no Interstates.

Regulations in Saskatchewan are almost identical to those in the MoU. However, Saskatchewan has an extensive permit program that allows both very heavy (up to almost 100,000 kg) and very long (up to 40 m) trucks, well beyond MoU limits. In several cases, these permit truck operations extend to the border. Trucks hauling potash cross at Northgate for a short distance on a private road at just under 90,000 kg. It is possible to operate long trucks to the border on route 39, connecting to US 52, which is

authorized for similar trucks. It is not known if long trucks actually operate over the border.

Regulations in North Dakota are as described previously and regulations in Montana are described below. No surveys on trucks operating across the Saskatchewan-United States border have been located.

Alberta There are six roads between Alberta and the United States, and all but one is a Canadian primary road allowing B-trains at 62,500 kg and 25 m. On the US side, one is an Interstate, I-15 at Coutts-Sweetgrass, and one other is on the NN.

Alberta regulations are generally the same as those under the MoU. As in Saskatchewan, there are important permit programs, for forestry, other special commodities, and long trucks. Montana regulations are what is known as "uncapped formula B". Up to nine axles are allowed, and the GVW is determined by sum of axle loads or federal bridge formula B, which allows just over 130,000 lb (58,970 kg).

Table 8: Alberta-Montana Truck Traffic[13]

Coutts-Sweetgrass	
Tractor-semitrailers	79.4
A-trains	8.7
B-trains	11.6
C-trains	0.3
Total trucks with Montana permits	31.4
Overdimensional	9.8
Overweight	16.6
Canadian MoU truck	5.0

Table 8 summarizes the percent distribution of truck traffic at Coutts-Sweetgrass, which accounts for 92% of the total Alberta-Montana traffic. 21% of the trucks are doubles, a very high proportion, and B-trains make up over half of these. Almost one-third of the trucks operate in Montana with permits, which are required for operation over 80,000 lb on Interstates. Montana also allows Canadian B-trains at full Canadian axle and gross weights to operate on I-15 as far south as Shelby, a major rail head. It has just completed a study suggesting that the Canadian B-train may be acceptable state-wide.

British Columbia There are 18 roads between British Columbia and the United States: one in Montana, two in Idaho, 12 in Washington and three with Alaska, two of which are access routes to Yukon. All routes are believed to be primary, allowing 63,500 kg and 25 m. From the US side, only I-5 at Blaine is an Interstate, and eight others are NN highways.

Regulations controlling truck weights and dimensions in British Columbia are similar to the MoU, with minor variations. A wide range of log truck configurations, and possibly other trucks, operate under different rules but it is unlikely that any of these trucks operate across the border.

Montana, Idaho and Washington all allow 4.3 m (14 ft) overall height, higher than in Canada, and a high GVW on all roads, from 105,500 lb in Washington to 130,000 lb in Montana. There are minor variations in length limits among and between these states and BC. For example, semitrailers up to 56 ft long may be possible in some places whereas on other roads it appears that 48 ft is still the maximum. Washington allows doubles a longer box length than BC. Regulations in Alaska are considered below.

Table 9: British Columbia-United States Truck Traffic, 1995[14]

Border Crossing	Sumas route 11	Aldergrove route 13	Douglas-Blaine route 15
Truck	7.0	10.6	9.9
Truck-trailer	3.5	21.2	2.2
Tractor-semi	62.0	52.2	76.5
B-train	9.5	2.7	2.9
A/C-train	18.0	13.3	11.4
2 axles	5.0	8.9	7.7
3 axles	2.0	1.8	2.8
4 axles	1.0	7.1	1.5
5 axles	44.5	18.6	59.2
6 axles	18.5	28.3	16.5
7 axles	6.0	22.1	4.2
8 axles	23.0	13.3	8.1

Information on trucks accounting for 77% of all cross-border truck traffic in lower BC is shown in Table 9. Doubles on these three routes account for 22% of the trucks, the highest incidence of doubles of any border crossing. Also, and unlike other crossings, a large proportion of these A-trains are spec'd for heavy hauls, as 86% have 7 or more axles, and only 14% are typical 5- or 6-axle A-trains used by less-than-truckload carriers.

Three-quarters of the trucks at these three BC crossings have an origin or destination in the Fraser Valley and Washington state—that is, relatively local trips. A surprising 29.6% of the trucks are empty (another characteristic of short-haul trucking); 21.1% are carrying forest products (wood, lumber, paper, etc); 7.9% are carrying food products; 4.4% are carrying containers; and 4.1% are carrying general freight.

The Aldergrove crossing is primarily a local route, as only trucks with pre-arranged paperwork may use it. 38% of the observations are accounted for by two carriers. One made 26 trips, all with 6-axle tractor-semitrailers generally carrying woodchips south and returning empty. The second carrier made 17 trips hauling rock northbound, returning empty, with a 3-axle straight truck and a 4-axle full trailer. Considering all three crossings, 25% of tractor-semitrailers used 3-axle semitrailers.

Yukon There are four roads between Yukon and Alaska, two of which also cross into British Columbia. These are all primary, allowing B-trains at 62,500 kg and 25 m, and, in fact, weights higher than this are generally possible. From the US perspective, these are all state roads. US federal regulations do not control trucks in Alaska. Regulations in Yukon have historically been similar to those in Ontario, although new ones are to be implemented incorporating MoU limits. Regulations in Alaska allow 38,000 lb tandems and very heavy GVW, up to 150,000 lb with a permit

No surveys have been located for truck traffic between Yukon and Alaska. It is known, however, that very heavy trucks operate in some cases under permit, at over 77,000 kg to Skagway, and that trucks longer than 25 m can also operate between these jurisdictions by permit.

CONCLUDING OBSERVATIONS

There are 119 roads between Canada and the United States, at least roads on which Canada Customs has a post. Of these, 54 are Canadian primary roads where the maximum GVW of 62,500 kg or higher in three cases and an overall length of 25 m are allowed. 13 are US Interstate, and 18 others are also on the US National Network. 10.3 million trucks crossed the Canada-US border in 1995, almost double the 5.8 million trucks crossing the US-Mexico border. The 54 Canadian primary roads carried 92% of these trucks, Interstates carried 79%, and the National Network, 84%. There are also seven roads on the Canadian side where it is possible to operate trucks

longer than 25 m to the border, and ten on the US side. Three of these routes link up and long trucks actually operate across the border at these points.

Truck traffic has been increasing at a rate of 5.2% per year over the past decade, over twice the rate of the Canadian economy. This has clearly been affected by two trade agreements signed in the last decade, and it more than likely has something to do with the decline in the Canadian dollar.

It is significant that no more than 6.8% of the trucks cross the border on US roads where the US federal GVW limit of 80,000 lb absolutely governs. These are on Interstate routes in Maine and Vermont, and Minnesota roads, though the latter are allowed 88,000 lb in the winter. Despite the apparent unimportance of the 80,000 lb gross weight cap, the standard US 5-axle tractor-semitrailer is still the most common truck by a wide margin, accounting for two-thirds of all trucks crossing the border.

Most other trucks have significantly higher GVW capability. A rough extrapolation of the surveys suggests that 20% of the trucks crossing the border have six or more axles. Many of these are 6-axle tractor-semitrailers. Doubles are a tiny fraction of the traffic in Eastern Québec and New Brunswick, and only to 2-4% from Western Québec to Manitoba, but are up to 20% of the traffic in Alberta and British Columbia. The MoU B-train can operate into the United States at restricted length, and generally at much reduced axle and gross weights. However, at three places, the Peace Bridge in Ontario, Coutts-Sweetgrass (Alberta-Montana), and one road into Idaho, it now operates at full Canadian weights and dimensions into the United States. It also operates at higher weights, under permit, between Yukon, BC and Alaska.

The conventional view that cross-border trucking is conducted under US federal regulations by 5-axle tractor-semitrailer at 80,000 lb clearly captures the most important aspect of this flow of trucks. But there are a significant number of trucks (≈20%) operating under more local regulations, with more axles, at higher weights. There is evidence that heavier truck traffic is increasing and, because of trends in state regulations, there is evidence that the diversity of configurations is also increasing.

ENDNOTES

1 Fred Nix is a transportation consultant. John Billing works for the Ontario Ministry of Transportation. Michèle Delaquis teaches at l'Institut Maritime du Québec in Rimouski.

2 Nix, F.P. & M Delaquis, 1996, *Weight and Dimension Regulations: Harmonization of Standards Under NAFTA: Industry Perspective*, Transport Canada, Ottawa.

3 StatsCan #65-202 (Table 3) and StatsCan #65-202 (Table 5).

4 StatsCan #53-222 for both the large and small for-hire carriers.

5 StatsCan #13-201.

6 StatsCan data derived from Canada Custom's count of commercial vehicles entering Canada. The total trucks is assumed by doubling StatsCan figures.

7 Survey by NB Department of Transportation in October/November, 1996.

8 More recently New York has authorized another class of permit specifically for non-New York equipment (at 91,000 lb).

9 1996 survey by the Ministère des transport du Québec.

10 There may be a 130,000 lb bridge limit.

11 CVS data from Ontario Ministry of Transportation; 1995 data are preliminary. 1990 data from Ripley, G. & D. Smith, 1992, *Niagara International Bridge Travel Survey Analysis of the Truck Component 1990*, Ontario Ministry of Transportation, Toronto. 1996/97 data collected by the authors.

12 Montufar, J. & A. Clayton, 1996, *Manitoba-related Trucking on the I-29/I-35 Corridor*, Manitoba Department of Highways and Transportation. Winnipeg.

13 Alberta Transportation and Utilities. 1994. *Coutts Commercial Vehicle Survey: Summary Report*

14 BC Ministry of Transportation and Highways O/D survey, Feb/March 1995. Original raw data edited by the authors. Observations exclude bobtail tractors and unidentified configurations. C-trains are not distinguished from A-trains.

MESURE DE PRIX ET DE PRODUCTION DANS L'INDUSTRIE DU TRANSPORT AÉRIEN AU CANADA

Raynald Ouellet
Analyse économique, Politiques
Transports Canada

1.0 Introduction

Dans le domaine des transports, mesurer la production au cours d'une période de temps donnée est toujours difficile puisque les ressources nécessaires à la prestation d'un service varient beaucoup en fonction de la distance, du poids, du type de services et de la nature des produits transportés. Dans l'industrie du transport aérien, la plupart des analystes utilisent le nombre de passagers-kilomètres ou encore le nombre de tonnes-kilomètres comme mesure de production. Cette méthode est adéquate quand la distance, le type de services, et le ratio marchandises/passagers demeurent constants au cours de la période étudiée. Toutefois, au Canada l'industrie du transport aérien a connu des changements structurels importants depuis 1981. Entre autres, la proportion du trafic international a augmenté sensiblement, entraînant une augmentation de la distance moyenne des trajets. Nous croyons que les auteurs qui utilisent le nombre de passagers-kilomètres ou encore le nombre de tonnes-kilomètres surestiment la production.

Comme alternative, cette étude présente une mesure de production dans l'industrie du transport aérien dérivée des recettes d'exploitation. À partir de l'équation suivante: les recettes d'exploitation sont égales à la quantité produite (production) multipliée par les prix; la production est mesurée en divisant les recettes d'exploitation par les prix.

La première partie de cette étude expose les bases de données utilisées. La deuxième partie décrit la méthodologie, les variables qui influencent les tarifs dans l'industrie du transport aérien, et les mesures qui ont été prises pour estimer nos indices de prix afin d'évaluer adéquatement la production. La troisième partie présente les indices de prix et de production par type de

services pour l'industrie du transport aérien au Canada. Enfin, la dernière partie compare nos indices de prix et de production à d'autres indices de prix et de production pour l'industrie du transport aérien.

2.0 Les bases de données utilisées

Notre analyse utilise principalement les deux bases de données suivantes: "Services réguliers à horaire fixe, statistiques des recettes d'exploitation" et "Services d'affrètement, statistiques des recettes d'exploitation". Ces bases de données sont produites par le Centre des statistiques de l'aviation à Statistique Canada.

En ce qui a trait aux services réguliers, les transporteurs retenus pour cette étude sont Air Canada et Canadien International de même que leurs principaux affiliés; c'est-à-dire Air BC, Air Nova, Air Alliance et Air Ontario[1] pour Air Canada, ainsi que Canadian Partner, Inter-Canadian[2], Air Atlantic, et Time Air[3] pour Canadien International. Les données de Canadien International incluent les données des transporteurs suivants: CP Air, Pacific Western Airlines, Eastern Provincial Airlines, Nordair, et Wardair. Pour les services d'affrètement, en plus des familles d'Air Canada et de Canadien, nous avons inclus Air Transat, Nationair, Worldways, Royal et Canada 3000.

3.0 La méthodologie

Comme nous l'avons déjà mentionné, la production dans l'industrie du transport aérien peut être mesurée à partir de l'équation suivante:

1 - Recettes = Prix * Quantité (Production)
2 - Production = Recettes / Prix

Les recettes étant connues, la clé de l'exercice réside dans la construction d'indices de prix robustes pour chaque type de services des transporteurs. Pour chaque famille, nous avons estimé des indices de prix pour le secteur intérieur, transfrontalier, transatlantique, pacifique, australe, et autre secteur international. De plus, nous avons construit des indices de

[1] Les données d'Air Ontario incluent celles D'Austin Airways.
[2] Les données d'Inter-Canadian incluent celles des transporteurs suivants: Québécair, Intair, Québec Aviation Ltée et Nordair Métro.
[3] Les données de Time Air contiennent les données de Norcanair.

prix pour les services réguliers et les services d'affrètement, de même que pour les passagers et les marchandises.

Pour construire nos indices de prix, nous avons utilisé les recettes moyennes par passager-kilomètre pour les passagers, et les recettes moyennes par tonne-kilomètre pour les marchandises. Avant d'utiliser ces mesures, nous allons expliquer les facteurs qui peuvent influencer ces dernières dans l'industrie du transport aérien. Pour chaque facteur, nous allons également décrire les corrections qui ont été effectuées s'il y a lieu. Les facteurs que nous avons retenus sont les suivants: la taille des aéronefs, le coefficient de remplissage, le type de services, le secteur d'activité, la distance des trajets, et enfin une discussion du revenu par passager-kilomètre comme mesure d'indice de prix.

1) La taille des aéronefs

Il existe une relation inverse entre le coût par siège et la taille des aéronefs. Ainsi, quand la taille des aéronefs augmente, le coût par siège-kilomètre diminue. Cette relation s'explique parce que le rapport entre certains coûts - comme les coûts du personnel de bord - et le nombre de sièges diminue quand la taille des aéronefs augmente. Par exemple, supposons qu'une compagnie aérienne décide de diminuer la taille de ces aéronefs, en supposant que le nombre de passagers et les coefficients de remplissage demeurent constants, il y aura une augmentation des fréquences. Si les profits sont constants, les revenus devront donc augmenter du même montant que les coûts. Par conséquent, les recettes par passager-kilomètre vont augmenter.

Puisque les transporteurs canadiens offrent des services dans plusieurs petites municipalités, une augmentation des fréquences signifie dans la plupart des cas une amélioration des services. Pour cette raison, nos indices de prix ne doivent pas tenir compte des augmentations de revenu par passager-kilomètre suite à une augmentation de la fréquence. Ainsi, la production physique (nombre de personnes transporté d'un point A à un point B) peut être constante, mais la qualité des services (production) a augmenté, ce que représente une augmentation réelle de la production. Depuis 1981, les améliorations de services dues à une augmentation des fréquences se sont produites quand les transporteurs principaux ont transféré la plupart de leurs routes de courtes distances aux transporteurs régionaux/locaux. Pour ne pas inclure ces augmentations des prix dans

nos indices, nous avons développé des indices de prix pour chaque transporteur. Ainsi, le prix d'un service transféré est annexé à la structure de coût du transporteur qui offre le service.

2) Le coefficient de remplissage

À long terme, il y a une relation inverse entre le coefficient de remplissage et le coût par passager. Dans l'industrie du transport aérien une grande partie des coûts sont directement reliés à l'exploitation des aéronefs, par conséquent, les coûts moyens par passager vont diminuer avec une augmentation du coefficient de remplissage. En supposant que les profits sont relativement stables à long terme, les recettes par passager-kilomètre vont diminuer avec une augmentation du coefficient de remplissage, ce qui implique une réduction réelle des tarifs. Par conséquent, aucun ajustement ne doit être effectué pour ce facteur.

3) Le type de services

Le revenu par passager-kilomètre est aussi fonction du type de service offert par les transporteurs. Étant donné que les coefficients de remplissage sont généralement (voir toujours sauf exception) plus faibles pour les vols réguliers que les vols d'affrètement, le revenu par passager-kilomètre est plus élevé pour les vols réguliers.

En ce qui a trait au transport des marchandises, puisqu'il ne s'agit pas de l'activité principale des transporteurs et que le coût marginal du transport des marchandises est relativement faible, il est fort probable que les prix varient différemment que pour le transport des passagers.

Pour toutes ces raisons, nous avons développé des indices de prix pour chaque type de services offert par les transporteurs, c'est-à-dire pour les passagers services réguliers, les marchandises services réguliers, les passagers services d'affrètement, et les marchandises services d'affrètement.

4) Le secteur d'activité

Dans le domaine du transport aérien, la compétition peut être très différente d'un secteur d'activité à un autre. Pour cette raison, nous avons développé des indices de prix pour tous les secteurs dont nous avions de

l'information c'est-à-dire: les secteurs intérieur, transfrontalier, atlantique, pacifique, austral, et autre secteur international.

5) La distance des trajets

La distance des trajets a une très grande importance sur le revenu par passager-kilomètre. Ainsi quand la distance augmente les coûts par passager-kilomètre, et par conséquent les revenus par passager-kilomètre diminuent significativement. Ceci est principalement dû aux deux facteurs suivants: premièrement, sur les longues distances le capital et la main d'oeuvre sont utilisés d'une façon plus intensive, et deuxièmement, au décollage les aéronefs consomment beaucoup de carburants.

Par contre, quand la distance moyenne des trajets d'un transporteur augmente, ceci ne veut pas dire pour le consommateur que les tarifs entre le point A et le point B ont diminué. Il n'y a donc pas de baisse de prix mais simplement un changement dans la structure des routes d'un transporteur ou encore un changement de préférence des consommateurs. Par conséquent, nos indices de prix ne doivent pas tenir compte de cette baisse de revenu par passager-kilomètre.

Entre 1981 et 1995, la distance moyenne des transporteurs canadiens a fluctué beaucoup. Pour le secteur intérieur, la distance moyenne parcourue par les transporteurs régionaux/locaux a augmenté de 40%, tandis que la distance moyenne de Canadien International est passée de 943 km en 1981 à 1 539 km en 1995. En ce qui a trait à Air Canada, en 1981, sa distance moyenne était de 1 469 km, elle a chuté à 1 228 km en 1986, pour enfin remonter à 1 426 en 1995.

L'impact de la distance sur les tarifs a été calculé en deux étapes. La première étape établie la relation qui existe entre le revenu par passager-kilomètre et la distance pour un groupe de transporteurs désignés. Cette relation a été estimée à partir d'analyses de régression en effectuant des transformations Box-Cox sur les variables utilisées. Les données ont été tirées des "Services réguliers à horaire fixe, statistiques des recettes d'exploitation" de 1990. Au total, quatre analyses ont été retenues, les données regroupées d'Air Canada et de Canadien pour chacun des secteurs, et l'ensemble des données des transporteurs régionaux/locaux. Les résultats des analyses sont présentés au tableau 1.

Tableau 1
Relation entre le revenu par passager-kilomètre et la distance

	AC & CI Intérieur	AC & CI Transfrontalier	AC & CI Autre Intl.	Régionaux/ Locaux
Constante	6,33	0,60	0,35*	10,45
Distance	-2,62	-0,59	-0,57	-6,20
$\lambda^{\text{Revenu par passager-kilomètre}}$	0,09	0,35	0,34	0,42
$\lambda^{\text{Distance}}$	-0,28	-0,22	-0,24	-0,52
R^2	0,86	0,47	0,42	0,92
Nombre d'observation	78	22	79	38

* Non-significatif

Les coefficients λ représentent les transformations Box-Cox; une valeur de 1 indique une relation linéaire, tandis qu'une valeur de 0 indique une relation logarithmique. À l'exception de la constante pour le secteur autre international, toutes les variables sont significatives, notamment pour le secteur intérieur où les variations de distances sont plus grandes.

Enfin, la dernière étape consiste à corriger nos indices de prix des variations de distance en créant des scalaires à partir des équations définies au tableau 1. En d'autres mots, ces ajustements standardisent les indices de prix de chaque transporteur en fonction d'une distance moyenne unique pendant toute la période étudiée.

6) Le revenu par passager-kilomètre comme mesure d'indice de prix

Dans l'industrie du transport aérien, il existe un grand éventail de tarifs à savoir: première classe, classe affaires, classe économique, les tarifs réduits (le tarif noli-prix, le tarif de solde de place, le tarif excursion payable à l'avance, le tarif de groupe), et autre tarif. Le prix de chacun de ces types de tarifs est très différent l'un par rapport à l'autre et en principe chacun d'eux devrait correspondre à une qualité de service supérieure ou inférieure. En développant un indice de prix spécifique pour chaque groupe de tarifs, un changement de la demande dans un groupe des tarifs n'a pas d'impact sur l'indice de prix, par contre, le revenu moyen par passager-kilomètre va varier.

Les indices de prix spécifiques sont pertinents à la condition que la différence de prix entre deux types de services soit expliquée par une différence au niveau de la qualité des services[4]. Effectivement, la

[4] En d'autres termes, le rapport de prix de deux types de services doit être égal au rapport de l'utilité marginale de ces mêmes services.

première classe et la classe affaires - qui représentent environ 6% des passagers donc la part est relativement constante au cours de la période étudiée - ont un meilleur service que les autres classes, par exemple fauteuils plus larges, places attribuées à l'avance, consommations gratuites. Cependant, la différence de qualité de services entre toutes les autres classes est beaucoup plus difficile à percevoir. En effet, les fauteuils, la nourriture, et tous les autres services à bord sont identiques.

S'il existe un grand éventail de tarifs dans l'industrie du transport aérien, notamment en ce qui a trait aux tarifs réduits, ce n'est pas parce que la qualité des services est très différente, c'est simplement parce que l'industrie offre un bien (service) qui est complètement périssable. Ainsi, un siège vide au décollage ne pourra jamais être vendu plus tard. Comme le coût marginal d'un passager supplémentaire est faible, les entreprises ont tendance à réduire leurs tarifs afin d'augmenter leurs coefficients de remplissage. Le pourcentage des passagers de la classe économique a chuté de façon spectaculaire au cours de la dernière décennie au profit de la classe de tarifs réduits, sans toutefois réduire la qualité des services. Pour le secteur intérieur, entre 1983 et 1995, le pourcentage des passagers en classe économique[5] est passé de 49,2% à 26,0%, tandis que le pourcentage des passagers payants des tarifs réduits est passé de 45,9% à 70,7%. Comme nous l'avons mentionné, dans un indice de prix de spécification[6], les changements dans la répartition des passagers entre les différents types de tarifs n'affectent pas l'indice de prix, ce qui à notre avis aura tendance à surestimer l'augmentation des prix. Par contre, l'utilisation de tarifs à valeur unitaire comme le revenu moyen par passager-kilomètre a l'avantage de tenir compte des changements dans la répartition entre les différents types de tarifs[7].

4.0 Les résultats de l'étude

Cette partie présente les indices de prix et les indices de production pour les marchés intérieur, transfrontalier et autre international. Chacun des indices présente l'évolution de la famille d'Air Canada et la famille

[5] Comprend également les passagers classe affaires qui représentent environ 5% des passagers.
[6] Statistique Canada utilise trois types de tarifs pour construire ses indices de prix: première classe, classe économique (y compris la classe affaires) et les tarifs réduits.
[7] À notre avis, pour déterminer le changement réel des tarifs dans l'industrie du transport aérien il serait préférable de construire des indices de prix à partir de deux types de tarifs, la première classe (y compris la classe affaires) et tous les autres tarifs. Malheureusement, ces données sont disponibles seulement pour les transporteurs de niveau 1.

Canadien International pour la période 1981 à 1995. Toutefois, avant de présenter les indices, nous donnons un bref aperçu des recettes d'exploitation dans d'industrie du transport aérien au Canada.

4.1 Le profil des recettes d'exploitation

Le tableau 2 illustre les recettes d'exploitation par secteur d'activité pour les familles d'Air Canada et de Canadien International. Pour les services d'affrètement, nous avons également inclu les données de Worldways, Nationair, Canada 3000, Royal et Air Transat.

Tableau 2

Recettes d'exploitation des familles d'Air Canada et de Canadien International ($ 000 000)

	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
Services réguliers de passagers															
Intérieur	1 848	1 845	1 852	2 001	2 184	2 371	2 569	2 850	3 060	3 304	3 034	2 948	2 937	3 126	3 284
Transfrontalier	413	382	374	403	421	441	443	507	611	660	573	553	670	775	928
Autre international	653	656	672	872	869	1 053	1 175	1 419	1 522	1 582	1 473	1 586	1 598	1 627	1 844
Services d'affrètement des passagers															
Tous les secteurs	474	555	565	559	634	608	636	671	671	760	744	765	702	683	822
Services réguliers et services d'affrètement des marchandises															
Tous les secteurs	437	466	451	507	561	572	557	591	566	595	536	519	500	514	551
Grand total	3 826	3 902	3 914	4 241	4 670	5 043	5 380	6 037	6 431	6 900	6 361	6 371	6 408	6 725	7 429

Les services réguliers des passagers sont nettement le secteur d'activité le plus important pour les transporteurs aériens canadiens, comptant pour plus de 82% des recettes d'exploitation en 1995. Même si le marché intérieur est toujours le plus important, le pourcentage des recettes provenant de ce marché a diminué significativement au cours de la période passant de 63% en 1981 à 54% en 1995, tandis que la part du secteur autre international passait de 22% à 30%.

Le pourcentage des recettes provenant des services d'affrètement de passagers à été relativement stable au cours de la période avec environ 12% des recettes d'exploitation. Par ailleurs, la part des recettes d'exploitation provenant du transport des marchandises est passé de 11% en 1981 à 7% en 1995.

4.2 Le secteur intérieur - indices de prix et de production

Selon le tableau 3, l'indice de prix des passagers pour le secteur intérieur a augmenté de 70%, soit une croissance annuelle moyenne de 3,9%. Entre 1981 et 1995, l'indice de prix des marchandises a fluctué passablement; cependant en 1995, l'indice avait augmenté seulement de 5% par rapport à 1981.

Tableau 3

Indices de prix et de production - services réguliers pour le secteur intérieur (1986=100)

	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
Indices de prix															
Passagers	82.4	93.3	98.2	93.3	98.5	100.0	107.2	106.6	115.0	124.4	132.5	128.5	138.2	141.5	140.3
Marchandises	93.3	99.9	100.6	92.5	96.0	100.0	99.8	104.1	102.3	108.2	110.0	112.0	99.1	92.9	98.2
Total	83.6	94.0	98.4	93.2	98.2	100.0	106.5	106.3	113.8	122.9	130.3	126.9	134.4	137.0	136.3
Indices de production															
Passagers	94.7	83.4	79.6	90.5	93.5	100.0	101.0	112.8	112.3	112.0	96.6	96.8	89.7	93.2	98.8
Marchandises	84.6	86.2	84.5	97.3	100.4	100.0	98.6	95.9	98.5	97.8	88.8	84.1	87.2	79.2	78.8
Total	93.4	83.7	80.1	91.2	94.3	100.0	100.8	111.0	110.8	110.5	95.7	95.4	89.2	91.8	96.9

L'indice de production des passagers a fluctué beaucoup au cours de la période étudiée. Malgré ces fluctuations, le niveau de la production en 1995 était seulement 4% supérieur au niveau de 1981. Entre 1983 et 1988, la production a augmenté de 42%; cependant elle a diminué de 14% en 1991 et de 16% entre 1981 et 1983. Le niveau de production pour le transport des marchandises a chuté de 21% entre 1986 et 1995.

4.3 Le secteur transfrontalier - indices de prix et de production

Le tableau 4 présente les indices de prix et de production pour les services réguliers de passagers et de marchandises pour le secteur transfrontalier.

Tableau 4

Indices de prix et de production - services réguliers pour le secteur transfrontalier (1986=100)

	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
Indices de prix															
Passagers	83.4	88.9	90.3	91.6	100.0	100.0	102.5	99.0	106.0	107.0	111.9	109.2	111.3	120.5	122.0
Marchandises	107.5	122.5	111.8	111.7	123.6	100.0	123.6	113.9	107.6	114.2	95.3	89.9	90.7	111.0	121.3
Total	85.4	91.7	92.1	93.3	102.0	100.0	104.0	100.2	106.3	107.7	111.0	108.1	110.1	120.1	122.1
Indices de production															
Passagers	112.6	97.5	94.0	99.8	95.8	100.0	98.3	116.2	130.9	140.1	116.2	115.0	136.8	146.1	172.8
Marchandises	89.1	91.5	99.1	113.1	109.9	100.0	93.4	96.7	101.3	107.5	106.8	96.2	128.7	109.5	117.0
Total	110.0	96.7	94.4	100.9	97.0	100.0	97.8	114.5	128.3	137.1	115.1	113.3	135.8	143.0	168.2

L'indice de prix des passagers pour le secteur transfrontalier a augmenté moins rapidement que pour le secteur intérieur, soit une augmentation de 46% au cours de la période étudiée. Par contre, comme pour le secteur intérieur, l'indice de prix des marchandises a fluctué d'une année à l'autre, cependant à la fin de la période, l'augmentation des prix est relativement modeste comparée à le début de la période, soit une augmentation de 13%.

Le niveau de la production pour les services de passagers a augmenté de 54% entre 1981 et 1995. Cependant, il faut noter que la production a chuté de 17% en 1991, et augmenté de 49% entre 1991 et 1995. La chute de production en 1991 peut être expliquée par la récession économique, tandis que la forte

augmentation entre 1991 et 1995 s'explique par l'Accord de libre échange signé en 1991, de même que par l'Accord ciel ouvert signé au début de 1995. L'augmentation de la production au niveau du transport des marchandises a été plus modeste, à 31%. Il faut également mentionner que l'Accord de libre échange et l'Accord ciel ouvert n'ont pas stimulé le niveau de production comme on aurait pu l'anticiper; en fait depuis 1991, le niveau de production a augmenté seulement de 10%.

4.4 Le secteur autre international - indices de prix et de production

Au niveau de la cueillette des données, le secteur autre international est divisé en quatre grandes régions, à savoir: le secteur transatlantique, le secteur austral, le secteur asiatique, et autres destinations. Pour les fins d'analyse de cette étude, nous avons regroupé tous les secteurs.

Tableau 5

Indices de prix et de production - services réguliers pour le secteur autre international (1986=100)

	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
Indices de prix															
Passagers	86.8	89.9	92.7	92.0	91.2	100.0	102.5	102.2	103.5	107.7	115.6	110.6	110.6	112.9	111.5
Marchandises	95.3	98.8	83.3	89.8	98.6	100.0	91.1	90.2	79.3	80.6	80.5	76.6	68.5	72.6	73.4
Total	88.0	91.1	90.6	91.4	92.4	100.0	100.7	100.3	99.7	103.5	110.0	105.2	103.8	106.5	105.6
Indices de production															
Passagers	71.4	69.3	68.9	79.8	90.6	100.0	108.9	131.9	139.8	139.6	121.1	136.2	137.3	136.9	160.6
Marchandises	68.3	70.7	77.8	91.6	96.0	100.0	104.2	123.0	131.1	139.3	124.9	131.1	138.8	161.2	182.6
Total	71.1	69.8	70.6	82.0	91.6	100.0	108.0	130.3	138.1	139.0	121.1	135.0	136.9	139.1	162.3

Selon le tableau 5, l'augmentation des tarifs des passagers pour le secteur autre international est encore plus faible que pour le secteur transfrontalier, croissant de 29% au cours de la période étudiée. La guerre du Golfe, en 1991, semble avoir eu un impact néfaste sur les tarifs. Ainsi, entre 1991 et 1992, les tarifs aériens ont chuté de 5%, et depuis lors, l'indice de prix est relativement stable. En ce qui a trait à l'indice de prix des marchandises, il a littéralement chuté avec une baisse de plus de 23%.

Au niveau de la production, le secteur autre international a été de loin le plus performant, aussi bien pour les passagers que les marchandises. Au niveau des passagers, la production a augmenté de 125% au cours de la période étudiée. Le taux de croissance le plus élevé a été le secteur asiatique avec un taux de croissance supérieur à 300%. Le niveau de production des marchandises a augmenté de 167%, ce qui n'est pas comparable à aucun des autres secteurs. Incluant les passagers et les marchandises, la production a augmenté de 128% au cours de cette période.

4.5 Les services d'affrètement - indices de prix et de production

Étant donné que les services d'affrètement sont beaucoup moins importants au niveau des recettes totales, nous allons présenter les indices pour l'ensemble des secteurs. Rappelons que, pour les services d'affrètement, notre étude comprend le trafic des familles d'Air Canada et de Canadien International, ainsi que le trafic d'Air Transat, Nationair, Worldways, Royal et Canada 3000.

Tableau 6

Indices de prix et de production - services d'affrètement tous les secteurs (1986=100)

	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
Indices de prix															
Passagers	96.6	96.2	96.7	99.1	104.8	100.0	95.5	96.5	97.0	100.8	103.3	98.6	98.9	103.4	107.2
Marchandises	80.4	83.8	71.4	75.8	92.3	100.0	103.9	101.7	158.9	166.5	144.5	157.4	149.5	126.9	78.0
Total	95.8	95.6	95.3	97.8	104.1	100.0	95.9	96.7	98.0	102.0	104.4	99.7	100.0	104.3	108.1
Indices de production															
Passagers	80.6	94.9	96.2	92.8	99.5	100.0	109.6	114.4	113.9	123.9	118.6	127.6	116.7	108.7	126.1
Marchandises	135.7	98.7	115.3	100.1	100.3	100.0	82.2	74.6	25.1	6.8	2.9	2.4	7.2	9.4	7.0
Total	83.0	95.1	97.0	93.1	99.6	100.0	108.2	112.3	108.9	116.9	111.5	119.9	110.1	102.7	118.9

Les tarifs aériens des services d'affrètement ont augmenté moins rapidement que pour les vols réguliers. De 1981 à 1995, les services d'affrètement des passagers ont augmenté seulement de 11%. Pour les marchandises, l'indice des prix a été très erratique au cours de la période. Ceci peut s'expliquer parce que le volume du trafic pour les services d'affrètement des marchandises est très faible. L'augmentation de l'indice de production des passagers s'élève à 56% au cours de la période, ce qui est supérieur à la croissance de la production des passagers pour les vols réguliers.

4.6 Sommaire des résultats

Le tableau 7 présente les indices de prix et de production pour les passagers et les marchandises pour l'ensemble des services et des secteurs.

Tableau 7

Indices de prix et de production - tous les services et tous les secteurs (1986=100)

	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
Indices de prix															
Passagers	85.2	92.3	95.6	93.4	97.7	100.0	104.0	103.4	108.8	115.1	122.0	117.8	122.4	126.4	126.2
Marchandises	93.3	99.2	92.7	91.5	98.5	100.0	98.3	99.4	94.1	97.9	97.4	95.9	86.2	87.9	91.0
Total	86.1	93.1	95.3	93.2	97.8	100.0	103.4	103.0	107.3	113.4	119.6	115.6	118.8	122.5	122.7
Indices de production															
Passagers	88.9	83.3	81.0	89.4	94.1	100.0	103.7	117.8	120.6	122.5	106.8	111.1	108.0	109.9	122.6
Marchandises	81.8	81.8	84.9	97.4	100.0	100.0	99.5	102.4	104.9	105.9	95.9	94.4	101.0	101.9	108.7
Total	88.1	83.1	81.4	90.3	94.8	100.0	103.2	116.1	118.8	120.6	105.5	109.3	107.0	108.8	121.0

Les tarifs aériens (passagers et marchandises) ont augmenté de 43% entre 1981 et 1995. Par contre, la hausse des tarifs a été inégalement répartie entre les passagers et les marchandises. Alors que l'indice de prix des passagers augmentait de 48%, celui des marchandises chutait de 2%.

Somme toute, la production dans le domaine aérien au Canada a augmenté de 37% au cours de cette période. La production des services des passagers a augmenté de 38%, tandis que celle des marchandises était légèrement inférieure à 33%.

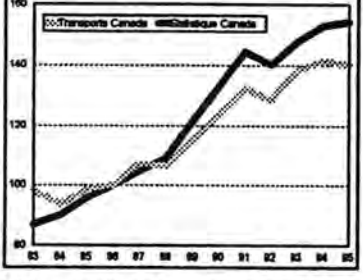
5.0 Comparaison avec d'autres indices

Cette dernière section est divisée en deux parties. Premièrement, nous comparons nos indices de prix pour le secteur intérieur et le secteur international aux indices des prix estimés par Statistique Canada à l'aide de l'Enquête sur la base tarifaire[8]. Deuxièmement, nous comparons notre indice de production à un autre indice de production (nombre de passagers-kilomètres) pour les services réguliers de passagers.

5.1 Comparaison des indices de prix

Depuis 1983, Statistique Canada produit des indices de prix pour les secteurs intérieur et international pour les services réguliers de passagers.

Figure 1: Indices des prix aériens
Marché intérieur (1986=100)

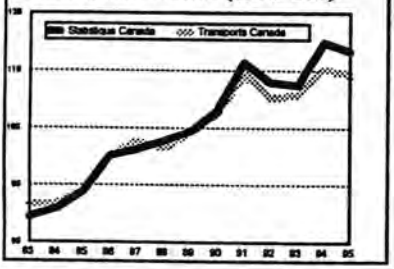


Pour le secteur intérieur, nous voyons à la figure 1 que les deux indices de prix ont le même profil. Cependant, l'indice de prix estimé par Statistique Canada à un taux de croissance plus rapide, soit une augmentation de 78% depuis 1983 comparativement à 43% pour notre indice de prix. Deux facteurs peuvent expliquer cette différence. Premièrement, comme nous avons déjà mentionné une partie importante des passagers qui achetait des billets en classe économique en 1983 achète maintenait des billets à prix

[8] L'Enquête sur la base tarifaire se limite aux transporteurs canadiens de niveau I, et en 1983 comprenait 657 paires de villes, de ce nombre 223 paires de villes ont été retenues pour le calcul des indices de prix, soit les plus importantes en termes des recettes totales de 1983.

réduit, et l'indice de spécification de Statistique Canada ne capte ce changement. Une deuxièmement explication est l'introduction d'Air BC et de Time Air dans l'enquête en 1991, au moment où ces derniers joignaient le groupe des transporteurs de niveau I. Puisque ces derniers utilisent des aéronefs plus petits, donc les coûts par siège étant plus élevés, on doit s'attendre à des tarifs plus élevés.

Figure 2: Indices des prix aériens
Marché international (1986=100)



Pour le secteur international, la différence entre les deux indices est très minime. On pourrait souligner que la croissance de notre indice de prix est légèrement inférieure à celle de Statistique Canada. Cette différence peut également être expliquée par une légère diminution des tarifs économiques au profit des tarifs réduits depuis 1983.

5.2 Comparaison des indices de production

Cette section compare nos indices de production au nombre de passagers-kilomètres pour les services réguliers de passagers et pour chaque famille de transporteurs.

Tableau 8
Comparaison de nos indices de production au nombre de passagers-kilomètres (1986=100)

	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
Famille d'Air Canada - tous les secteurs et tous les services réguliers de passagers															
Nos indices	99.8	90.5	85.8	98.0	100.0	100.0	97.9	107.2	114.7	117.4	101.7	105.4	102.5	111.6	126.4
Passagers-kilomètres	102.2	93.4	89.0	95.7	100.0	100.0	97.3	106.6	113.6	117.8	98.6	104.4	99.9	112.0	129.0
Distance moyenne	114.2	117.9	119.5	100.2	102.5	100.0	98.0	96.9	96.9	100.7	98.3	102.6	100.5	106.5	111.1
Famille de Canadien International - tous les secteurs et tous les services réguliers de passagers															
Nos indices	81.6	72.0	71.5	79.5	84.9	100.0	109.4	133.0	132.0	131.4	115.0	120.3	120.3	115.5	127.8
Passagers-kilomètres	74.0	66.6	67.5	75.5	80.7	100.0	111.4	137.3	137.0	131.6	114.5	120.8	121.2	125.3	134.1
Distance moyenne	77.1	81.1	86.0	88.2	89.5	100.0	105.2	112.7	118.0	116.0	117.0	122.1	129.4	134.1	135.3
Les deux familles - tous les secteurs et tous les services réguliers de passagers															
Nos indices	91.8	82.5	79.7	90.0	93.5	100.0	102.8	118.3	122.1	123.0	107.1	111.3	109.6	112.3	125.3
Passagers-kilomètres	89.8	81.5	79.5	86.7	91.5	100.0	103.5	120.2	124.0	123.9	105.6	111.6	109.3	117.9	131.3

Il est intéressant de comparer les familles d'Air Canada et de Canadien International parce que les changements au niveau de la distance moyenne des trajets ont été très différents entre les deux familles, et ces changements nous démontrent comment le nombre de passagers-kilomètres comme mesure de production peut biaiser les résultats. La

distance moyenne des trajets de la famille d'Air Canada a connu peu de changement, soit une diminution de moins de 3%. Par conséquent, le nombre de passagers-kilomètres comme mesure de production devrait s'avérer juste; en fait, notre indice indique une augmentation de la production de 26,7% contre 26,2% pour l'indice des passagers-kilomètres. La situation de la famille de Canadien a été très différente. Ainsi, la distance moyenne des trajets a augmenté de plus de 75%, ce qui devrait entraîner une surestimation importante de la production mesurée à partir du nombre de passagers-kilomètres. En fait, notre indice indique une augmentation de la production de 59% contre 81% pour l'indice des passagers-kilomètres, ce qui surestime la production de plus de 20%.

En compilant les deux familles, le taux de croissance de notre indice de production est plus bas que le taux de croissance de l'indice des passagers-kilomètres, respectivement 37% contre 46%. Nous pouvons donc en déduire que le nombre de passagers-kilomètres surestime la production d'environ 9%. Nous devons également ajouter que la distance moyenne a augmenté de 24% au cours de la période de temps étudiée.

6.0 Conclusion

Entre 1981 et 1995, l'ensemble des tarifs aériens a augmenté de 43%. Par contre, l'augmentation a été beaucoup plus forte pour les services réguliers dans le secteur intérieur avec une augmentation de 63% contre 43% pour le secteur transfrontalier, 20% pour le secteur autre international, et 13% pour l'ensemble des services d'affrètement. La production totale a augmenté de 37%. Encore une fois, cette augmentation a été très différente d'un secteur à l'autre: les services réguliers pour les secteurs intérieur, transfrontalier et autre international ont connu une croissance respective de 4%, 53%, 128%, tandis que l'ensemble des services d'affrètement augmentait de 43%.

Cette étude a également démontré que le nombre de passagers-kilomètres est une bonne mesure de production pour les passagers quand la distance moyenne des déplacements est constante, par contre cette mesure est inadéquate quand la distance varie au cours de la période étudiée. Entre 1981 et 1995, nous avons estimé que la distance moyenne des trajets pour les transporteurs canadiens a augmenté de 24% pour l'ensemble des services réguliers de passagers, ce qui a entraîné une surestimation de la production basé sur le nombre de passagers-kilomètres de 9%.

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Remerciement: L'auteur tient à remercier Jean-Pierre Roy pour l'aide qu'il a apportée tout au long de ce travail.

Note: Les opinions exprimées dans ce texte sont celles de l'auteur et ne reflètent pas nécessairement celles de Transports Canada.

The Effect of Liberalized Air Transport Bilaterals on Foreign Visitor Volume and Traffic Diversion: The Case of Canada

by
Martin Dresner and Tae Hoon Oum

Abstract

This paper investigates the effects of Canada's 'facilitating' bilateral air agreements with the UK, the Netherlands and Germany, on the volume of visitors from those countries to Canada, and the effects of the U.S. 'liberal' bilateral air agreements on diverting Canadian foreign visitors away from direct routes to routes that transit the U.S. These objectives are accomplished by estimating visitor volume models (direct volume to Canada, and total volume including via-US routing) and direct-routing share models on a panel data of 22 countries for the 1975-94 period.

The empirical results can be summarized as follows:

- Canadian facilitating bilaterals have had significant positive effects on increasing the number of DIRECT visitors to Canada. Although magnitudes of the effects vary between the alternative models, the most reliable empirical result indicates that Canada's facilitating bilaterals have increased both the DIRECT and TOTAL visitors by about 20% from those countries that signed these agreements with Canada.

- The US liberal bilaterals did not have statistically significant effects on the DIRECT or TOTAL volume of foreign visitors to Canada.

- However, the US liberal bilaterals have had a moderate but statistically significant negative effect on the *share* of DIRECT visitors to Canada. The average effect of the US liberal bilateral with a country was to reduce Canada's DIRECT visitor share from that country by 3.1%.

The Effects of Liberalized Air Transport Bilaterals on Foreign Visitor Volume and Traffic Diversion: The Case of Canada

I. Introduction

Between 1978 and 1982, the United States government signed "liberal" or partially "liberal" air transport bilaterals with 23 countries (Haanappel, 1983). The agreements were implemented in parallel with the United States' domestic air transport deregulation, and were designed to enhance competition on U.S. international air routes, leading to lower prices and increased passenger traffic. The liberal bilaterals differed from the existing "Bermuda" agreements in that they expanded the number of allowable international routes, restricted the ability of governments to reject market-driven rates, and encouraged competitive, rather than cartel, price setting by carriers.[1] In 1995, the U.S. government resumed its efforts to increase competition on U.S. international air routes by initiating an "open skies" policy, signing new liberal agreements or amendments with 16 countries, one of these being Canada (Air Transport Association of America, 1995).

The Canadian government has been much more cautious in its approach to promoting competition in international air transport, not withstanding its long-awaited open skies agreement with the United States. Previous studies (Dresner and Tretheway, 1987; Mitchell, 1991) have shown that Canadian bilateral agreements tend to restrict, rather than facilitate, international competition. Even three of Canada's most liberal agreements, with the United Kingdom, the Netherlands and Germany, contain clauses limiting the pricing freedom of carriers operating to and from Canada. The restrictive nature of Canadian bilateral agreements is significant in light of the more liberal U.S. approach and the ability of Canadian international traffic to divert to U.S. international routes, if price and service offerings are better. As well, the restrictive agreements could impede the implementation

[1] The original Bermuda agreement was signed by the U.S. and the UK in 1947 (Bermuda I), and first revised in 1976 (Bermuda II). The Bermuda I agreement became the model for many post-World War II bilateral air agreements signed around the world.

of Canada's new international air transport policy with a goal (among others) to "...ensure consumers benefit from increased price and service competition..." (Canada, Transport Canada, 1994).

The purpose of this paper is twofold: First, to examine the effect of the restrictive Canadian air transport policy in light of the more liberal policy pursued by the United States. Second, to see if Canada's limited experience with liberalized agreements has increased Canadian international air traffic.[2] Specifically, the following three questions are addressed: First, what effect has the Canadian liberal air policy had on the volume of foreign visitors to Canada? In particular, have Canada's three most important 'facilitating' agreements with the United Kingdom, the Netherlands, and Germany contributed to increased visitors from those countries to Canada? Second, what effect have the U.S. liberal bilateral air agreements had on the volume of visitors from those countries (that have liberal bilaterals with the US) to Canada? Third, have the U.S. liberal bilaterals and/or Canadian 'facilitating' bilaterals influenced the routing choice of the Canadian foreign visitors, and, if so, what effect have these agreements had on the *share* of visitors who flew directly to Canada as opposed to those who entered Canada through the US?

The structure of the paper is as follows: Section II briefly describes U.S. and Canadian international air policies. Section III employs econometric analysis to more formally examine bilateral effects on passenger volume and on the share of visitors traveling directly to Canada from overseas points. Finally, Section IV summarizes key results and draws conclusions from the analysis.

II. U.S. and Canadian International Air Policy

The international airline industry is largely regulated by bilateral agreements that establish the conditions of air transport between two countries. Until the advent of the liberal bilateral, the vast majority of agreements contained one clause regulating capacity and a second clause

[2] The Canada-U.S. transborder market is omitted from this analysis as it represents a unique international market for Canadian carriers and passengers. For analyses of this market, see: Dresner, Hadrovic and Tretheway (1989); Gillen, Hansen and Ramos (1991); Oum (1991); Dresner (1992; 1994); and, Gesser (1992).

allowing either of the governments that signed a bilateral to reject fare levels (single disapproval regime). The liberal bilaterals, on the other hand, typically allowed the airlines to freely determine capacities without governmental interference and restricted governmental disapproval authority over fare levels. In some of the liberal bilaterals, both of the governments had to reject fares before they were disapproved (double disapproval regime). In other agreements, only the country in which a flight originated could reject a fare. Other features generally incorporated in the liberal agreements included: (1) the multiple designation of airlines, allowing each government to designate a number of carriers to serve routes between the two states; and (2) a reduction in route restrictions, resulting in the authorization of more routes between more cities in the two countries. The United States has been the major force behind the signing of liberal bilaterals.[3] Between 1978 and 1982, the U.S. signed 23 liberal or partially liberal agreements and since 1995 has signed an additional 16 liberal or "open skies" bilaterals.

While the U.S. was signing pro-competitive liberal bilaterals, the Canadian government, in general, pursued a traditional international aviation strategy, more protective of airline interests. Mitchell (1991) states that Canadian international air policy was defined as an attempt to promote growth in the airline industry without the "destructive impact of competition". The center piece of the policy, in place from 1965 to 1987, was a "division of the world (DOW)" formula, whereby international markets were divided between the two major Canadian international carriers (Air Canada and Canadian) so that each carrier would have exclusive jurisdiction over its respective regions of the world.[4] Other Canadian

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[3] A few other countries have signed a limited number of liberal or partially liberal agreements, most notably the United Kingdom.

[4] For details on the Division of the World policy, see Oum (1992). It was not until 1994, nearly 30 years after its inception, that the Canadian government replaced the Division of the World policy (Canada, Transport Canada, 1994). The new "use-it-or-lose-it" policy allows for the replacement of a designated carrier if it is not using, or is "under-utilizing" its route rights granted by a bilateral agreement. (A route is considered "under-utilized" if the designated

carriers were allowed only very limited access to Canadian international routes. According to Mitchell (1991, p. 21), the DOW policy was "intended that cooperation should be established between the two [primary Canadian international] carriers so that, to the extent possible, their initiatives would support the carriage of passengers on Canadian carriers".[5]

The restrictive nature of Canadian international air policy was evident in the bilateral agreements signed by Canada. Dresner and Tretheway (1987) examined 13 agreements signed between 1978 and 1986 and found that 8 allowed only single designation of air carriers (i.e., each country could designate only one carrier per route), that 7 required a carrier or governmental agreement on capacity levels and that all 13 specified that the preferred means of price-setting was through the industry rate-setting association, IATA, or by airline agreement (rather than through market forces).[6]

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carrier provides less than twice weekly service with its own airplanes or less than near daily service on a code-sharing basis using its own equipment for a significant portion of the route.) As well, the new policy: (1) provides for the allocation of a second designated carrier to serve an international market if that market is in a country with at least 300,000 scheduled one-way passengers per year (Canada, Transport Canada, 1995); and (2) allows a foreign carrier to gain operating rights on a route to Canada if no Canadian carrier has an interest in a route. Under the previous policy, the Canadian government would generally not negotiate route rights unless a Canadian carrier had interest in using those rights.

[5] In 1989, Canadian acquired Wardair which had route authority to London, Paris and Frankfurt, all historically within Air Canada's service territory. After Canadian started to serve these cities, the division of the world between Air Canada and Canadian became blurred (Oum, 1992). Canada formally repealed its DOW policy in 1994 when it announced its new international air policy (Canada, Transport Canada, 1994).

[6] The Canadian agreements may be even *more* restrictive than they appear to the public. According to Mitchell (1991), of the 60 bilateral agreements Canada had in place at that time, 20 had attached *confidential* instruments. These confidential addenda likely enforce revenue sharing, capacity restrictions and/or price-setting

Within the last decade, Canada has cautiously altered its bilateral approach and signed a limited number of bilateral agreements with more liberal features. Three of the most important "liberalized" agreements are those with Germany (Canada, 1983), the United Kingdom (Canada, 1988) and the Netherlands (Canada, 1990). The agreement with the United Kingdom allows carriers open access to any routes between the two countries, allows carriers limited freedom to set prices without the approval of both governments, and allows mutiple designation of carriers. The bilateral with the Netherlands allows carriers freedom to match prices on routes without governmental approval and does not restrict a carrier's ability to unilaterally determine capacity levels. The bilateral with Germany allows for multiple designation of carriers, and allows carriers freedom to set capacity levels without governmental approval. However, unlike the bilaterals with the U.K. and the Netherlands, the German agreement tightly controls price competition by requiring competing carriers to agree on prices. Although the bilateral with Germany is somewhat more restrictive than those with the U.K. and the Netherlands, it is regarded as substantially more liberal than Canadian agreements with other countries (Mitchell, 1991). Therefore, following the classification of Mitchell (1991), in this paper the bilaterals with the U.K., the Netherlands and Germany are all classified as "facilitating". The term "facilitating" is used to differentiate the Canadian agreements from the U.S. "liberal" bilaterals, all of which have fewer restrictions than even the most facilitating Canadian agreement.[7]

III. Modeling the Effect of Liberal Bilaterals

Two methods of analysis were developed for determining the impact of liberal and facilitating bilaterals on Canadian international air traffic. The first method is used to assess the impact of both U.S. liberal and

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agreements not included directly in the bilateral agreements. It should be noted that the United States does not have confidential addenda to its bilateral agreements.

[7] For example, the Canadian bilateral with the United Kingdom has provisions that restrict carriers from setting prices, without the approval of both governments, unless they are at least 60 percent of a reference fare level or meet certain round trip and advanced booking restrictions. Canada's bilateral with the Netherlands has provisions that restrict the number of carriers on a route to two per country.

Canadian facilitating agreements on the volume of air traffic flows to Canada. The second is used to determine the effect of the agreements on the share of passengers traveling directly to Canada rather than through the United States. The volume models for air traffic flows to Canada are discussed first.

3.1 Models for the Direct and Total Canadian International Visitors

The first method used to determine the effect of U.S. liberal and Canadian facilitating agreements is to estimate their effect on passenger flows to Canada. An estimating model is presented in Equation 1, below:

$$PASS=\beta 0+\beta 1 POP+\beta 2 INC+\beta 3 EXCHRT+\beta 4 CDNLIB+\beta 5 USLIB+\sum_{k} \beta k COUNTRYk+\sum_{t} \beta t YEARt \quad (1)$$

where:

- PASS is (1) the number of visitors to Canada flying directly into the country (PASS: DIRECT), or (2) the total number of visitors flying directly into Canada or flying via the United States into Canada (TOTAL-AIR), or (3) the total number of visitors flying to Canada directly or entering via the US including land border crossings (TOTAL).[8] All three versions of the model are estimated with the passenger variable calculated on an annual basis by the country of origin of the visitors (e.g., the number of visitors arriving in Canada from the Netherlands in 1988 would be one case).
- POP is the population of the country of the visitors expressed as millions of people (e.g., Netherlands population in 1988).
- INC is the gross domestic product (GDP) per capita of the country of origin of the passengers (e.g., the gross domestic product per capita of the Netherlands in 1988).
- EXCHRT is an index reflecting changes in the exchange rate between a passenger's country of origin and Canada. The index for all exchange rates is set to 1 for the base year, 1975, and calculated

[8] Travelers entering Canada from the United States may arrive either by air or by land. Travelers who arrive in Canada by land, but stay less than one day, are excluded from the total.

for subsequent years based on the change from the base year.(e.g., if in 1975 a Canadian dollar was worth 2 Dutch guilders, the base exchange rate of 2 to 1 is indexed to 1. If by 1988, the guilder has decreased in value so that it takes 4 guilders, instead of 2, to purchase a Canadian dollar, the index is set to 0.5. Devaluations decrease index values while appreciations increase values).

- CDNLIB is a dummy variable set to 1 for those observations where visitors can travel directly to Canada under a facilitating bilateral agreement. (e.g., the Netherlands-Canada facilitating agreement entered into force in 1990. This variable would be coded 0 for all Netherlands observations prior to 1990 and 1 for all Netherlands observations 1990 and subsequent.)
- USLIB is a dummy variable set to 1 for those observations where visitors could have traveled directly into the United States under a liberal agreement before entering Canada. (e.g., the U.S. signed a liberal agreement with the Netherlands in 1978. All the Netherlands observations prior to 1978 are coded 0 and all those observations 1978 and subsequent are coded 1.)
- $COUNTRY_k$'s are dummy variables for those countries that have large residuals not otherwise explained by the other independent variables in the model. (e.g., if the base model without country dummy variables under-predicted traffic from the Netherlands to Canada due to unexplained factors, all Netherlands observations would be coded 1 in the subsequent regression runs. The dummy variables improve the fit of the regression and improve the econometric efficiency of the estimation.)
- $YEAR_t$'s are dummy variables for each of the years in the data set coded 1 for the year of the observation and 0 otherwise. These variables are included to account for the residual growth in visitor traffic to Canada over the years 1975 to 1994.

It is possible to hypothesize, *a priori*, the signs of some of the estimated coefficients in the model. The coefficient for the population (POP) variable should be positive, indicating that countries with higher populations should produce greater numbers of visitors to Canada. The coefficient for per capita income (INC) should also be positive indicating that, all other factors being equal, countries with higher per capita incomes should produce more visitors to Canada. The coefficient for the exchange

rate variable (EXCHRT) is predicted to be positive, signifying that there should be an increase in visitors from a country if the currency of that country appreciates against the Canadian dollar.

The coefficient for the Canadian facilitating bilaterals (CDNLIB) should be positive showing that the signing of a facilitating bilateral by the Canadian government attracts increased visitors to Canada from that country. This finding should especially be true when the dependent variable measures only visitors traveling directly to Canada, rather than the total number of visitors, including those arriving via the United States. The sign of the coefficient for the U.S. liberal bilateral (USLIB) should be negative when the dependent variable is the direct travel volume to Canada (DIRECT), but the sign is indeterminate when the dependent variable is the total travel volume to Canada including those coming to Canada via U.S. (TOTAL-AIR or TOTAL). The reason for the latter is two fold. On one hand, US liberal bilaterals encourage foreigners to travel to the U.S. instead of coming to Canada, and thereby reduces foreign travel to Canada (destination substitution effect). On the other hand, the US liberal bilaterals induce more foreigners to come to Canada by making cheaper and more convenient travel to Canada via the United States (generalized price reduction effect).

The coefficients for the years should show an increase in traffic over the years of the data set (i.e., higher values for later years and lower values for earlier years). As for the country dummies, one would expect positive coefficients for those countries that have otherwise unexplained attractions to Canada (e.g., since many people in Canada speak English, one might expect that greater numbers of visitors would arrive from the United Kingdom to Canada, than is otherwise predicted by the model.)

The models were estimated using panel data for the years 1975 to 1994 for 22 countries in which visitor data were reported in the series collected by Statistics Canada (1975-1994).[9] Demographic and exchange

[9] Statistics Canada (1975-1994) also provided data on numbers of visitors from Bermuda, Israel, and Mexico. However we were not able to obtain GDP data for Bermuda or reasonable exchange rate information for Israel and Mexico given currency devaluations over the period of analysis.

rate information was gathered mainly from the International Monetary Fund (1975-1995). Canadian bilateral information was collected from Dresner and Tretheway (1987), Mitchell (1991) and from copies of the agreements published in the *Canada Treaty Series*. U.S. bilateral information was gathered from the Air Transport Association of America (1996) and from Dresner and Windle (1992). Table 1 provides descriptive statistics on the variables, while Table 2 shows a country by country listing of the types of bilateral agreements for the U.S. and Canada.

From Table 1, it can be seen that on average, 41,774 visitors per year entered Canada directly from the countries in our data set. The maximum number of visitors, 404,600, entered Canada in 1994 from Great Britain while the minimum, 900, entered Canada in 1975 from South Africa. The second row in Table 2 provides similar statistics on total (direct + U.S. transit by air and land) visitors to Canada. The next two rows in the table provide information on two demographic variables in the data set, country populations and GDP per capita. The exchange rate index has a mean of 1.02 suggesting that, on average, the currencies from the 22 countries increased marginally in value in terms of Canadian dollars from the base year, 1975. The largest appreciation against the Canadian dollar was by the Japanese Yen while the largest depreciation was by the Greek drachma.

The Canada/U.S. exchange rate reflects the number of Canadian dollars it takes to purchase a U.S. dollar. A high value for this variable indicates a relatively low value for the Canadian dollar. The Canadian dollar was at its lowest in 1986 (C$1.39) and at its highest in 1976 (C$0.99), relative to the U.S. dollar. Finally, the mean value of the direct to total passenger ratio for our sample was 0.51. This ratio indicates that during our sample period slightly more than 50% of the passengers traveled to Canada directly rather than through the U.S.

Table 2 shows the liberal bilateral country classification used in the estimations. As illustrated in the table, three countries signed facilitating agreements with Canada while the U.S. signed five liberal agreements with countries in our data set. The table shows that the U.S. signed its liberalized agreements much earlier (1978-1980) than did Canada (1983-1990).

3.2 Estimation and Choice of the Models

The models were estimated using the "POOL" procedure described in the econometric package, *Shazam*. The POOL procedure is a generalized least squares estimation designed to remove the first order auto-regressive component in panel data.[10] It is noteworthy that the t-statistics for virtually all variables improved significantly after correcting for autocorrelation. The results of the estimation of direct foreign visitors (DIRECT) are presented in Table 3 and of total foreign visitors (TOTAL-AIR, and TOTAL) in Table 4. In each case, three models are estimated. Models 1 and 2 (in both tables) differ only in the inclusion of year dummy variables in Model 2. Residual analysis showed that without the inclusion of dummy variables for the United Kingdom, France, and Germany, passenger counts from these countries would be under-predicted. Therefore, it was decided to include these country dummies.[11]

An F-test on the coefficients for the 19 year dummy variables in the estimation of DIRECT passengers (Table 3) rejected the hypothesis of zero coefficients for the year dummy variables at the 1% level of significance,[12] indicating that Model 2 (with year dummy variables) is superior to Model 1 (without year dummies). Model 3 of Table 3 differs from Model 2 in that it replaces the three country dummy variables (UK, France and Germany) by a European country dummy variable. A European country dummy was tried because European countries are closer to Canada both historically and geographically than the other countries in the data set. However, Model 3, with the European dummy variable, provided a much lower goodness of fit than did Models 1 and 2.

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[10] Initial ordinary least squares procedures showed the error terms in the models to be highly auto-correlated. The POOL procedure also has an option to correct for heteroscedasticity, but we did not opt to use this procedure because there was no apparent pattern for heteroscedasticity present in the residuals, after correcting for autocorrelation.

[11] It is worth noting that two of the three countries have *a priori* expectations for the inclusion of country dummy variables. The two founding nations of Canada are Britain and France and the two official languages of Canada are English and French.

[12] The observed F-statistics (df = 19, 440-27) was 7.90 as compared to the critical value of 2.03 at $\alpha = 0.01$.

The dependent variable in Models 1 and 2 in Table 4 is the total air visitor volume including those flying to Canada via US airports (TOTAL-AIR). The dependent variable for Model 3 is the total visitor volume to Canada, including those arriving in Canada via U.S. air or land routes (TOTAL). After conducting f-tests on the year dummy variables, it was found that the models which include the year dummy variables provided a better fit. Although Model 2 (for TOTAL-AIR) and Model 3 (TOTAL) are mainly used when interpreting the empirical results, it is worth noting that all alternative models yielded similar empirical estimations.

3.3 Interpretation of Empirical Results on Visitor Volume Models

Referring first to Table 3, the empirical results of the three DIRECT visitor models are consistent in that the regression coefficients have the same signs and similar statistical significance. In all three models the coefficients for the population, exchange rate and the Canadian facilitating bilateral variables are statistically significant at the 1% level, while the per-capita income variable is not statistically significant. The results show that population size and that country's exchange rate vis-a-vis the Canadian dollar are the two most significant determinants of the direct travel volume from a foreign country to Canada. The next most important determinant is whether Canada has a facilitating bilateral agreement with a country. Since Canada has little influence over the population or exchange rate of a foreign country, clearly the liberalization of air bilateral agreements is an important policy variable for increasing the number of direct foreign visitors to Canada. Model 2 (the superior model in terms of fit) indicates that, after controlling for the effects of all other variables in the model, a facilitating air agreement with a country can be expected to increase direct travel volume, on average, by over 13,000 visitors per year. The results for the country dummies in Model 2 showed that after controlling for all other effects, the UK, France and Germany can be expected to send about 265,000, 130,000 and 69,000, respectively, more visitors directly to Canada than the average country.

In Table 4, Models 1 and 2 estimate the total volume of non-resident air visitors entering Canada, including those flying to Canada via US gateway airports (TOTAL-AIR). The only difference between the two models is that Model 2 includes year dummy variables while Model 1 does not. Model 3 is the same as Model 2 except that the dependent variable is

the total visitors arriving in Canada (TOTAL) including those who enter Canada via the US by land (and stay one or more nights in Canada). Again, the three models provide similar results in terms of coefficient signs and statistical significance of key variables. As in the case of DIRECT air traffic volume, the population, exchange rate, and Canadian facilitating bilateral variables are statistically significant at the 1% level while the US liberal bilateral variables are not statistically significant. Again, the UK, France and German dummy variables are statistically significant. The coefficients for these country dummy variables are greater in Model 3 than Model 2 because Model 3 includes the extra visitors to Canada via US land borders. Models 2 and 3 indicate that a Canadian facilitating bilateral with a foreign country can be expected to increase annual TOTAL-AIR visitors by nearly 17,000 and TOTAL (direct + U.S. air + U.S. land) visitors by over 20,000 people. As was the case with the estimation of DIRECT visitors, all three models reported in Table 4 show that the U.S. liberal bilaterals have statistically insignificant effects on the total volume of foreign visitors to Canada.

Our regression models show that Canada's facilitating air bilaterals have led to significantly increased numbers of foreign visitors arriving in Canada. However, the effect of a facilitating air bilateral may depend on the size of a passenger market. For example, since the Canada-UK market is much larger (404,600 direct visitors in 1994) than the Canada-Netherlands market (61,800 direct visitors in 1994), the facilitating bilateral between Canada and the UK can be expected to provide greater increases in the number of visitors than the agreement with the Netherlands. In order to capture the effect of market size, we replaced the Canadian facilitating bilateral dummy by the same dummy variable multiplied by the three-year average market size prior to the signing of the facilitating bilateral agreement. The results are shown in Table 5. The coefficient for the new facilitating bilateral variable can be interpreted as the percentage change in the travel volume due to a facilitating agreement. In all of the three models, this coefficient is about 0.2 and is statistically significant. The implication is that a Canadian facilitating bilateral agreement can increase the visitor volume to Canada by about 20%.[13] The coefficients of all other variables in

[13] Model 2 in Table 3 reports that a Canadian facilitating bilateral would increase the DIRECT traffic by 13,083 passengers. Model 3 of Table 4 shows that a Canadian facilitating bilateral increases TOTAL visitors to Canada by 20,323 passengers.

the three models are very similar to those reported in Tables 3 and 4.

3.4 Estimation and Interpretation of the Share of Canadian Direct Visitors

In addition to estimating foreign passenger flows to Canada, it is also useful to estimate the share of direct to total passengers. A basic share model is estimated as follows:

$$SHARE = \alpha_0 + \alpha_1 * EUROPE + \alpha_2 * USEXCH + \alpha_3 * CDNLIB + \alpha_4 * USLIB \quad (2)$$

where:

- *SHARE* is (1) the ratio of direct foreign visitors to total (direct + U.S. transit) visitors or (2) the natural logarithm of the ratio of direct foreign visitors to U.S. transit visitors, depending on the model (henceforth referred to as 'LOGIT').[14]
- EUROPE is a dummy variable for European country observations. It is used to account for the greater numbers of Europeans who travel directly to Canada, compared to visitors from other parts of the world.
- USEXCH is the Canadian/U.S. exchange rate in Canadian dollars per U.S. dollars. An increase in this ratio (i.e., more Canadian to

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Twenty percent of the average DIRECT passengers in our sample (41,774 reported in Table 1) is 8,355 passengers and 20% of the average TOTAL visitors in our sample (74,160 reported in Table 1) is 14,832 passengers. Therefore, the use of a simple facilitating bilateral dummy variable, without distinguishing it by market size, appears to over-estimate the average effect of the facilitating bilaterals.

[14] The tradition of using the logarithm of the odds or the ratio of two shares is well established in mode-split models in transport economics. It essentially borrows the advantage of using a 'logistic' or 'logit' functional form in modeling a market or modal share. The main advantages of using a 'logit' form are two-fold. First, it constrains the predicted share from the model to lie between 0 and 1. Second, it allows for a nonlinear relationship between market share and any of the continuous independent variables. For an interesting application of the 'logit' model to an aggregate data set, see Boyer (1977) and Levin (1978). For cautions of applying logit models to aggregate demand data, see Oum (1979).

U.S. dollars) indicates a devaluation in the Canadian dollar relative to the U.S. dollar.

- CDNLIB is a dummy variable for Canadian facilitating bilaterals as defined previously.
- USLIB is a dummy variable for U.S. liberal bilaterals as defined previously.

The expectation for the EUROPE coefficient is positive; that is the estimation should show that Europeans travel directly to Canada in greater proportions than visitors from other countries. The coefficient for the USEXCH variable should also be positive, indicating that when the Canadian dollar is devalued relative to the U.S. dollar, more travelers will come directly to Canada rather than through the U.S. The expected sign on the coefficient for the Canadian facilitating agreement is positive indicating that these bilaterals should increase the ratio of passengers who travel directly to Canada. Finally the expected sign for the coefficient for U.S. liberal agreements is negative indicating that when the U.S. signs these agreements, visitors to Canada are more likely to transit through the U.S. on their way to Canada.

The data for these estimations were derived from the same sources as the data used in the previous estimations. Again, the models were estimated using panel data for the years 1975 to 1994 for 22 countries in which visitor data were reported in the series collected by Statistics Canada (1975-1994).

Table 6 reports three models. The dependent variables for Models 1 and 2 are the share of DIRECT visitors to TOTAL visitors (including those who enter Canada via US points by air and land).[15] The dependent variable for Model 3 is the natural logarithm of the ratio of DIRECT visitors to the visitors who enters Canada via US points by air or land (LOGIT). The only difference between Models 1 and 2 is the inclusion of a European country dummy variable in Model 2. The coefficient for the EUROPE dummy variable is highly significant, and the addition of this variable improves the R2 from 0.012 to 0.127. Clearly, Model 2 is statistically superior to Model

[15] The alternative definition for the total visitors (TOTAL-AIR) was also estimated. The results were very similar to those reported in Table 6.

1. Models 2 and 3 are not statistically comparable because these two models have different dependent variables. Although the actual coefficients are different, both Models 2 and 3 provide similar predictions.

It is interesting to observe that the US liberal bilateral variable has statistically significant negative coefficients in all three models. The coefficient is significant at the 1% level in Models 2 and 3 while it is significant at 10% level of significant in Model 1. These results indicate that a US liberal bilateral with a foreign country negatively affects the share of passengers flying directly from that country to Canada. The coefficient of the U.S. liberal bilateral variable in Model 2 (-0.031) indicates that a U.S. liberal bilateral with a foreign country reduces the share of DIRECT foreign visitors to Canada from that country by 3.1%. Based on the average number of annual visitors to Canada per country in our data (74,160 as stated in Table 1), the signing of a liberal agreement by the U.S. would divert about 2,300 passengers per year per agreement signed.

The Canadian facilitating bilateral variable, on the other hand, does not have a statistically significant coefficient. As noted previously, Canadian facilitating agreements contribute to an expansion in traffic flows to Canada, but it appears from this result that the facilitating agreements do not divert passengers to Canadian international routes from U.S. transit routes.

It is interesting to note that the coefficient of the Canadian/US exchange rate variable is positive, as predicted, but not statistically significant. This indicates that the Canadian vs. US dollar exchange rate does not appear to influence a foreign visitor's choice of travel routing to Canada (direct vs. via US). This result may be because international air prices are set in U.S. dollars so that a devaluation of the Canadian dollar (relative to the U.S. dollar) will not affect air prices on Canadian international routes. The coefficients of the European country dummy variable in all three models are highly significant and positive indicating that Europeans are more likely than other visitors to travel to Canada directly. The coefficient of the European country dummy variable in Model 2 (0.333) indicates that compared to visitors from other countries, 33% more Europeans come to Canada directly than through the U.S.

IV. Summary and Conclusions

At the outset of this paper three questions were posed. First, what effect has the Canadian liberal air policy had on the volume of foreign visitors to Canada? In particular, have Canada's three most important facilitating agreements with the United Kingdom, the Netherlands, and Germany contributed to increased visitors to Canada? Second, what effect have the U.S. liberal bilateral air agreements had on the volume of visitors to Canada? Third, have the U.S. liberal bilaterals and/or Canadian facilitating bilaterals influenced the routing choice of foreign visitors to Canada, and, if so, what effect have these agreements had on the share of DIRECT visitors.

In order to accomplish these objectives, regression models were estimated on DIRECT, TOTAL and TOTAL-AIR visitor volumes, and the share of DIRECT visitors to Canada. The empirical results based on the best fitting model in each category indicate the following:

- Canadian facilitating bilaterals have had significant positive effects on increasing the number of DIRECT visitors to Canada. The average effect was an increase of over 13,000 passengers per country per year. The average effect on the TOTAL volume of visitors (including those entering Canada via the U.S.) was an increase of over 20,000 passengers per country per year. When we exclude those who enter Canada via the U.S. by land, the average effect on the TOTAL-AIR volume was 16,900 per year.
- From the models modified to account for the differential size of the U.K.- Canada, the Netherlands-Canada and Germany-Canada markets, the effect of Canada's facilitating bilaterals was measured to be about a 20% increase in both DIRECT visitors and TOTAL visitors.
- The US liberal bilaterals did not statistically affect DIRECT, TOTAL, or TOTAL- AIR volumes of foreign visitors to Canada.
- However, the US liberal bilaterals had a statistically significant negative effect on the *share* of DIRECT visitors to Canada. The average effect of a US liberal bilateral with a foreign country was to reduce Canada's DIRECT visitor share by 3.1%.
- Canada's facilitating bilaterals had no significant effect on the share of DIRECT foreign visitors to Canada. This result is consistent with the finding that the facilitating bilaterals increased both DIRECT visitor volumes and TOTAL passenger volumes by the same percent (20%).

Canadian facilitating bilaterals may be too restrictive to induce foreign visitors to travel to Canada directly.

In conclusion, evidence was found that Canadian facilitating bilaterals appear to expand Canadian international air markets. This finding is in agreement with previous work on the affect of liberalized agreements on traffic flows.[16] U.S. liberal bilaterals, on the other hand, were found to divert passengers from direct air routes to Canada to routes that transit the United States. It may be that Canada can avoid this diversion by further liberalizing its facilitating agreements or by liberalizing those agreements that still have both pricing and capacity restrictions.

[16] The findings do differ from those of Dresner and Windle (1992) who found that partially liberalized agreements did not affect passenger flows on U.S. international air routes. The Canadian facilitating agreements are not fully liberalized in that they retain pricing limitations, as discussed previously. The difference in findings between this paper and Dresner and Windle (1992) may be due to differences between Canadian international and U.S. international air choices. It could be that since U.S. travelers choose between liberal, partially liberal and non-liberal direct routings, that, compared to the liberal alternative, partially liberal routes did not attract additional traffic. Since no Canadian international routes are completely liberalized, the choice facing Canadian travelers on direct routes is only between facilitating and non-facilitating routes, thereby increasing the chance that facilitating routes are chosen.

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Table 1
Descriptive Statistics

Variable	Mean	Std. Dev	Maximum	Minimum
Direct Passengers	41,774	73,494	404,600	900
Total Passengers*	74,160	114,910	582,100	4,000
Population (Millions)	25.08	28.84	124.96	3.07
GDP per Capita ($U.S.)	15,245	6,700	35,626	1,926
Exchange Rate Index	1.02	0.49	3.90	0.18
Canada/U.S. Exchange Rate	1.21	1.11	1.39	0.99
Ratio Direct to Total Passengers	0.51	0.15	0.82	0.11

* Total passengers include the foreign passenger who flied directly to Canadian airports and those who entered Canada through the United States by air or land, and stayed in Canada one or more nights.

Table 2
Liberal/Facilitating Bilateral Classification by Year

Country	Canada		United States	
	Restrictive	**Facilitating**	**Restrictive**	**Liberal**
Australia	1975-1994	No Years	1975-1994	No Years
Austria	1975-1994	No Years	1975-1994	No Years
Belgium	1975-1994	No Years	1975-1977	1978-1994
Denmark	1975-1994	No Years	1975-1994	No Years
Finland	1975-1994	No Years	1975-1979	1980-1994
France	1975-1994	No Years	1975-1994	No Years
Germany	1975-1982	1983-1994	1975-1977	1978-1994
Greece	1975-1994	No Years	1975-1994	No Years
Hong Kong	1975-1994	No Years	1975-1994	No Years
Ireland	1975-1994	No Years	1975-1994	No Years
Italy	1975-1994	No Years	1975-1994	No Years
Japan	1975-1994	No Years	1975-1994	No Years
Netherlands	1975-1989	1990-1994	1975-1977	1978-1994
New Zealand	1975-1994	No Years	1975-1994	No Years
Norway	1975-1994	No Years	1975-1994	No Years
Portugal	1975-1994	No Years	1975-1994	No Years
South Africa	1975-1994	No Years	1975-1994	No Years
Spain	1975-1994	No Years	1975-1994	No Years
Sweden	1975-1994	No Years	1975-1994	No Years
Switzerland	1975-1994	No Years	1975-1994	No Years
Taiwan	1975-1994	No Years	1975-1979	1980-1994

United Kingdom	1975-1987	1988-1994	1975-1994	No Years

Table 3
Estimation Results on Direct Traffic
(T-Statistics in Parentheses)

Dependent Variable: Direct Non-Resident Visitors (DIRECT)

Independent Variable	Model 1	Model 2	Model 3
Population (millions)	556* (5.08)	587* (7.83)	1510* (10.87)
Income (000s $U.S.)	0.125 (1.25)	0.092 (0.60)	0.172 (1.16)
Exchange Rate Index	5687* (3.23)	11230* (4.76)	6953* (3.03)
Canadian Facilitating Bilateral	**19707* (2.88)**	**13083* (2.74)**	**10574# (2.29)**
U.S. Liberal Bilateral	**-212 (-0.17)**	**-1074 (-0.67)**	**-2532^ (-1.70)**
United Kingdom	263810* (13.82)	264970* (17.73)	-
France	132200^ (1.86)	130210# (2.43)	-
Germany	69040* (5.77)	68745* (8.52)	-
Europe	-	-	13250* (3.60)
Constant	1655 (0.87)	6691# (2.34)	-9768# (2.18)
R^2	0.65	0.77	0.56
Number of observations	440	440	440

* Significant at the 99% confidence level
# Significant at the 95% confidence level
^ Significant at the 90% confidence level

Note: Models 2 and 3 include year dummies.

Table 4
Estimation Results on Total Traffic
(T-Statistics in Parentheses)

Dependent Variables:
Models 1 and 2: TOTAL-AIR (Total Non-Resident Air Visitors- Includes those via US airports)
Model 3: TOTAL (Total Visitors to Canada - Includes those via US by Air and Land)

Independent Variable	Model 1	Model 2	Model 3
Population (millions)	807* (4.99)	745* (10.05)	1155* (7.41)
Income (000s $U.S.)	0.275 (1.92)	0.158 (0.75)	0.219 (0.79)
Exchange Rate Index	8711* (3.59)	12120* (3.54)	15083* (3.20)
Canadian Facilitating Bilateral	**25252* (3.22)**	**16900* (3.01)**	**20323* (2.84)**
U.S. Liberal Bilateral	**-1045 (-0.66)**	**-1270 (-0.60)**	**-909 (-0.31)**
United Kingdom	302040* (13.34)	310560* (17.70)	374030* (17.00)
France	130700^ (1.81)	135490# (2.51)	146750* (2.60)
Germany	71795* (5.14)	80991* (9.63)	113160* (8.48)
Constant	423 (0.17)	12057* (3.09)	11399# (2.08)
R^2	0.70	0.80	0.78
Number of observations	440	440	440

* Significant at a 99% confidence level
# Significant at a 95% confidence level
^ Significant at a 90% confidence level

Note: Models 2 and 3 include year dummies.

Table 5
Estimation Results on Direct and Total Traffic
(T-Statistics in Parentheses)

Dependent Variables:
Model 1: DIRECT (Direct Air Visitors to Canada)
Model 2: TOTAL-AIR (Total Air Visitors To Canada including those via US airports)
Model 3: TOTAL (Total Visitors To Canada including those via US by air or land)

Independent Variable	Model 1	Model 2	Model 3
Population (millions)	575* (7.37)	739* (9.98)	1139* (7.36)
Income (000s $U.S.)	0.065 (0.43)	0.129 (0.63)	0.179 (0.66)
Exchange Rate Index	11726* (5.04)	11877* (3.50)	14738* (3.16)
Canadian Facilitating Bilateral * market size	**0.203* (5.17)**	**0.212* (5.64)**	**0.199* (5.11)**
U.S. Liberal Bilateral	**-875 (-0.58)**	**-944 (-0.47)**	**-406 (-0.15)**
United Kingdom	249800* (22.29)	291930* (23.76)	354630* (21.28)
France	130430# (2.38)	135780# (2.48)	147660* (2.58)
Germany	63099* (7.73)	74271* (8.97)	104860* (7.82)
Constant	6687# (2.35)	12185* (3.13)	11522# (2.12)
R^2	0.82	0.85	0.83
Number of observations	440	440	440

* Significant at a 99% confidence level
# Significant at a 95% confidence level
^ Significant at a 90% confidence level

Note: All Models include year dummies.

Table 6
Estimation of Direct Share Models

Dependent Variable Models 1 and 2: Ratio of Direct to Total Passengers
Dependent Variable Model 3: Log(Ratio of Direct to US Transit Passengers)
T-Statistics in Parentheses

Independent Variables	**Model 1**	**Model 2**	**Model 3**
Canada/US Exchange Rate	0.022 (0.89)	0.026 (1.09)	0.121 (1.16)
Canadian Facilitating Bilateral	**0.019** **(1.54)**	**0.016** **(1.03)**	**0.044** **(0.88)**
U.S. Liberal Bilateral	**-0.022^** **(-2.18)**	**-0.031*** **(2.61)**	**-0.136*** **(-2.42)**
European Countries	-	0.228* (7.45)	0.984* (6.64)
Constant	0.515* (16.61)	0.333* (8.11)	-0.745* (-3.93)
R^2	0.0120	0.1271	0.1074
Number of Observations	440	440	440

* Significant at 99% confidence level
# Significant at 95% confidence level
^ Significant at 90% confidence level

The Toronto and Montréal Aviation Markets—A Tale of Two Cities

Gordon G. Baldwin
Chief, Aviation Statistics Centre
Transportation Division, Statistics Canada

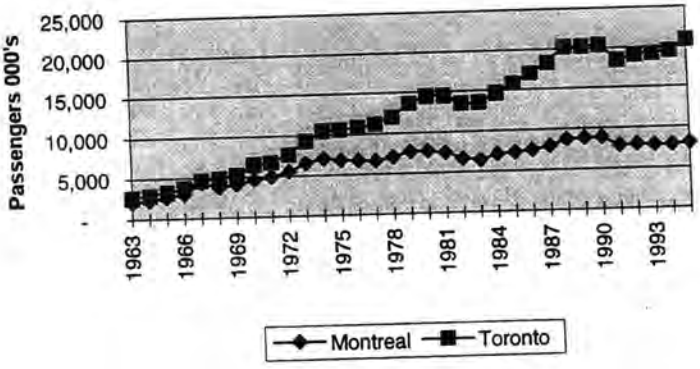
Introduction

In the 1960's, Montréal and Toronto were Canada's two largest cities, with the aviation passenger market at Toronto approximately 18% higher than Montréal's. By 1995, the number of passengers handled at Toronto's L.B. Pearson International exceeded the passengers handled at Montréal's Dorval and Mirabel airports by 160%. This paper will examine the possible reasons for the differences in the aviation passenger growth in these two key Canadian markets. While many factors have been cited in the past, ranging from government policies, multiple airports and airport access infrastructure, this analysis will pay particular attention to the major socio-economic variables used in airport passenger forecasting by Transport Canada, the US Federal Aviation Administration and others to see if they help to explain the different growth patterns.

Trends in the Toronto and Montréal Aviation Markets: "It was the best of times, it was the worst of times..."[1]

The total number of passengers enplaned and deplaned at Montréal (Dorval) and Toronto (Pearson) was quite close in 1963 with 2.6 million at Toronto and 2.2 million at Montréal. Chart 1 shows what happened between 1963 and 1995. The figures for Montréal include both Dorval and Mirabel airports while the figures for Toronto are for L.B. Pearson International. While the number of passengers handled at Montréal increased four fold, the increase at Toronto was eight fold.

Chart 1 Enplaned and Deplaned Passenger Traffic, Montréal and Toronto



Source: Aviation Statistics Centre, Statistics Canada

There are often cited technical reasons for the faster aviation passenger growth at Toronto than at Montréal:

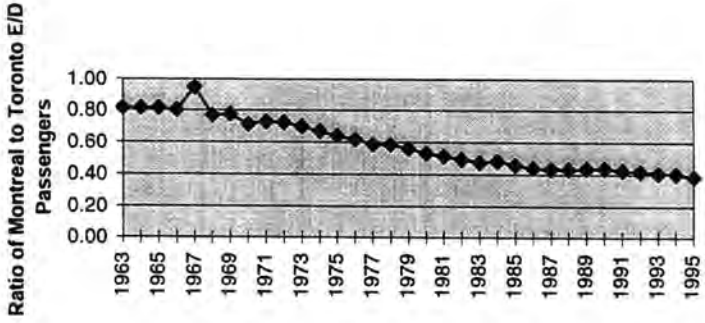
- "Montreal had been the gateway to Canada because you had to land there, the planes wouldn't go any further, but Toronto was the market people were heading for, and when they could overfly Montréal, they would. Now they can."[2] Flights between Europe and North America had used Montréal as a refueling point and gateway. As the aircraft flight ranges became longer, flights non-stop to Toronto became possible.

- Slow growth of traffic at the Montréal airports was due to " the change in overseas traffic patterns between Montréal and Toronto, which followed new bilateral agreements (of the early 1970s) between Canada and several European countries..." which gave "traffic rights to Toronto".[3] Alitalia, Lufthansa, KLM, Swissair and Air France all commenced scheduled service to Toronto between 1972 and 1976.[4]

- "Two airport systems are an abomination in air travel that is to be avoided at all costs" was the opinion of one travel agency.[5] The issue of passengers finding airport transfers between Mirabel and Dorval airports a deterrent to travel via Montréal is a discussion that continues with the recent attempts of les Aéroports de Montréal to transfer the international scheduled flights from Mirabel to Dorval. "Montréal's dual airport operation over the last 20 years has severely curtailed its potential to become a major hub in North America," said Jean-Jacques Bourgeault, Air Canada Senior Executive Vice-President. "The decision to maintain the status-quo is simply disastrous for Montréal. Opportunities for new jobs and a much needed boost to the metropolitan region's economy will be lost."[6]

Chart 2 shows the passenger traffic at Montréal relative to the passenger traffic at Toronto over the period 1963-1995. The positive impact of Expo 67 is evident with the traffic at Montréal reaching 95% of the level of traffic at Toronto. After that high, however, Toronto continues to outstrip Montréal. In all of the statistical data presented in this paper, the market of Montréal will include the data for both Dorval airport and Mirabel airport. It is interesting to note that the impact of the introduction of Mirabel airport in November 1975 is not visible in Chart 2. The declining importance in Montréal relative to Toronto's aviation traffic had already been established. In this paper, the focus will be an examination of the variables used in aviation forecasting models in an attempt to determine if there were underlying socio-economic trends that explain the different aviation passenger growth rates.

Chart 2 Ratio of Enplaned and Deplaned Passenger Traffic, Montréal/Toronto



Source: Aviation Statistics Centre, Statistics Canada

Both the Federal Aviation Administration (FAA) and Transport Canada have developed top-down forecasting models for aviation. The models are national rather than airport/city specific models and tend to use more aggregate variables. Among the key variables considered by the FAA and/or the Transport Canada forecasts are:

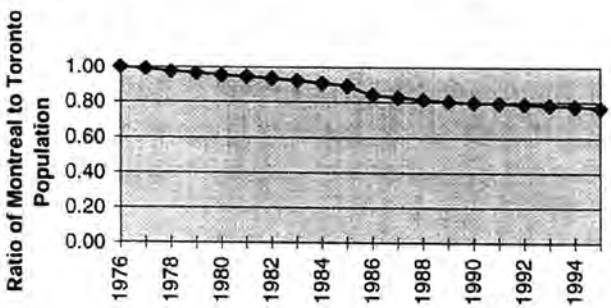
- Population (Transport Canada and FAA)[7]
- Gross domestic product (Transport Canada and FAA)[8]
- Income (Transport Canada and FAA)[9]

The trends for the Montréal and Toronto areas for these variables will be examined to see if they may explain the different trends observed in the Montréal and Toronto aviation markets.

Population

It would be tempting to attribute the differences in the passenger aviation market growth between Toronto and Montréal to being simply differences in population growth. This is almost certainly an explanation for some of the difference. The population of the census metropolitan areas (CMA's) of Montréal and Toronto were both approximately 2.8 million in 1976. By 1995, Montréal had grown to 3.3 million but the population of metropolitan Toronto was one million higher (4.3 million). With a larger population, Toronto would tend to be the larger aviation market. As Chart 3 shows, however, the population of the Montréal CMA although declining relative to the Toronto CMA between 1963 and 1995 was still at 77% of the Toronto CMA population in 1995. The decline in the relative size of the Montréal aviation passenger market relative to Toronto's observed in Chart 2 was from 95% to 39%. The relative passenger decline was twice that of the relative population decline.

Chart 3 Ratio of Census Metropolitan Area Population, Montréal/Toronto

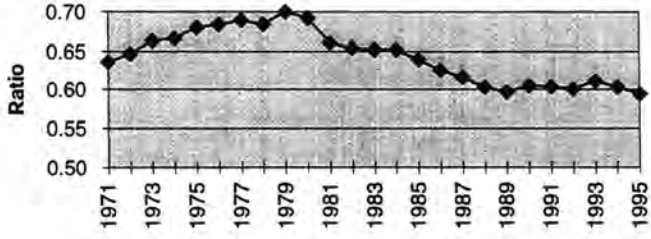


Source: Statistics Canada CANSIM matrices C122107, D122107, C122121, D122120

Gross Domestic Product (GDP)

There is a strong relationship between aviation growth and the economy. Both the U.S. Federal Aviation Administration and Transport Canada use GDP as a variable in their aviation forecasts. The Airport Inquiry Commission into the Pickering Airport stated that "Historically air travel has responded to the Gross National Product."[10] Unfortunately, it is difficult enough to produce provincial estimates of economic activity let alone estimates for metropolitan areas. For this reason the provincial estimates will be used. The ratio of Québec to Ontario for the provincial estimates for final domestic demand in millions of dollars at 1986 prices are shown in Chart 4. On the assumption that much of the economic activity of the two provinces is centred in their largest metropolitan areas, the provincial data may be considered a proxy for Montréal and Toronto. The data would suggest that Toronto (Ontario) should have had the faster aviation growth than Montréal (Québec).

Chart 4 Ratio of Final Domestic Demand, Québec/Ontario, 1971-1985



Source: Statistics Canada CANSIM matrices D44570 and D44588

Income

There is a strong relationship between income and the propensity to use air travel. Transport Canada has tried using average per capita personal income (Statistics Canada), average per capita personal income (Taxation) and average family income (Statistics Canada) as the variable to represent "income" in their aviation forecasting models. "There was no significant difference in the performance of the model, whichever of these highly correlated variables was used."[11] The FAA states that "Non-business travel has grown over the years... [as] the incomes of average Americans have grown".[12] The Canadian Transport Commission also concluded in a study on inter-city air travel that the "proportion increased steadily with income".[13]

Table 1 Household Income—All Private Households, Montréal and Toronto Census Metropolitan Areas, 1991

Household Income	Montréal CMA, % of Households	Toronto CMA, % of Households
under $10,000	11	5
$10,000-$39,999	44	33
$40,000-$69,999	29	31
$70,000 and over	16	30

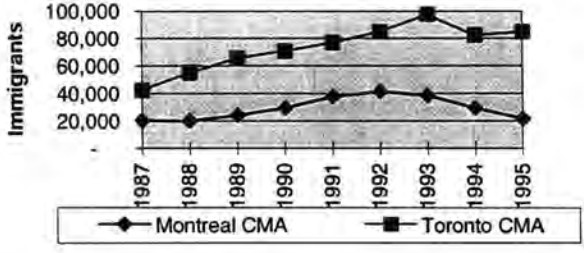
Source: Statistics Canada Catalogue 93-338

Table 1 shows that, in 1991, the Montréal CMA had a higher proportion of low income households than the Toronto CMA. The percentage of Montréal households with incomes under $10,000, 11%, was double Toronto's. Toronto had almost twice the percentage of households (30%) in the highest income bracket. In absolute numbers, there were 175 thousand families in the Montréal CMA with an income of $70,000 and over. The Toronto CMA had 338 thousand families in this highest income group with the greater propensity to travel by aviation.[14]

Immigration

Immigration is a variable not used by either Transport Canada or the FAA in their forecasting models but which may be another important variable explaining the aviation markets.[15] The 1991 Census data indicate that the Toronto census metropolitan area has been greatly influenced by immigration. The data show an immigrant population of 1.5 million or 38%. This compares to an immigrant population one third the size at one-half million or 17% in the Montréal CMA. [16] Chart 5 shows that the annual immigration during the period 1987-1995 continues to be higher in Toronto. This could help to explain the differences seen in the aviation growth in the two markets: "recent immigrants with a high propensity to generate international travel to their countries of origin (at least for the first and second generation)". [17] The Visiting Friends and Relatives (VFR) market would tend to be positively influenced in two ways in a market with a larger proportion of foreign born residents. This could have a stimulative effect on new Canadians returning to visit their countries of origin. In an article concerning the re-commencement of flights to Toronto from Yugoslavia, a spokesman for JAT Yugoslav Airlines "said the airline will primarily cater to the large Yugoslavian community in Toronto, adding the non-stop Canada-Belgrade service will look attractive to those wanting to visit Yugoslavia to see relatives".[18] A large immigrant community could also be a draw for those from the "home country" to visit relatives in Canada.

Chart 5 Immigration by Census Metropolitan Area, Montréal and Toronto, 1987-1995



Source: Statistics Canada CANSIM matrices C122188 and C122202

Business Travel—Head Offices

While much of the discussion above tended to concentrate on personal travel, business travel is another portion of the aviation market. What factors could affect business travel? Much has been written in the press about the exodus of head offices from Montréal to Toronto (and elsewhere in Canada). According to the Montréal Gazette, "the top three head-office cities, in order, are Toronto (258), Montréal (150) and Calgary (92). Even though Montréal is actually No. 2, today's head-office stats are in stark contrast to those of the 1950s, before Toronto took over as finance capital."[19] A loss of head offices could have a negative effect on the demand for business travel originating in Montréal as well as affecting the demand for trips to Montréal as a destination.

Conclusion

Over the past thirty years, the aviation markets of Montréal and Toronto have both grown but the growth has been markedly greater for Toronto. This paper attempted to show that outside of the technical reasons often cited for the different patterns (division of traffic between Mirabel and Dorval, changes in aircraft stage lengths, changes in bilateral agreements) there were underlying socio-economic reasons[20] for the changes. Toronto's larger increase in population, better economic performance, higher income, greater immigration and gains in head offices all contributed to a better performance than Montréal in terms of the aviation passenger market.

Note

The views and opinions expressed in this paper are those of the author and do not necessarily reflect those of Statistics Canada. I would like to thank Lisa Di Piétro, Rolf Hakka, Tricia Trépanier and John Ross for their valuable comments, corrections and criticisms while retaining all responsibility for any remaining errors.

Endnotes

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[1] Charles Dickens, A Tale of Two Cities.
[2] Paul Davoud, former Chairman Air Transport Board quoted in Walter Stewart's Paper Juggernaut, page 25, (McClelland and Stewart, Toronto, 1979).
[3] T.M. McGrath, History of Canadian Airports, (Lugus Publications, 1992), page 156.
[4] T.M. McGrath, History of Canadian Airports, (Lugus Publications, 1992), page 233.
[5] Dominion Travel Agency of Toronto Board quoted in Walter Stewart's Paper Juggernaut, page 35, (McClelland and Stewart, Toronto, 1979).
[6] Air Canada press release, AIR CANADA TO CANCEL NEW MONTREAL SERVICES FEBRUARY 27, February 19, 1997.
[7] Transport Canada, Canadian Aviation Forecast Conference, December 8, 1994 Conference Proceedings, page 13.
Federal Aviation Administration, FAA Aviation Forecasts Fiscal Years 1979-1990, page 46.
[8] Transport Canada, Canadian Aviation Forecast Conference, December 8, 1994 Conference Proceedings, page 13.
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[9] Transport Canada, Canadian Aviation Forecast Conference, December 8, 1994 Conference Proceedings, page 13.
Federal Aviation Administration, FAA Aviation Forecasts, Fiscal Years 1996-2007, page II-12.
[10] Report of the Airport Inquiry Commission, page 46, (Information Canada, Ottawa, 1974).
[11] Transport Canada, PODM: Air Passenger Origin-Destination Model, TP 2195E, Volume 1: Summary Report; page II-3; Policy & Coordination, Economic Analysis, Air Statistics and Forecasts.
[12] Federal Aviation Administration, FAA Aviation Forecasts, Fiscal Years 1996-2007, page II-12.
[13] R. Daigle, Personal Travel and Transportation Expenditures in Canada, page 27 (Research Branch, Canadian Transport Commission, Ottawa, August 1978).
[14] Statistics Canada catalogue 93-338, Profile of Census Metropolitan Areas and Conglomerations -Part B, pages 56 and 126.

[15] While not a direct variable, Transport Canada's population forecasts does include immigration estimates.
[16] Statistics Canada catalogue 93-338, Profile of Census Metropolitan Areas and Conglomerations -Part B. Immigrant population "refers to persons who are, or have been, landed immigrants in Canada".
[17] Richard Fisher in Transport Canada's, Canadian Aviation Forecast Conference, December 8, 1994 Conference Proceedings, page 83.
[18] Canadian Travel Press, JAT Set To Resume Canadian Service, May 2, 1996, pages 1, 21.
[19] Montreal Gazette, Calgary No. 2? Not yet But we're facing head-office drain, November 26, 1996, page A1.
[20] The socio-economic factors included in the Transport Canada and the Federal Aviation Administration aviation forecasting.

EVALUATION OF THE NEW JERSEY I-80 HOV LANE

by Nicholas C. Antoniou, Hong Lin, and Louis J. Pignataro
Institute for Transportation, New Jersey Institute of Technology

ABSTRACT

This paper presents the results of the I-80 High Occupancy Vehicle (HOV) lane evaluation study based on two years of operation. The purpose of the study is to determine the effectiveness of the eastbound and westbound I-80 HOV lanes between Route 15 and I-287 in Morris County, New Jersey. The evaluation program included defining the goal and objectives for operation of the HOV lanes, and measures of effectiveness to determine if objectives were met, based on the following tasks: (i) Review of available traffic count data, (ii) Data collection, and (iii) Data analysis.

The I-80 HOV lanes extended from the vicinity of Route 15 to approximately one mile east of I-287. The lanes are 10.6 miles eastbound and 10.2 miles westbound. The HOV lanes operate in the left travel lane eastbound from 6:00 AM to 9:00 AM and westbound from 3:00 PM to 7:00 PM for buses and carpools/vanpools with two or more people. When not operating as an HOV facility, the lanes are open to general-purpose traffic. There are no buffers to separate the eastbound and westbound left travel lanes from the adjacent travel lanes. HOV traffic may enter and exit the HOV lanes from the adjacent travel lanes along their entire length. The HOV lane pavement is marked with the standard diamond symbol. Signing alerts motorists to the HOV designation, vehicle occupancy requirements, and operating periods.

The inside shoulder adjacent to the HOV lane is typically 9 feet wide. At intervals of 3 to 4 miles the inside shoulder is widened to provide enforcement areas. At these locations, troopers can observe traffic in the HOV lane and pull over violators.

The goal of the I-80 HOV lanes is to increase the people-moving capacity of the I-80 corridor during peak periods by moving more people in fewer vehicles than if the left lanes had been opened to general purpose traffic.

The principal results of this evaluation are: (i) overall traffic congestion relief, (ii) reduction in vehicle miles of travel and (iii) reduction in vehicle emissions. Based on these results, it can be stated that the I-80 HOV lane has been implemented successfully.

INTRODUCTION

This paper focuses on the evaluation of the effectiveness of Route I-80 High Occupancy Vehicle (HOV) lane in Morris County, New Jersey.

Congestion is a significant and growing problem in all urban areas in this country. There are several suggested solutions for freeway congestion. Most of them, however, are not politically or financially feasible. Additional new freeways, light-rail and other high-capital alternatives are not viable in most areas because of fiscal constraints, limit of right-of-way as well as some policy restrictions such as the Clean Air Act Amendments of 1990.

Studies show that on most congested highways there are only seven occupants for every six automobiles in use. If just one more of these single-occupant vehicles doubled its occupancy, it would reduce traffic volume by at least 10 to 15 percent [1].

Less costly alternatives such as an HOV facility are more feasible currently. An HOV facility is a reserved lane(s) on a freeway for the exclusive use of buses, carpools and vanpools, so that they can bypass peak period congestion on the general use lanes. These alternatives attempt to make the existing highway system more efficient by accommodating greater demand for the movement of people rather than vehicles. The Federal Clean Air Act Amendments of 1990 and Intermodal Surface Transportation Efficiency Act of 1991 limit new highway construction to HOV lanes in urban areas that do not comply with clean-air requirements.

New Jersey is within one of the six non-attainment areas that do not comply with the requirements of the Clean Air Act. The two major air pollution items caused by automobiles are ozone and carbon monoxide.

Priority facilities for HOVs are steadily gaining acceptance throughout North America. A consensus appears to exist that, in the proper environment, priority HOV lanes can be an effective means of increasing the person-movement capacity of a corridor.

Adding a HOV lane to an existing highway can potentially increase the efficiency of a highway in the following ways:

(a) by increasing people-movement capacity of the facility;
(b) by offering high-speed travel to a large number of people;
(c) by providing an incentive for people choosing ridesharing (increasing the vehicle occupancy);
(d) by decreasing vehicle operating costs.

HOV lanes on I-80

A new fourth lane was added in each direction within the previous median of I-80 from Route 15 to the vicinity of Route I-287 (average length of 10.5 miles). These new lanes were opened to traffic as a dedicated HOV lane during the peak periods (6:00 to 9:00 AM for east bound and 3:00 to 7:00 PM for west bound) on March 1994.

The feasibility study for the I-80 HOV lane was initiated by the New Jersey Department of Transportation in February 1991. The evaluation study included an analysis of technical data (traffic patterns, nature of congestion, roadway characteristics) and a public attitudes survey via telephone and executive interviews [2]. Similar stages, which included preliminary concept viability, alternative identification, development of recommended alternatives as well as project documentation, of other corridors in US were being used in the study. In January 1992, the steering committee agreed that the HOV lane could operate successfully on I-80, based on:

- HOV lanes are needed due to
  - traffic congestion
  - Clean Air Act Amendments;
- The lanes should be implemented in late 1994 upon completion of the Route I-80 widening;
- A major public outreach program is needed.

The I-80 HOV lanes were open to traffic in March 1994. Traffic data such as volumes, vehicle occupancy, travel time and travel speed of both HOV lanes and general purpose lanes were collected by the Institute for Transportation at New Jersey Institute of Technology and Parsons Brinkerhoff Quade & Douglas, Inc. every month through March 1995, and then quarterly through March 1996.

There are more than forty projects in operation on either separate rights-of-way or within freeway rights-of-way in North America. Besides, there are many more applications of HOV projects on arterial streets, bus-only lanes in downtown areas, and HOV bypasses at freeway ramp meters.

Although there are no two HOV projects that are exactly the same because each is tailored to specific objectives and local policies, four categories are normally adopted in the classification of high-occupancy vehicle lanes [3]:

- *Two-way (or Bi-directional) barrier-separated lanes: One or more lanes operating in both directions of travel, usually on a 24-hour basis.*

- *Reversible-flow: One or more barrier-separated lanes operating in one direction in the morning and the opposite direction in the evening.*
- *Contraflow: Usually one lane that is borrowed from the mixed-flow lanes and converted to operate in a direction opposite that of adjacent traffic during at least portions of the day.*
- *Concurrent-flow (or contiguous): One or more lanes operating in the same direction as adjacent mixed-flow traffic lanes, operable for at least portions of the day.*

I-80 HOV lanes are in operation of non-separated concurrent flow lanes, which represent the largest group of HOV facility projects. There are more than twenty HOV facilities currently in operation with concurrent flow HOV lanes. Concurrent flow lanes utilize both the inside and outside lanes or shoulders of the expressway to provide an operation that corresponds to, and frequently interacts with, the direction of traffic next to it. The concurrent flow lanes could be either buffer-separated or non-separated lanes. The obvious benefits of non-separated concurrent flow lanes are low requirements of right-of-way and compatible operation with an adjacent traffic stream. But the inherent ease of entering and exiting the lanes also results in safety consideration associated with differences in travel speeds and high violation rates.

HOV CONSIDERATIONS

Planning

Studies [3] [4], have indicated that priority facilities of HOV are appropriate in corridors where:

- Significant traffic congestion is observed or forecast (The goals of HOV lanes are to provide more efficient travel for HOVs. than vehicles on mixed flow. This can only be true with severe, recurrent traffic congestion.),
- It is difficult or unfeasible to add more mixed-flow lanes,
- Affinities for ridesharing and transit use are rather high, and
- An opportunity exists to provide a preferential means of circumventing congestion.

Demand Forecasting

At the project planning level forecasting of demand of HOV facilities can be reasonably well predicted. The traditional four steps of demand forecasting can be used in the forecasting of HOV facility projects.

Within the 4-step process (trip generation, trip distribution, mode split and network assignment and analysis), there is no total agreement on what elasticity is appropriate to use.

Design

A set of guidelines on HOV facility was published by AASHTO[1] in 1991. The AASHTO report includes three major sections: planning and operation, design, and design of HOV facilities on surface and arterial streets.

The ITE[2] also published a report on the *Design Features of HOV Lanes*; the report provides information containing a summary of practices that may be useful in designing HOV facilities [5]:

- The design characteristics of the different types of HOV lanes are detailed. Cross-sections for the different types of facilities are also provided in the report.
- Different approaches of signing and marking HOV facilities are outlined and discussed.

HOV projects can be developed as part of new freeway construction, freeway reconstruction, re-striping existing freeways, or some combination of these [6]. HOV facilities separated by barriers or buffers are generally regarded as the design option, which offers more operational benefits than non-separated or contiguous HOV facilities. Sometimes, the separated option is often precluded by right-of-way constraints.

Safety

Studies have shown that accident rates on barrier separated HOV facilities and on exclusive, buffers separated facilities tend to be low. Accident rates on concurrent flow facilities are difficult to identify because of lack of data, and it is hard to determine if the accident was caused by either traffic in HOV lanes or in general purpose lanes.

The safety issue of concurrent flow HOV facilities could be extremely complex since most of these facilities involve using the narrowing of general-purpose freeway lanes. However, most of the available data showed that the accident rate kept constant or even went down after the utilization of HOV facilities compared to the before accident rate.

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[1] American Association of State Highway Transportation Officials

[2] Institute of Transportation Engineers

The distribution of accident locations is critical to determining any influence of the operation of the HOV lane. A study showed that there was significant migration of accident locations. *The shift is due to the severe traffic bottlenecks downstream of the project* [7].

Occupancy and off-peak use

Occupancy is one of the flexible aspects of an HOV facility. The occupancy requirement is very important to the effectiveness of an HOV facility and should be defined based on the anticipated demand and goals of each project. It may be necessary to raise the occupancy requirement if travel demand keeps increasing.

How to use HOV facilities more efficiently is another issue relating to the operations of HOV facilities. Currently, many HOV facilities only have occupancy restrictions during peak periods. So all vehicles can use both the HOV facilities and general-purpose lanes during off-peak periods to reach network equilibrium and use the facilities efficiently.

The I-80 HOV lanes are designated to have occupancy restriction only in the peak direction during peak periods.

Enforcement Cases

Adequate enforcement measures should be incorporated into the design of HOV lanes. Enforcement personnel should have a convenient and safe area to pull violators over and issue a citation [8]. Different enforcement strategies should be applied, depending upon the purpose. For example, warning and mail-out (based on license plate) are suitable for the first few weeks of the project. Citations should not be issued until people become familiar with the concept and function of HOV facilities.

The possibility of using video equipment in HOV lane surveillance and enforcement activities has arisen in the current investigation of HOV lane violations. But the accuracy of a video camera to document with certainty the exact number of vehicle occupants is questionable.

Enforcement personnel should be involved in all aspects of planning, designing, and operating HOV facilities.

Some studies are trying to identify factors leading to high violation rates and developing counter measures to address these factors.

Evaluation

Several aspects of an HOV facility should be evaluated in order to understand the efficiency of the facility [9].

Comparing the number of people in the HOV lane with the number of people in the fixed-traffic lanes is the most common approach for

evaluation since the people moving capacity of HOV facilities is quite important.

Shorter travel times experienced on an HOV lane compared to that on general purpose lanes could provide the best understanding for establishing HOV lanes. Studies have indicated that people are more sensitive to travel time saving than fare reduction or other incentives. Reliability and shorter travel time are the most effective incentives for ridesharers.

Evaluation of the whole corridor instead of just the HOV facilities will provide more sophisticated insight of the effectiveness of HOV facilities. Mode shift should be measured very carefully, it is necessary to conduct surveys of HOV lane users to identify the formation of new carpools and vanpools. Long-term measurements and evaluations are needed to identify the full range of benefits that may develop over time.

It is important to continue to monitor HOV facilities to evaluate the success of the lanes, identify potential violation problems, and provide adequate management and public information for the facilities.

Demand Management

Based on the concept that both financial and right-of-way resources should be conserved by influencing or managing the demand on the transportation system, different approaches should be taken to influence the distribution of demand.

Normally, incentives and disincentives are combined to manage transportation demand more efficiently. Incentives of HOV facilities include travel timesaving, cash reward by employees, preferential parking locations, and so on. Disincentives include fines for HOV facility violators, narrowing the speed difference between single occupancy automobiles and transit. The most effective single action for managing transportation demand would be to *start charging the full cost for all transportation* [10], however, the question of equity must be dealt with when applying the concept of congestion toll pricing.

There are several travel demand management (TDM) strategies that are currently used to encourage riders to shift to carpools and vanpools.

Adequate enforcement is another important feature of the HOV system management strategies. Vehicle occupancy levels and other usage restriction should be provided for successful operation of HOV facilities.

A number of other services are also used to support the HOV lanes. These include expanded or new bus services, marketing, rideshare matching services, and the monitoring program [11].

Research Needs

Based on prior national conferences on HOV systems, Charles A. Fuhs concluded that the following topics, concerning the planning and evaluation of HOV facilities, were deficient and needed more research and technology exchange [3]:

- *The Planning Process.* Existing planning tools have not been modified to reflect experience gained, although several publications have attempted to address planning warrants and measure effectiveness when studying candidate corridors.
- *Evaluation Methods.* Dissemination and testing of the measures of effectiveness are needed to provide a better basis for evaluation.
- *Demand Estimate.* More research is needed on the factors that affect demand estimate, and "standard procedure" for demand estimate should be developed.
- *Transportation Demand Management (TDM) and Private Sector Relationship.* More TDM research is needed for understanding the effectiveness of HOV facilities relative to benefits associated with related TDM strategies.
- *Cooperation Technology Linkages.* HOV planning and evaluation is a multidisciplinary subject that require understanding of such topics such as air quality statues and ITS technologies. Technical linkages between HOV practice with other disciplines should be promoted in the future studies.

EVALUATION METHODOLOGY

Objectives

The objectives of I-80 HOV lanes are [12]:

- *Improving the capability of the I-80 corridor to move more people during peak periods by increasing the number of persons per vehicle within one year of beginning operation of the HOV lane,*
- *Provide travel time savings to high-occupancy vehicles utilizing the I-80 HOV facility (as compared to general purpose traffic),*
- *Increase the person movement efficiency of I-80,*
- *Provide and maintain a quality of flow for HOVs that is a minimum of level of service C and is equal to or better than the quality of flow for general purpose lanes,*
- *Be safe and not unduly impact the safety of the I-80 general purpose lanes,*
- *Have public support for I-80 and other future HOV projects,*

- *Have favorable impacts on air quality and energy consumption,*
- *Increase (or at a minimum sustain) the operating efficiency of bus service in the I-80 corridor,*
- *A low violation rate of the I-80 HOV lanes should be achieved and maintained,*
- *Be a cost-effective transportation improvement.*

In accordance with the Evaluation Plan made by the New Jersey Department of Transportation, there are three time periods that were considered in the determination of desirable performance levels.

Evaluation Time Frame:

• March 1994	"Day One" of Operation
• April 1994 through March 1995	One Year Startup Period (Year One of Operation)
• April 1995 through March 1996	Second Year Short Term Operation (Year Two of Operation)

All the conclusions drawn from the existing data in this paper are compared with the desirable performance levels of the startup period specified in the I-80 HOV lane Evaluation Plan.

Measures of effectiveness

Improve the capability of the I-80 corridor to move more people during peak periods by increasing the average vehicle occupancy within one year of beginning operation of the HOV lane.

Increase in the average vehicle occupancy (AVO) for I-80. Actual AVO on I-80 is compared to the AVO, which would have been experienced if all lanes of I-80 were open to general-purpose use.

Number of persons served by the HOV lane in the peak-hour versus the average number of persons served per general-purpose lane in peak-hour.

Actual number and percent increase in carpools and vanpools for I-80 facility (general-purpose lanes plus the HOV lanes).

Provide travel time saving to high-occupancy vehicles utilizing the I-80 HOV facility (as compared to general-purpose traffic).

Provide and maintain a quality of flow for HOVs that is a minimum of LOS C and is equal to or better than the quality of flow of general purpose traffic.

EVALUATION RESULTS

Most evaluations of HOV facilities are in the form of before and after studies, which are structured to examine the same location before and after the implementation of the HOV lane. That situation is somewhat different from that of the HOV lanes on I-80 because the data on traffic conditions before the implementation of HOV lanes on I-80 is either unavailable or cannot reflect normal traffic conditions because of the construction on the segment.

Actual vehicle and passenger counts for HOV lanes and general purpose lanes were obtained from an on-site survey. Manual counts of occupancy and vehicle classification were taken at key ramps and mainline locations. Occupancy counts recorded passenger cars with one, two, and three or more passengers, and vans with three or more passengers. Classification counts recorded passenger cars, light trucks, heavy trucks and buses.

The manual count program focused on the peak direction of travel. All of the eastbound counts were taken between 6:00 AM to 9:00 AM, and all of the westbound counts were taken between 3:00 PM and 7:00 PM.

Travel speed and travel time data were also obtained.

This paper only considers the survey data from the count station located at milepost 38.4 on I-80. Data was complied from July 1994 to April 1995 (on a monthly basis, year one of operation), and June 1995 to February 1996 (on a quarterly basis, year two of operation).

Traffic Volume

Traffic volumes are used in operational analysis. Highway Capacity Software (HCS), which is used in the analysis, is based on the 1994 Highway Capacity Manual [13]. HCS considers only the total volume of a basic freeway section, and assumes equilibrium distribution is achieved in the corridor. Normally, equilibrium distribution is acceptable if there are no restrictions on motorists' choice, and all the motorists are expected to use the lane that will minimize travel time, which results in system equilibrium.

The existence of HOV priority lanes in the corridor prevents equilibrium distribution from being reached. Operational analysis of general-purpose lanes and HOV lanes is performed separately using HCS. Table 1 shows peak period and peak hour traffic volumes, as a total, as per HOV lane, and as a total of vehicles with two or more occupants on I-80.

Table 1. I-80 Traffic Volumes

	Total		HOV Lane		Total 2+	
A.M.	Peak Period	Peak Hour	Peak Period	Peak Hour	Peak Period	Peak Hour
Day One Operation	17,000	6,330	2,500(14.7%)	960(15.2%)	2,710(15.9%)	1,030(16.3%)
Year One Operation	17,000	6,290	2,040(12.0%)	810(12.9%)	2,300(13.5%)	890(14.1%)
Year Two Operation	17,800	6,430	2,150(12.1%)	750(11.7%)	2,340(13.1%)	830(12.9%)
P.M.						
Day One Operation	21,600	6,200	3,060(14.2%)	870(14.0%)	4,110(19.0%)	1,140(18.4%)
Year One Operation	21,200	6,010	2,670(12.6%)	780(13.0%)	3,540(16.7%)	1,000(16.6%)
Year Two Operation	22,000	6,210	2,800(12.7%)	890(14.3%)	3,740(17.0%)	1,090(17.6%)

Table 2 shows peak hour traffic volumes and LOS, as an average for all lanes, as an average for the general-purpose lanes, and the HOV lane on I-80. From these results, it can be readily seen that the LOS on the HOV lane is better than that of the GP lanes.

Table 2. I-80 Lane Traffic Volumes and Level-of-Service (LOS)

	Average Lane		Average GP Lane		HOV Lane	
A.M.	Peak Hour	Level-of-Service	Peak Hour	Level-of-Service	Peak Hour	Level-of-Service
Day One Operation	1,580	C	1,790	C	960	B[3]
Year One Operation	1,570	C	1,830	C	810	B[3]
Year Two Operation	1,610	C	1,890	C	750	B[3]
P.M.						
Day One Operation	1,550	C	1,780	C	870	B[3]
Year One Operation	1,500	C	1,750	C	780	B[3]
Year Two Operation	1,550	C	1,770	C	890	B[3]

Vehicle Occupancy

Since I-80 was under construction for more than three years before the HOV lanes were opened to traffic, there are no reliable traffic volume and occupancy data available for those three years. In May 1991, vehicle occupancy counts were taken at key mainline locations in the I-80 corridor as part of the feasibility study. The average vehicle occupancy was 1.21 persons per vehicle eastbound in the AM peak period and 1.28 persons per vehicle westbound in the PM peak period [12]. Table 3 shows people movement on I-80 as a total and with two or more occupants, while Table 4 shows the average vehicle occupancy on I-80.

[3] LOS for single lane is not addressed in the HCM

Table 3. I-80 People Movement

	Total People		Total People in 2+ Vehicles	
A.M.	Peak Period	Peak Hour	Peak Period	Peak Hour
Day One Operation	21,100	8,080	6,770(32.1%)	2,730(33.8%)
Year One Operation	20,700	7,810	6,070(29.3%)	2,350(30.1%)
Year Two Operation	22,300	8,230	6,760(30.3%)	2,560(31.1%)
P.M.				
Day One Operation	27,700	7,880	10,060(36.3%)	2,750(34.9%)
Year One Operation	27,100	7,620	9,310(34.4%)	2,530(33.2%)
Year Two Operation	28,400	8,000	10,070(35.5%)	2,810(35.1%)

In the Evaluation Plan, the desirable AVO was 1.24 persons per vehicle eastbound in the AM peak period and 1.26 persons per vehicle westbound in the PM peak period [12]. The target AVO has been achieved for the first two years of operation.

Table 4. I-80 Average Vehicle Occupancy

A.M.	Peak Period	Peak Hour
Day One Operation	1.244	1.276
Year One Operation	1.219	1.243
Year Two Operation	1.256	1.280
P.M.		
Day One Operation	1.279	1.271
Year One Operation	1.280	1.268
Year Two Operation	1.293	1.288

Travel Speed

Tables 5[3] and 6[4] show the average travel speed and travel time savings for vehicles in the HOV lanes compared with vehicles in the general-purpose traffic lanes. Travel time savings in the HOV lanes result from the higher travel speed in the HOV lanes compared to the general-purpose lanes.

Table 5[4]. I-80 Peak Hour Average Travel Speed and Time Savings

		Average Travel Speed				Time Savings(min)	
		A.M. Peak Hour		P.M. Peak Hour		A.M.	P.M.
		HOV Lane Speed (mph)	G.P. Lane Speed (mph)	HOV Lane Speed (mph)	G.P. Lane Speed (mph)	Peak Hour	Peak Hour
July	**1994**	64	55	58	26	1.5	14.0
August		60	43	64	64	4.0	0.0
September		55	35	50	29	6.0	9.5
October		58	44	65	58	3.3	1.0
November		59	49	61	47	2.0	3.0
December		57	42	57	43	4.0	3.7
January	**1995**	66	59	63	43	1.0	5.0
February		63	57	62	54	1.0	1.5
March		60	45	67	56	3.5	2.0
April		64	54	67	61	1.7	1.0
June		60	46	64	47	3.3	3.7
October		58	49	61	47	2.0	3.0
December		57	46	61	48	2.5	3.0
March	**1996**	61	40	48	23	5.1	15.7

Additionally, the range of speed is considerably smaller in the HOV lanes compared with the general-purpose lanes.

Table 6[5]. I-80 Peak Period Range in Observed Speeds

	A.M. Peak Period		P.M. Peak Period	
	HOV Lane	G.P. Lane	HOV Lane	G.P. Lane
Highest Speed (mph)	72	65	72	64
Lowest Speed (mph)	54	21	47	23

I-80 HOV Lane Violation Rates

Low violation rates (i.e., less than 10%) have been achieved consistently despite the changing State Police enforcement patterns. This trend should continue provided that a random enforcement pattern be maintained for the HOV lanes.

I-80 Accident Experience

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[4] Travel time savings are for the 10.5 mile average length of the HOV lane (travel times in the HOV lane compared to travel times in the adjacent general-purpose lanes). Travel time savings are based on the "floating car" method wherein test vehicles float with the traffic (i.e., keep up with traffic in the HOV lane, and pass as many vehicles as pass the test vehicle in the general purpose lanes).

[5] Speeds indicated are average speeds over the 10.5 mile average length of the HOV lane and the adjacent general-purpose lanes.

The accident data that was collected suggests that accidents have increased in the months following the initiation of HOV lane operations. However, the evaluation period includes a transition period where motorists were becoming familiar with the new roadway geometry and traffic operation. Therefore, the accident experience should not be entirely attributed to the HOV lane. A follow-up study should be under taken to examine the effect of the HOV lane on accident rates.

CONCLUSIONS

The principal objectives of the HOV lane are satisfied:

a) the HOV lane vehicles move more people than general-purpose lanes,
b) the target AVO is achieved,
c) the HOV lane vehicles experience higher speeds than general-purpose lane vehicles, thus reduce travel times for HOV travelers,
d) the HOV lane vehicles have equal or better level of service than general-purpose lane vehicles, and
e) a low HOV lane violation rates exists.

These results suggest that HOVs from other parallel roadways will divert onto I-80 to take advantage of travel time savings on the HOV lane; in addition some SOVs will divert to the I-80 to receive benefit from better traffic flow on general-purpose lanes. A new equilibrium in the roadway will balance congestion between the three general-purpose lanes and other parallel roadways. However additional study is needed to verify this condition.

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EMERGENCE OF THE MODERN ROUNDABOUT AS A REALITY IN VERMONT AND ITS RELATION TO VERMONT URBAN DESIGN AND DEVELOPMENT

Abstract

The sudden emergence of the modern roundabout in North American transportation results in a growing interest in the brief history and status of roundabout development. The modern roundabout era in the North America began in 1990 and the approximately ten roundabouts in 1994 tripled by the end of 1996. In 1995 two roundabouts in Vail, Colorado and one in Montpelier, Vermont became the first constructed in snowbelt locations. The Montpelier roundabout, first in the northeastern United States, located a block from a middle school and few blocks from the Vermont State House, serves arterial streets.

This paper examines three aspects of Vermont roundabout development and performance: (1) a case study of the four-year Montpelier roundabout history, including the first 19 months of operation; (2) information about five Vermont funded roundabouts and others planned; and (3) an examination and discussion of the roundabout as an urban tool for transportation and land use enhancement based on the Vermont experience.

Following a brief history and description of the modern roundabout and its advantages, the grassroots Montpelier roundabout origin and development is documented. The Montpelier roundabout before-and-after technical performance tabulation is followed by the results of a strongly positive public opinion survey of neighborhood residents and workers. The five funded Vermont roundabouts and others in planning stages are outlined.

The roundabout as an urban phenomenon in Vermont is considered in the context of community and regional land use regulation. Does the roundabout provide a transportation mechanism enabling policy makers to purposefully accelerate automobile "attrition?" For new and existing urban space, can the roundabout foster greater densities and facilitate non-motorized and public transport and commerce – thereby curing or forestalling car-caused "erosion?" "Erosion" is the common sense concept of the general negative automotive-caused process of urban space devolution.

Introduction

The first modern roundabouts built in the United States in 1990 serve a Las Vegas, Nevada major housing subdivision. By 1995 when the Montpelier and Vail, Colorado roundabouts appeared – the first in snow climes in the United States – the modern roundabout population reached ten. A 1996 year-end survey placed modern roundabouts population at about thirty. In Vermont alone, in addition to the Montpelier roundabout, five others are now approved for final design with construction scheduled during the next three years. To dimension the Vermont roundabout activity consider the fact that six roundabouts in Vermont extrapolates to 3,000 nationally.

The Modern Roundabout – the Historical Context

Modern roundabouts emerged first in Britain in the 1960s, spread to British influenced countries and then Europe during the 1970s and 1980s. The recent character of the modern roundabout movement is reflected in an Australian roundabout design guide showing just three entries dating to back as far as the mid-1970s (Austroads, 1993). It was the British adoption of the yield-at-entry (offside priority) rule in 1963 that marks the modern roundabout era beginning. Australia and New Zealand were notable British Commonwealth countries that quickly adopted roundabouts in somewhat different forms starting in the 1970s. France lead the European roundabout movement.

The earliest ancestors of the roundabout no doubt include the centuries-old village centers with circular traffic patterns found throughout the world. In Vermont and New England the town commons evolving in late 17th and early 18th century contain the circular travelways friendly to horse and buggy transportation. Pierre L'Enfant's design of Washington, D. C. early in the 19th century featured radiating boulevards with rotaries at major intersections. Another Frenchman, Eugene Henard, receives credit for the basic roundabout concept late in the 19th century with a design surprisingly close to the modern form (Brown, 1995, p 2). Then in a brief five year period – 1905 to 1910 – Henard's early concept of the roundabout was introduced first in New York City (1905), then in Paris (1907) and finally Britain (1910).

William Phelps Eno, the father of transportation engineering and first New York City traffic engineer, receives credit for instituting the first roundabout at Columbus Circle. The Paris roundabout located at what is now Place Charles d'Gaulle opened in 1907 followed by first British roundabout, "Sollershott Circus," in 1910, part of Letchworth, a new town development.

With the advent of traffic signals use in the mid-1920s, they came to dominate intersection control in most countries. But roundabouts continued to be the major factor in Britain. Today roundabouts and offset T-intersections are the British standard intersection configuration – a cross intersection is an exception. With the yield-at-entry rule in 1963, the potential of the roundabout for service and safety quickly became apparent. British road research and computer software provided the first standard tools for the roundabout designer. Australia and other countries developed somewhat different roundabout design guidelines and analytical tools.

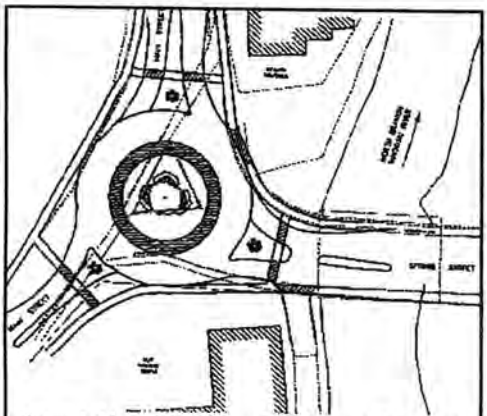


Figure 1 Montpelier, Vermont Roundabout at Keck Circle Design (Pinkham Engineering)

Defining the Modern Roundabout

When the term roundabout is used here, it means the modern roundabout, that can be defined as a intersection control device containing a central island, splitter entry islands, and a circulating travelway. In the United States a roundabout with capacity to handle all vehicles requires a minimum diameter of 28 m (90 feet). One to three lane roundabouts usually feature diameters of no more than 55 m (180 ft) (Wallwork, 1996, p 2), while traffic circles and rotaries diameters are 76 m (250 ft) or more in diameter. Roundabouts of less than 28 m (90 ft) diameter can operate carrying a full complement of traffic with some restrictions to larger vehicles.

In addition to the yield-at-entry rule, there are two main characteristics of a modern roundabouts compared to traffic circles and other circular traffic designs: (1) size and (2) deflection. Roundabouts are small compared to the old time traffic circles or rotaries found New England and New Jersey. Drivers strongly dislike traffic circles with their typical operating speeds of 50-65 kmh (31-41 mph) and high accident rates. Yet even large traffic circles accident records place them on an equal footing with traffic signals when accident severity is taken into consideration.

In addition to size, deflection is the second key to the performance of the roundabout. Deflection is the roundabout structure that causes a vehicle to slow at entry because of the curvature of the splitter island plus the reverse curvature the vehicle must negotiate after entry on the circular travelway. Deflection assures speed is reduced at entry and regulated to assure safe negotiation of the circular travelway.

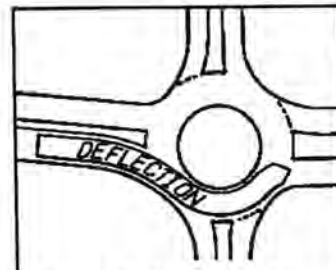


Figure 2 The Principle of Deflection

Advantages of Roundabouts

Roundabout advantages over other types of intersection control include:

1. SAFETY – Compared with signalized or sign control, with careful design smaller roundabouts reduce collisions for all but bicycles (little change) and injury severity for all modes. On average roundabouts experience about half the collision rate of other types of intersection control (Ourston, 1996, p 5). Since about one third of all accidents and injuries occur at intersections, safety is the most important benefit conveyed by roundabouts.
2. INCREASED CAPACITY – Roundabouts provide approximately 30 % greater capacity for motor vehicles than comparable signal systems.
3. REDUCED DELAY – "Stop delay" for three-leg roundabouts at peak hour is about half that of signals, for four-leg roundabouts one third that of signals. During non-peak hours roundabouts routinely operate at Level of Service A (under 5 seconds delay). Even a moderately busy intersection of 25,000 daily entering vehicles at a four-way intersection averages annual stop delay of 50,000 to 70,000 hours at a signal more than the delay at a roundabout.
4. REDUCED FUEL CONSUMPTION AND IMPROVED AIR QUALITY – Roundabouts save fuel usage connected with rapid acceleration and deceleration characteristic of signal or signed controlled intersections. Vermont air quality officials estimate an hour of car idling for a composite motor vehicle consumes 3.8 l (1 gal) of fuel. Thus, the roundabout with 25,000 entering vehicles referred to above may reduce the pollution associated with an annual use of about 227,000 l (60,000 gal) of fuel from additional stop delay compared to a signalized intersection.
5. COST – Roundabouts capital costs are about 10% less than signalized intersections. Roundabout operation and maintenance costs are minor.

Signalized systems consume electric power, require periodic roadway detector loops replacement, and major costs of upgrades and replacement.
6. AESTHETICS – The value of the beauty and aesthetic impact of roundabouts should not be underestimated. Roundabouts can define a community gateway, enliven an intersection area, and highlight adjacent historic buildings. Signals are simply ugly.
7. OTHER FEATURES – Among other advantages of roundabouts are: enabling easy U-turns, reducing noise pollution, traffic calming 91 m (300 ft) in each direction, and improving access to adjacent properties.

Roundabouts surely for foreseeable future will provide the best return for the dollar of transportation investment in North America. A 1997 training manual provides a basic benefit/cost analysis methodology employing time and accident cost savings (Jacquemart, 1997, Sec 3.5).

Roundabouts and Safety

Roundabouts experience substantially lower motor vehicle collision rates than other types of intersections. Accommodating pedestrians and bicycles safely at roundabouts does require careful engineering design. Studies show that pedestrian accidents and severity decrease at roundabouts. Bicycle accidents do not change appreciably but injury severity decline.

Generally, collision rates at signalized intersections are higher than intersections controlled by stop and yield signs, and roundabout collisions were lower than either signalized or sign controlled intersections (Ourston, 1996, pp 2-3). One Netherlands study of 181 new modern roundabout installations before-and-after performance presents data of motor vehicle occupant injuries reduced by 95%, pedestrian injuries 89%, and bicycle injuries 30% (Schoon and van Minnen, p 143).

The few signalized intersections converted to roundabouts – a growing phenomenon – reveal reduced vehicle collision rates, equal or lower pedestrian injuries, and equal or slight increases in bicycle injuries. The first United State data shows sharp declines in collisions and injuries in the 60-70% reduction range (Flannery and Datta, 1996, p 13).

Montpelier's Keck Circle Roundabout

Two young bicyclists inaugurated the first modern roundabout in the northeastern US in the early evening of August 16, 1995 at Spring and Main Streets intersection, about five blocks from Vermont's Capitol. The origin of Keck Circle roundabout in Montpelier, as with many community developments, started in a living room where small gatherings talked about a neighborhood road problem and ways to solve it. In late 1991, the Towne Hill neighborhood discussions sought an answer on how to improve their narrow 1.3 km (0.8 mi) street lacking sidewalks, a road residents

viewed as: (1) subject to frequent accidents; (2) a source of injuries to their children while walking and bicycling; (3) already too high speed for a residential neighborhood; (4) a negative environment for anyone wanting to walk or bike; and (5) soon to be flooded with more traffic from reconstructing and paving of a dirt road connecting link to an arterial highway, US 2 (completed in 1993), thereby making Towne Hill a short cut from outlying towns to Montpelier workplaces.

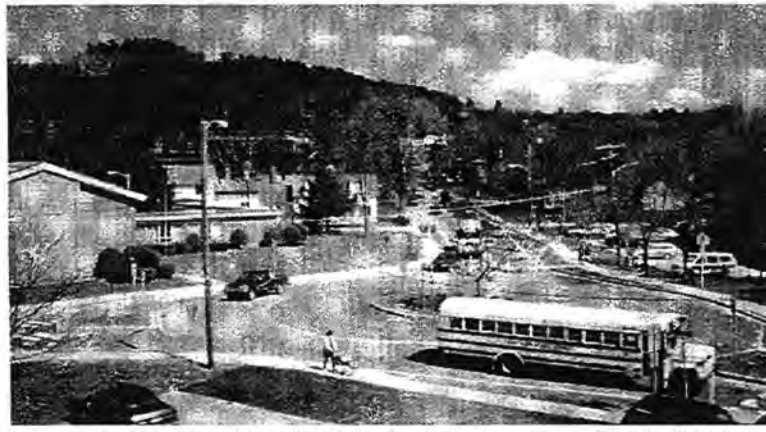


Figure 3 - Keck Circle Roundabout, Montpelier, Vt., 1996 (JIM KNAPP, WILLIAMSTOWN)

The neighborhood expressed a desire for a narrow, slow, pedestrian and bicycle friendly road – not the wider faster smoother highway about to built next door. A full neighborhood meeting in early 1992 articulating this view drew nearly 60 residents. Clearly speed humps and bumps, the only techniques most were familiar with, were not particularly popular alternatives.

A summer 1992 pedestrian and bicycle design training included a day on "traffic calming" techniques. A Florida State Department of Transportation team taught the sessions. One team member, Michael J. Wallwork, P.E., a former district engineer from Melbourne and a leading proponent of roundabouts in the United States, took Towne Hill Road as an example for employing traffic calming techniques, including roundabouts. Wallwork along with a California engineer, Lief Ourston, of Santa Barbara, deserve the positions of Johnny Appleseeds for roundabouts in America. Following Wallwork's presentation, the Towne Hill representatives and other

Montpelier citizens saw roundabouts as a possible traffic calming device for a Towne Hill reconstruction and as a remedy for poorly functioning City intersections. The City Council in the fall of 1992 said "yes" to a request to create the Montpelier Roundabout Demonstration Committee (Committee). The Committee included the Towne Hill group chair, the

Table 1 MONTPELIER'S KECK CIRCLE ROUNDABOUT INFORMATION – BEFORE AND AFTER

DATE OPENED – August 16, 1995 at 7:45 p.m. (two young bicyclists first users).

NORTHEAST FIRST – Keck Circle is the first modern roundabout built in the northeast (north of Maryland and east of the Mississippi). Also, Keck Circle and two roundabouts in Vail, Colorado, opening in mid-1995, were the first built in US snowbelt areas. Keck Circle is the first built in a US urban setting that is used by substantial numbers of pedestrians.

TYPE OF INTERSECTION – A "Y" intersection composed of north to south Main Street intersecting with Spring Street to the west.

ANNUAL AVERAGE DAILY TRAFFIC (AADT) VOLUME – Approximately 11,000 daily; approximately 7,300 AADT each leg. During a typical weekday, about 40 tractor trailers pass through between 6 a.m. and 6 p.m., one about every 20 minutes.

ADJACENT LAND USES – land uses within 152 m (500 ft) include Main Street Middle School (about 400 students), single family and apartment housing, a considerable number of professional and service business offices, a Masonic Temple, historic buildings, the Inn at Montpelier, and a senior housing complex.

THE KECK CIRCLE NAME – Named for a citizen activist, Andy Keck of Montpelier, a Committee member, who died shortly after roundabout construction began.

ACCIDENTS – From 1991 to May 1996, 1.4 accidents per year (all), 0.7 injury accidents per year. Accidents August 16, 1996 through March 16, 1997 (19 months): one, an 83-year-old pedestrian who received bumps and bruises when hit on a crosswalk early in the afternoon. No reportable vehicle collisions (minimum damage over $1,000).

PEDESTRIAN TRAFFIC – Pedestrian counts vary, but intersection counts show volumes up to 260 for the a.m. and p.m.period on school days.

TRUCK ACCOMMODATION – accommodates all trucks including interstate tractor trailers (WB-62).

STRAIGHT "A" "LEVEL OF SERVICE" (LOS) – Before peak hour delay (individual legs A, B, and C) was 6.3 seconds for the average vehicle, LOS B overall. All legs and the intersection overall are LOS A, 2.7 second average delay, for the roundabout (Gamble, 1996). (At non-signalized intersections: LOS A is less than 5 second delay, B 5-10 seconds, and C 10-20 seconds.)

RADIUS OF KECK CIRCLE – Not a perfect circle, the Keck Circle radius (to the outside curb) ranges from 16.1 m to 16.5 m (52.7 ft-54.2 ft). COST – Total cost was $162,000 USD, including 274 m (900 ft) of new sidewalk.

Public Works Director, Police Chief, City Planner and three citizens, one a planning commissioner. Wallwork counseled the project from time to time throughout the period of development. The Committee report went to the City Council in January 1993. The Council encouraged choosing a site and preparing a concept for review. The Committee settled first on a signalized intersection adjacent to the Capitol in part so a roundabout would reduce costs by eliminating a traffic signal.

Public meetings later in 1993 found citizen concerns, particularly over a demonstration roundabout without a walk signal light replacing a signal with a walk phase. Research shows no particular difference in pedestrian safety between an intersection with a typical signal with or without a pedestrian phase (Ogden, p 373). Additionally, the first site could not, as a demonstration site, fully accommodate buses. The Committee decided to look for another site, settling on Keck Circle, then a difficult Y intersection with a triangular island containing a tree, now at the roundabout center. The roundabout cuts pedestrian roadway exposure with a mid-street pedestrian refuge to about 8 m (25 ft) total from the previous 30 m (100 ft).

The City Council approved design and construction funding in early 1994. Public meetings were held during the engineering selection and design stages. An increased sense of confidence from two years of planning caused the decision to move forward with a permanent facility. Then in late spring 1994 with final design plans in hand, the Committee learned the project estimated cost – about $50,000 USD had been assumed – was about $100,000 USD too low. The cost of side walks (274 m [900 ft]) and landscaping alone totaled about $50,000 USD.

With construction plans ready but construction impossible in 1994, the Committee undertook community education and information activities, a fund raising, and grant applications. In the next City budget cycle, December 1994 and early 1995, the Council added $100,000 USD to the $50,000 USD already allocated and the project went to construction in mid-June.

The Committee prepared educational materials, including the brochure "Roundabouts – How to Move in the Right Circles," providing safety and rules targeted to drivers, pedestrians and bicyclists. There was some negative public reaction during construction. The experience where other roundabouts were introduced in the United States was also initially negative from the media and segments of the public. Once introduced, roundabouts quickly become popular, and in Montpelier this was also the case.

Opinion Survey

To measure public opinion, the Committee, a year after the roundabout opening, carried out an unscientific survey of those working and living at or near Keck Circle. The Committee's intent was to: (1) to determine the public opinion after a reasonable time from roundabout installation; and (2) to determine the likes and dislikes of the roundabout, information helpful to Montpelier and others when considering new roundabouts or improvements to existing ones.

The survey results from a 111 person sample are contained in Table 2. Conducted during the summer and early fall of 1996, the five-question survey included two-open response questions inquiring about "likes" and "dislikes" of the roundabout and what was "miss[ed] about the old intersection." Comments totaled 214 from the 111 respondents.

Table 2: MONTPELIER ROUNDABOUT SURVEY RESULTS
OCTOBER 23, 1996 N=111

Please answer the following questions about the roundabout at Keck Circle, Spring/Main Streets. We would like your opinions on how the roundabout operates. Concerns about costs and other issues can be placed in the comments section.

1. Would you say your opinion of the Keck Circle roundabout is:
27.0% (30) – VERY FAVORABLE
30.6% (34) – FAVORABLE
27.9% (31) – NEUTRAL
8.1% (9) – UNFAVORABLE
6.3% (7) – VERY UNFAVORABLE
0.0% (0) – OTHER

2. Is there anything you like or dislike about the roundabout?
Likes _____
Dislikes _____

3. Please check all that apply:
I have:
93.7% (104) – DRIVEN THROUGH THE ROUNDABOUT
80.2% (89) – WALKED THROUGH THE ROUNDABOUT
17.1% (19) – BICYCLED THROUGH THE ROUNDABOUT
0.9% (1) – OTHER (PLEASE EXPLAIN) _____

4. What do you miss about the old intersection? _____

5. Please check residence area and/or employment in area:
69.4% (77) RESIDENT OF NEARBY NEIGHBORHOOD

8.1% (9) MEADOW	**4.5% (5) CROSS/FRANKLINS**
16.2% (18) LIBERTY	**21.6% (24) LOOMIS**
18.9 % (21) MAIN/SPRING	**OTHER (PLEASE EXPLAIN)** _____
44.5% (49) WORK IN AREA	**82.7% (91) FROM MONTPELIER**
17.2% (19) FROM ANOTHER TOWN	

All told 85.5% respondents had a favorable or neutral opinion about the roundabout, 14.4% held an unfavorable opinion. By a four-to-one margin, 64-16, favorable opinions outnumbered unfavorable responses. By a 30-7 margin, "very favorable" responses outnumbered "very unfavorable" responses.

About a third of respondents were interviewed by telephone, a third door-to-door, and the final third were filled out at nearby workplaces – mostly the Main Street Middle School, home businesses, and professional offices. Favorable versus unfavorable ratios were little different among the three groups "drivers," "walkers," and "bicyclists."

Five More Vermont Roundabouts

Five additional Vermont roundabouts have been approved:

BRATTLEBORO – A 1994 intersection study by this small valley city of about 15,000 recommends the entire linear main community artery be redefined by a series of five roundabouts. This roundabout, being built at the VT 9/US 5 intersection, features two circulating lanes, a 53 m (174 ft) diameter, and four legs. The intersection is heavily impacted by trucks accessing New England's largest wholesale food distribution complex.

MANCHESTER – This historic tourist community with the State's largest number of upscale shops features a convergence of roads called "malfunction junction." A 1996 study proposes seven roundabouts, including a "bridgeabout" over a river that literally opens up an additional quadrant to the downtown area to development. The first single lane roundabout is set for 1997 construction.

RICHMOND – Approved in January 1997, this 48 m (157 ft) diameter roundabout becomes the first approved to serve a northeastern United States interstate interchange, I 89 ramps, US 2 and the start of VT 117.

STOWE – The Smuggler's Notch Scenic Road southern entrance becomes site of the first roundabout funded by the US Department of Transportation Scenic Byways Program. The intersection on VT 108 creates a gateway at the scenic road welcome area and serves as the entrance to the new base area of Stowe Mountain Resort.

BENNINGTON – Only a roundabout treatment, approved in 1996 on VT 67A at an entrance road to Bennington College, accommodates the five-leg intersection without impact on an adjacent historic building.

Under Act 250, Vermont's regional/state development regulatory system, certain corridors, including those in Brattleboro and Manchester, reached the point where additional growth was prohibited without increasing the capacities of the existing road system, or reduction of existing traffic through demand management. The quick adoption of roundabouts on a corridor basis in these communities is not surprising.

Roundabouts offer substantially more vehicle capacity along with the bonus of streetscaping, traffic calming, bicycle and pedestrian facilities.

The Roundabout as A Tool for Community Renewal – an Antidote for Urban Erosion, an Elixir for Automobile Attrition

To think of city traffic problems in oversimplified terms of pedestrians versus cars, and to fix on the segregation of each as a principal goal, is to go at the problem from the wrong end. Consideration for pedestrians in cities is inseparable from consideration for city diversity, vitality and concentration of use. In the absence of city diversity, people in large settlements are probably better off in cars than on foot. Unmanageable city vacuums are by no means preferable to unmanageable city traffic.

Erosion of cities by automobiles entails so familiar a series of events that these hardly need describing. . .

If the triumph of other pressures over traffic is carried a step further, however, so as to diminish vehicular traffic, then we have an example of attrition of automobiles by cities. Attrition of automobiles by cities is today almost always happenstance. Attrition, unlike erosion is neither recognized nor practiced as a policy. Nevertheless, it does occur.

Jane Jacobs, *The Death and Life of Great American Cities* (1961, pp 348-349, p 359)

Since the Jane Jacobs book, urban planners and policy makers can point to increasing numbers of successes and trends in automotive attrition. Toronto's Skydome started a welcome trend of downtown sports stadia depending to a larger extent on public transportation, a departure from the America's approach of placing a small sports arena in the middle of a virtual desert of parking spaces. Sparks Street in Ottawa and the Burlington (Vt.) Church Street Marketplace speak to urban space design alive and people-filled with cars relegated to the background. Both Montreal and Toronto underground shopping and service networks totally exclude the automobile.

The roundabout holds promise for renewing our urban spaces where car, pedestrians and other non-motorized modes still interact – from the largest metropolitan area to the smallest village center. The roundabout in its many forms may provide the first truly universal policy tool to enhance pedestrian and bicycle transportation while, surprisingly, contributing to both automobile attrition and automobile accommodation. It can contribute to enabling higher densities of urban development needed for the city to

flourish. In terms of capacity, the modern roundabout provides about 30% more capacity at an urban intersection (Wallwork, 1996, p 3).

The Intersection, Transportation, and the Roundabout Urban Role

The importance of roundabouts relates directly to the role of intersections in transportation and the community. Basic principles and problems of intersections can be found in the encyclopedic *A Pattern Language*, particularly in the describing road crossings (Alexander et al, 1977, pp 280-284):

> *Where paths cross roads, the cars have the power to frighten and subdue the people walking, even when the people walking have the legal right-of-way.*

A "physical arrangement" that favors pedestrians over cars at road crossings is recommended, such as bulbouts, a raised walkway, and "cars . . . forced to slow down when they approach the crossing (Alexander, p. 281)." Except for the raised crossing (certainly a design option), these conditions are met and exceeded by the modern roundabout. The roundabout features a narrowing of the roadway at approaches, slowing vehicle speeds through deflection, and even providing a median pedestrian refuge.

Traffic signals increase pedestrian delay, thereby discouraging pedestrian travel (Norland, 1996, p 10). A land use and transportation research study in Oregon revealed that "ease of street crossing" is one of four critical factors affecting levels of pedestrian use and concomitant decrease in car trips (1000 Friends of Oregon, 1993, p 35). The other three critical factors in pedestrian trip levels are: (1) presence of connective streets; (2) reasonably level topography; and (3) a continuous sidewalk system. Of the four factors, only two – streets connectivity and sidewalks – were controllable in the past. The modern roundabout solves the "ease of street crossing" problem.

In the large context of transportation and land use, the importance of access receives less attention than the twin transportation concept, mobility. Accessibility is a measure of the cost of overcoming spatial obstacles between two sites, most often measured in time and distance. Another way to measure accessibility is the opportunities provided by a number of travel choices. Cost becomes a common element to both approaches, and density of development directly relates to maximizing accessibility within and between nearby locations (Huang, 1997). Low cost transportation options – public transit along with bicycling and walking – are not major factors in suburban sprawl transportation. Their application in view of relatively lower costs compared to the automobile holds promise for a more compact land use design or redesign.

An urban design with strong transit, walking and bicycling elements can increase non-car trips and decrease car trips (1000 Friends of Oregon, 1993, p 31). A community with public transit and bicycle and pedestrian networks, therefore, has higher levels of access at lower cost than typical sprawl conditions. With relatively greater accessibility, as measured by the cost of transportation, in turn, one creates economic pressures for housing, employment, and other development in higher densities.

Urban Development – the Larger Context

What some urban experts term the disease of automotive-driven land use sprawl in North America is described by Joel Garreau (Garreau, 1991) as "edge city." The "edge" of metropolitan areas develops because of cheaper land and supposed universal availability of the car.

The United States is an anomaly in transportation. Except for Britain, all other modern nations protect urban areas from auto dominance (Vuchic et al, 1997, p 1). Canada, for example, changed the course of their auto dominance, in part, following the 1973 energy crisis by raising motor fuel taxes. They broke a trend shared with the United States after World War II of fueling the over dependence on automotive transportation. Today, Canadians drive 20% less per capita than US citizens – solely as the result of fuel pricing – and use transit at 100% higher rates (Schimek, 1996, p 1).

Demographic factors, including eroding incomes for most North Americans, environmental constraints, and limited non-renewable resources – all indicate a renewal and revitalization of inner cities may be a far more likely possibility than the thesis of edge city of endless high-cost sprawl.

Vermont Community and Transportation Renewal – Is it Community Roundabout Renewal?

Community and transportation renewal may well equate with community "roundabout renewal" since one cannot really deal with addressing traffic, circulation, and land use density problems without the use of roundabouts. Because of the multiple positive impacts of roundabouts, particularly in downtowns and village centers, the roundabout alone becomes a node of community renewal that benefits both non-motorized travel as well as increasing access to adjacent land uses. Each roundabout developed provides a node for higher density land use.

Two Vermont studies of community corridors to be renewed by roundabouts exist, Brattleboro (Brattleboro, 1994) and Manchester (Manchester, 1996).The Vermont experience shows that a traditional community planning process, citizens and planners quickly re-orient community design to use the advantages of roundabouts: (1) improving traffic flow and safety of all modes, (2) increasing land use capacities of

adjacent properties with improved access, and (3) enabling a re-design of streets for part or all of the corridor.

This last element, enabling full street re-design, is a surprise for community planners and citizens alike. Roundabouts and their relation to streets in Britain are referred in the concept "narrow roads and wide nodes," the roundabout representing the wide node with narrow road linking roundabouts (Ourston, 1993, p 1). Brattleboro and Manchester new streetscapes plans reflect the opportunities inherent in deploying several roundabouts. In other states this phenomenon has led to the start of wholesale change. University Place, Washington in winter 1997 undertook a thorough community dialogue about transforming a five-lane thoroughfare and creating a main street (the town has none) of two lanes, utilizing former roadway for landscaping, bicycle lanes, and improved sidewalks. All these changes can only be examined because of the application of roundabouts along the corridor. Avon, Colorado – near Vail on I 70 – approved $3.5 million in bond funds in November 1996 for five roundabouts from the I 70 interchange along the major community commercial corridor leading to the ski area that provides the livelihood for this tourist oriented community. The Vermont experience of community roundabout renewal can be found elsewhere in the United States.

In summary, the modern roundabout took root quickly in the United States since its introduction in 1990. The first modern roundabouts in northern climes in Montpelier and Vail proved the popularity of the device in severe winter climates as well as the practicality of maintenance in winter snows. The roundabout possesses a strong set of environmental, aesthetic, operational, cost and transportation advantages. The Montpelier experience featured a strong grass roots development process built on neighborhood concerns for a traffic calming of a major residential street.

Most important, perhaps, in Vermont not only are more roundabouts being built, but the roundabout provides the keystone to urban corridor redevelopment in two major Vermont communities, an experience being repeated in other states. The roundabout may well provide a strong ally in the efforts of small villages and metropolitan areas to aggressively bring a balance of non-motorized and public transport needs with the current automobile dominance, a process Jane Jacobs calls attrition. Most important, the roundabout not only provides attrition of the automobile and a fostering of transit and non-automotive based modes, it may encourage increased urban densities through increased transportation access, a possibility that could be part of the antidote to current sprawl and the edge city phenomenon.

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A Rough Sets Determination of Financial Variables Most Influential in Predicting Motor Carrier Failures

Ray R. Hashemi* **, Louis A. Le Blanc*, William Hinson, Walid Al-Masyabi*, and Garland Chow*****

*University of Arkansas at Little Rock
**National Center for Toxicological Research (U.S.)
***University of British Columbia

Introduction

The financial circumstances of motor carriers has traditionally been a concern of shippers, industry suppliers, carriers and public officials. The financial condition of a carrier is significant for numerous reasons. For example, shippers may want to minimize the risk of having freight delayed or lost by motor carriers declaring bankruptcy. Suppliers (e.g., equipment, capital, fuel, insurance) may wish to minimize their transactions with potential bankrupt carriers which may not be able to meet their obligations. Carriers contemplating acquisition or merger must evaluate the financial condition of prospective carriers, like any other investment.

Lenders and credit analysts examine a variety of financial indicators to make a balanced assessment of a motor carrier's financial health. These indicator, or ratios, are often grouped into separate categories, each gauging a particular aspect of financial strength or weakness. These categories of ratios include: return on investment, capital turnover, financial leverage, liquidity, cash position, receivables turnover, and expense. The purpose of this analysis with a machine learning technique, namely rough sets, is to identify which of the many financial ratios are most influential in predicting motor carrier bankruptcy. The resulting set of indicators could assist in predicting impending financial distress in motor carriers.

Rough Sets

Rough sets (RS) is a mathematical model used to deal with an approximate classification of objects. In this part of the paper, a brief mathematical background is provided. For a comprehensive discussion of RS, please refer to Pawlak (1982, 1984, 1995).

An *approximate space* P is an ordered pair P(U,R) where U is a finite and non-empty set called the universe and $R \subseteq U \times U$ is an equivalence relation on U. R divides the set U into a number of disjoint subsets (equivalence classes).

Let R^* be a family of subsets of R^* and let $X \subseteq U$. If for some $Y \in R^*$, X is equal to the union of all the sets in Y, then X is definable in P; otherwise, X is a *rough set* or *nondefinable*.

Example:

Let the universe of objects be {e1, e2, e3, e4, e5, e6, e7, e8, e9, e10}, Table 1. Furthermore, let R be the "equality of objects in their c1, c2, c3 and c4 values."

The equivalence classes are:

$\rho 1 = \{e1, e7, e10\}$ $\rho 2 = \{e2, e9\}$ $\rho 3 = \{e3\}$
$\rho 4 = \{e4, e8\}$
$\rho 5 = \{e5\}$ $\rho 6 = \{e6\}$ $\rho 7 = \{\varnothing\}$

Let X = {e1, e4, e5, e8). This subset of U is a nondefinable set for Y = $\{\rho 1, \rho 2, \rho 3, \rho 4, \rho 5\}$ where $Y \in R^*$. Because $U\rho_i \neq X$ (for i = 1 to 5).
If X is a rough set, then a decision algorithm may be generated such that for a given $x \in U$ it yields one of the three answers: 1) x is in X, 2) x is not in X, or, 3) x is unknown. Such a decision algorithm may be found using the lower and upper approximation spaces for each given decision.

If $X \subseteq U$, then

the lower approximation of $X = X_* = \{\rho_i \mid \rho_i \subseteq X, \text{ and } \rho_i \in R\}$
and

the upper approximation of $X = X^* = \{\rho_i \mid \rho_i \cap X \neq \emptyset$, and $\rho_i \in R\}$.

The set $M_p(X) = X^* - X_*$ is called a *boundary of X in P*. If the Object $x \in U$ is in the lower approximate space of X, then x is in X. If $x \in U$ is in the upper approximation space of X, then x may be in X (unknown). if $x \in U$ is in the boundary of X, then x is not in X. Suppose the equivalence classes for space P are visualized as a set of rectangles, Figure 1. The equivalence classes for which their objects are in the lower approximation space of X and in the upper approximation space of X are illustrated by dark shaded and light shaded rectangles, respectively. The non-shaded rectangles represent the objects in the boundary of X. The details of the process may be found in Hashemi, Jelovsek and Razzaghi (1993).

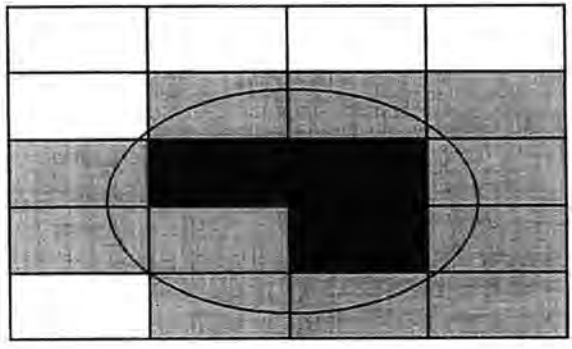


Figure 1. Visualization of Rough Set X

The attraction of rough sets is in formalization of information systems.

An information system, $S = (U, Q, V, \delta)$, where:

U is a non-empty finite set of objects, e:
Q is a finite set of attributes, q;
$V = \cup V_q$, where $q \in Q$ and V_q is the domain of attribute q.
δ is a mapping function such that $\delta(e,q) \in V_q$ for every $q \in Q$ and $e \in U$.
Q is divided into two parts: a set of condition attributes (C) and a decision attribute (D).

Example: Table 1 is an information system. The universe U is composed of ten objects, U = {e1, e2, e3, e4, e5, e6, e7, e8, e9, e10}. Each object in U represents a child (test subject, and e_i may be considered as a subject identification number). In this system, condition attributes are C = {c1, c2, c3, c4}(c_i is a measure of the subject's operant behavior). The decision attribute is the test subject's IQ (i.e., D = IQ). Here, the domain of attributes, v = {1, 2, 3}. The mapping schema (δ) is defined as follows. For the c1, c2, c3 and c4 attributes, 1 = "poor", 2 = "average", and 3 = "good". For the decision attribute IQ, 1 = "below average", 2 = "average", and 3 = "above average".

Two major advantages of the RS approach are: 1) the ability to reduce the number of condition attributes in an information system (system reduction); and, 2) the ability to define and manipulate an information system for the purpose of establishing the relationship between condition values (C) and the decision value (D) in the form of rules. This paper explores the first advantage of the RS approach.

The need for reducing an information system has a economic basis, as well as a broad variety of applications. Examples of RS applications include diagnostic systems, insurance transaction, financial and educational systems. An example of the economic basis for reducing an information systems might be a set of patients who are suffering from the same illness. Often the number of tests administered by a physician on these patients is too great. Does the physician really need the results of all the tests for the diagnosis? The answer is probably no. This means that the fewer tests that are administered bring about large savings for the involved parties, namely: insurance companies, patients, and in some cases for government agencies. But what is the *minimal subset* of the condition attributes that must be chosen. This question is addressed systematically in the next section.

Objects	Attribute 1 (C1)	Attribute 2 (C2)	Attribute 3 (C3)	Attribute 4 (C4)	Decision (D)
e1	1	2	2	1	1
e2	2	2	1	2	3
e3	3	1	1	1	1
e4	3	2	2	1	2
e5	1	2	3	2	2
e6	1	3	1	3	3
e7	1	2	2	1	1
e8	3	2	2	1	2
e9	2	2	1	2	3
e10	1	2	2	1	1

Table 1. A Universe of Objects (An Information System)

Objects	Attribute 1 (C1)	Attribute 2 (C2)	Attribute 3 (C3)	Attribute 4 (C4)	Decision (D)
z1 = {e1, e7, e10}	1	2	2	1	1
z2 = {e2, e9}	2	2	1	2	3
z3 = e3	3	1	1	1	1
z4 = {e4, e8}	3	2	2	1	2
z5 = e5	1	2	3	2	2
z6 = e6	1	3	1	3	3

Table 2. Vertical Reduction of the Information System of Table 1 (Q-Elementary Sets)

Objects	Attribute 1 (C1)
a1= {z1, z5, z6}	1
a2 = {z2}	2
a3 = {z3, z4}	3

Table 3: C1 - Elementary Sets

Objects	Attribute 1 (C1)	Attribute 3 (C3)	Decision (D)
z1 = {e1, e7, e10}	1	2	1
z2 = {e2, e9}	2	1	3
z3 = e3	3	1	1
z4 = {e4, e8}	3	2	2
z5 = e5	1	3	2
z6 = e6	1	1	3

Table 4. The Reduct of the Information System of Table 2

System Reduction

The information system is reduced by removing all redundant objects (rows) and condition attributes (columns) from it (i.e., the information system is reduced both vertically and horizontally). For details of system reduction consult Hashemi et al. (1997). In *vertical reduction*, all the rows that are identical, considering their values in the Q attributes, are collapsed into one row. In Table 1, rows one, seven and ten are identical in their values for the Q attributes and they are collapsed into one row. Also, rows two and nine are identical in their values for Q attributes and are collapsed into one row. Furthermore, rows four and eight are identical in their values for Q attributes and are collapsed into one row. Table 2 represents the vertical reduction that has generated six sets out of the initial universe of ten objects. These sets are z1 = {e1, e7, e10}, z2 = {e2, e9}, z3 = {e3}, z4 = {e4, e8}, and z6 = {e6} and they are called *Q-elementary* set. This means that rows for members of any given Q-elementary set are identical and rows for all sets in reference to their values in Q attributes are unique.

In horizontal reduction, the analysis determines whether the decision (D) depends on all the condition attributes (C) or a subset of C, like C′. If C′ exists, then replaces C and it is called the *reduct* of C. A given information system may have more than one reduct.

To find the reducts of C, if any exist, for the information system of Table 2, the following steps are taken.

a: All the possible subsets of the condition attributes are built. These subsets are: C1= {c1}, C2= {c2}, C3= {c3}, C4= {c4}, C5= {c1, c2}, C6= {c1, c3}, C7= {c1, c4}, C8= {c2, c3}, C9= {c2, c4},C10= {c3, c4}, C11= {c1, c2, c3}, C12= {c1, c2, c4}, C13= {c1, c3, c4}, and C14= {c2, c3, c4}.

b: Repeat steps c and d for all the subsets.

c: Considering only the condition attributes in C1, for example, the objects of Table 2 are organized into three sets called C1-elementary sets (Table 3).

d: If the C1-elementary sets are the same as the Q-elementary sets, then the condition attributes {c1, c2, c3, c4} are replaced by subset C1 = {c1}.

If more than one reduct exists, then one is chosen with the minimum number of condition attributes. If there is a tie, then one is chosen either arbitrarily or by expert consultation. The outcome of the system reduction for this example is shown in Table 4.

Data Analysis

Data were collected for 750 trucking companies for the ten year period of 1976 - 1985. Each motor carrier is represented by an identification section and three repeating groups: demographic, operating characteristics, and financial ratios. Within each repeating group, data were collected for ten years. Although ten sub-records would normally be expected for each repeating group, the actual number of companies with ten sub-records for each repeating group is small. There are two reasons for this: 1) the trucking company was bankrupted somewhere within the period 1976 - 1985; and/or, 2) data is not available for some of the years.

The identification setction along with the three repeating groups have 70 fields, of which 56 are financial ratios. These financial fields are derived from the financial statements of motor carrier firms. Each record also has a classification field. The classification field can exhibit one of two values: a one indicating bankrupt and a zero indicating non-bankrupt. To make the data more useable, four actions were performed on the data, namely cleaning, imputing, lessening and discritization.

Cleaning - Let the number of fields with missing data for a given record be M. If $M \geq 50$, then the record is referred to as a "corrupt" record. Let the number of sub-records for a given trucking company be N where $N \leq 10$. Furthermore, let the number of corrupted sub-records for the same company be K. if $K \geq 0.6N$, then remove the company from the file. This means that the companies with 60 percent or more corrupted sub-records will be removed from the file. Imputing fields of the corrupt records for such a company damages the credibility of the findings. By using this method of "cleaning,", 42 motor carriers were removed from the dataset.

Imputing - After cleaning the data, there were some records with missing data. An averaging approach was used to impute missing data for each field. If the data for the field F1 in G (where $0 < G < N$) sub-records of the motor carrier are x1, x2, ..., xg. The record of the motor carrier with missing data for the field F1 will carry the value of (x1, x2, ..., xg)/g. If $G = 0$, then it is impossible to provide a value of missing data. Therefore, the motor carrier will be removed from the dataset. In general, if $G \leq 0.8N$, then the motor carrier will be removed from the dataset. Eight more companies were removed from the dataset. As a

result, after cleaning and imputing the dataset, 700 motor carriers remained with no missing data.

Lessening - The objective is to replace N sub-records of each company with only one sub-record. To accomplish this, a *simple moving average* technique was employed using the following algorithm.

Algorithm LESSENING

Given:	A dataset with L records is given. Each record has K_i repeating groups. Within the repeating group K_i, there is N_i sub-records and each sub-record has n_i fields.
Objectives:	Replace each repeating group of K_i for the record L_j with one sub-record. Thus, record L_j will not have any repeating group.
Step 1:	Calculate the moving average, MV_m, for field F_m within N_i sub-record of record L_j.
Step 2.	Calculate the standard deviation, SD_m for MV_m.
Step 3.	Build one sub-record to replace all the N_i sub-record of record L_j. The field F_m in this sub-record is replaced by two fields of MV_m and SD_m

The data analysis proceeded to replace the N sub-records of each motor carrier with only one sub-record. For each field in the original dataset, an average (AV) and standard deviation (SD) was calculated. The original dataset was replaced by a new one with 600 records (motor carriers) with each record containing 140 fields.

Discritization - For a given field throughout the file, the values were discritized into three categories of "1", "2" and "3' for "low", "medium" and "high", respectively. Also, the standard deviation values were discritized into three similar categories. Suppose the AV_1 value for field F1 for a given record is two and the SD_1 value for the same field of the same record is three. The value that will represent the field F1 of the record will be 23. By doing so, the number of fields is reduced to the original number of 70.

After the discritization was completed, the dataset was divided into two files named "ratio" and "demographics." The former includes the 56 financial ratios plus the classification field. The latter contains the 14 demographic fields and the classification field.

Results

The RS eliminated 44 of the 56 financial ratios. In other words, these 44 ratios were not related to financial distress or bankruptcy of motor carriers. As a practical matter, only the remaining 12 ratios should be considered in any model building effort, whether the models be statistical or based on machine learning techniques. Table 5 lists the entire original set of 56 financial ratios in seven categories and indicates which ratios were not eliminated by RS. Table 6 shows only the 12 retained variables by category.

The RS eliminated 44 ratios, or 78.6 percent of variables in the analysis. RS eliminated all the ratios in the "cash position" and "expense" categories, although these were relative small categories. RS reduced the number of ratios by the following percentages in these categories: return on investment - 66.7 percent; capital turnover - 80 percent; financial leverage - 85 percent; and liquidity 71 percent.

Summary and Conclusions

RS can significantly reduce the size of an information system on both vertical and horizontal dimensions. The variables and records that are removed are essentially noise. As demonstrated by Le Blanc and Hashemi (1997), RS can improve the predictive accuracy of both neural networks as well as statistical models. More accurately predicting the financial health of motor carrier firms would be of considerable value for many parties, including shippers, suppliers to the trucking industry, and government policy analysts.

Table 5. Financial Ratios for Motor Carriers

Return on Investment (15)

1. Ordinary Income From Continuing Operations Before Taxes / Total Carrier Operating Revenues *
2. Ordinary Income From Continuing Operations After Taxes / Total Carrier Operating Revenues
3. Cash Flow / Total Shareholder Equity
4. Cash Flow Before Taxes / Total Shareholder Equity *
5. Cash Flow / Shareholder Equity + Minority Interest
6. Cash Flow Before Taxes / Shareholder Equity + Minority Interest
7. Cash Flow / Total Assets Less Intangibles
8. Cash Flow / Net Carrier Operating Property *
9. Cash Flow Before Taxes / Total Assets Less Intangibles
10. Cash Flow Before Taxes / Net Carrier Operating Property *
11. Ordinary Income From Continuing Operations After Taxes / Total Assets Less Intangibles
12. Ordinary Income From Continuing Operations After Taxes / Net Carrier Operating Property
13. Net Income / Total Shareholder Equity *
14. Net Income / Shareholder Equity + Minority Interest
15. Net Income / Shareholder Equity - Ordinary

Capital Turnover (10)

16. Quick Assets / Total Assets Less Intangibles
17. Cash Flow / Total Carrier Operating Revenues
18. Cash Flow Before Taxes / Total Carrier Operating Revenues
19. Total Current Assets / Total Assets Less Intangibles
20. Total Shareholder Equity / Total Carrier Operating Revenues
21. Shareholder Equity + Minority Interest / Total Carrier Operating Revenues
22. Total Carrier Operating Revenues / Total Assets Less Intangibles *
23. Total Carrier Operating Revenues / Net Carrier Operating Property *
24. Working Capital / Total Assets Less Intangibles
25. Working Capital / Net Carrier Operating Property

Table 5. Financial Ratios for Motor Carriers (continued)

Financial Leverage (13)

26. Total Liabilities / Total Assets Less Intangibles
27. Total Liabilities / Net Carrier Operating Property
28. Total Liabilities / Total Carrier Operating Revenues
29. Ordinary Income From Continuing Operations Before Taxes / Interest Expense *
30. Total Shareholder Equity / Total Liabilities *
31. Shareholder Equity + Minority Interest / Total Liabilities
32. Total Long-Term Debt / Total Current Assets
33. Cash Flow / Total Liabilities
34. Cash Flow Before Taxes / Total Liabilities
35. Cash Flow/ Total Current Liabilities
36. Cash Flow Before Taxes / Total Current Liabilities
37. Total Current Liabilities / Total Liabilities
38. Total Retained Earnings / Total Assets Less Intangibles

Liquidity (7)

39. Total Current Assets / Total Current Liabilities *
40. Quick Assets / Total Current Liabilities
41. Current Liabilities / Total Shareholder Equity *
42. Current Liabilities / Shareholder Equity + Minority Interest
43. Current Liabilities / Total Assets Less Intangibles
44. Working Capital (CA - CL) / Total Carrier Operating Revenues
45. Quick Assets / Total Current Assets

Cash Position (4)

46. Total Carrier Operating Revenues / Cash + Marketable Securities
47. Cash + Marketable Securities / Total Assets Less Intangibles
48. Cash + Marketable Securities / Total Current Liabilities
49. Quick Assets - Total Current Liabilities / Total Carrier Operating Expenses - Depreciation & Amortization

Table 5. Financial Ratios for Motor Carriers (continued)

Receivables Turnover (2)

50. Total Carrier Operating Revenues / Quick Assets *
51. Ordinary income From Continuing Operations Before Taxes / Net Accounts Receivable

Expense (5)

52. 365 x (Total Current Assets / Total Carrier Operating Expenses)
53. Total Carrier Operating Expenses / Total Carrier Operating Revenues
54. Total Salaries, Wages & Fringes / Total Carrier Operating Revenues
55. Total Salaries, Wages & Fringes / Total Carrier Operating Expenses
56. Net Carrier Operating Property / Total carrier Operating Property

* Indicates which financial ratios were retained by the rough sets analysis.

Table 6. Variables Identified as Most Influential in Predicting Motor Carrier Failure

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Return on Investment (5)

1. Ordinary Income From Continuing Operations Before Taxes / Total Carrier Operating Revenues *
2. Cash Flow Before Taxes / Total Shareholder Equity *
3. Cash Flow / Net Carrier Operating Property *
4. Cash Flow Before Taxes / Net Carrier Operating Property *
5. Net Income / Total Shareholder Equity *

Capital Turnover (2)

6. Total Carrier Operating Revenues / Total Assets Less Intangibles *
7. Total Carrier Operating Revenues / Net Carrier Operating Property *

Financial Leverage (2)

8. Ordinary Income From Continuing Operations Before Taxes / Interest Expense *
9. Total Shareholder Equity / Total Liabilities *

Liquidity (2)

10. Total Current Assets / Total Current Liabilities *
11. Current Liabilities / Total Shareholder Equity *

Cash Position (0)

Receivables Turnover (1)

12. Total Carrier Operating Revenues / Quick Assets *

Expense (0)

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DISAGGREGATE ANALYSIS OF FREIGHT TRANSPORTATION CHARACTERISTICS

Edward S.K. Fekpe, PhD. PEng.
Research Scientist, Transportation Division
Battelle Memorial Institute, Columbus, OH 43201, USA

ABSTRACT

The influence of freight characteristics on the choice of truck configurations within the constraints of the truck size and weight regulations and modal competition is presented in this paper. Corridor level analysis is a disaggregate approach that provides both qualitative and quantitative attributes required to address issues relating to the operation, decision making and modal competition in freight transportation at a national or global level. Disaggregate level analysis provides sufficient basis for assessing the likely implications of inter-jurisdictional, such as a Federal transport regulatory policy changes on truck operations and modal competition in freight transportation.

1.0 INTRODUCTION

Carriers select equipment that conform to the regulatory requirements of the environment in which they operate. In general, carriers attempt to optimize operations by selecting equipment that maximize the allowable weights and dimensions. The truck configuration and body types selected are also dependent on the major commodity types. In terms of freight generation, commercial and industrial activities are not evenly distributed across the country. While agriculture is the major freight generating activity in certain parts of the country, manufacturing and similar industrial activities may be the predominant economic activities in other parts. The analysis and discussions presented in this paper are based on the hypothesis that the legislative framework of the truck size and weight regulations and the nature of freight are the two main groups of variables that determine freight

movement characteristics. These in turn determine the levels of competition between the different modes freight transportation particularly, truck and rail.

Given the differences in the regulations and the spatial diversity of the freight generating activities across the country, an attempt to investigate the likely impacts of any national transportation policy on freight movement can be better addressed at a disaggregate level. This is achieved through detailed analysis of selected corridors. A corridor study is a disaggregate level analysis that provides a manageable size and a better reflection of the issues relating to the possible implications of a range of possible Federal truck size and weight (TS&W) policy initiatives. It also provides both qualitative and quantitative measures that reflect the operation, decision making and trends, modal competition, and the data that exist to develop an overall picture of the freight transportation currently taking place in the corridor. Such a detailed examination is difficult to conduct at the national level.

2.0 CORRIDOR ANALYSIS

Studies were designed to collect sufficient data on the trucking activities along selected corridors and how these activities are influenced by TS&W regulations. The information collected is expected to help understand the nature and develop a quantitative analysis of the transportation activities in the corridors (all modes); and understand the nature of the existing competition between modes and between carriers within each mode. These analyses will assist policy makers to identify specific ways in which changes in truck size and weight regulations will affect the trucking activities and the competitive balance between modes.

The data used in the analyses presented in this paper are obtained from three corridor studies conducted as part of the Multimodal Transportation Industry Analysis and Case Studies component of the U.S. DOT Federal Highway Administration (FHWA) compressive Federal truck size and weight study. These corridors are, the East-West I-90/I-94 corridor stretching a total of 3,273 miles from Seattle, WA to Chicago, IL (1); 1,763 miles of I-75 North-South corridor from Detroit, MI to Miami, FL (2), and East-West I-80 corridor from Chicago, IL to New York City, NY (3). Field data collection efforts include, identification of transport generators along these corridors, configurations and mix of truck traffic and transportation system infrastructure. An attempt was made to identify the main traffic generation and attraction points along each corridor and make field observations

necessary to provide a good perspective of the transportation characteristics within the study areas. Traffic generation is discussed in terms of the major economic, commercial and industrial activities. High concentrations of economical and industrial activities often have a direct linkage with trucking activities. The positive growths of economic activities are reflected in growth of freight and consequently, on truck traffic. Accurate information on commodities transported on a given corridor provides important insights on the likely truck configurations used for transporting the various commodities. For example, certain indicators such as wood products, tend to be associated with relatively heavy cargo loads and multiple trailer vehicles.

3.0 TRUCK SIZE AND WEIGHT REGULATIONS

The legislative frameworks of the governing regulations include, the Intermodal Surface Transportation Efficiency Act (ISTEA) freeze, state TS&W provisions, Federal TS&W provisions, and the Federal Bridge Formula B. It is not possible to present and discuss the size and weight limits of all states served by the corridors in detail. Only the maximum size and weight limits are summarized in the following sections.

Along the Seattle-Chicago (I-90/I-94) corridor, Washington, Idaho, Montana, North and South Dakota and Wyoming have regulations with grandfather provisions. These states permit the operation of longer combination vehicles (LCVs) and gross vehicle weights are determined according to the Federal Bridge Formula B. Triple trailers are not permitted in Washington. Turnpike and rocky mountain doubles are permitted in these states. The maximum gross vehicle weight (GVW) limits are 105,500 pounds in Washington, Idaho, North Dakota; 117,000 pounds in Wyoming, 129,000 pounds in South Dakota and 131,000 pounds in North Dakota. Minnesota, Wisconsion and Illinois maintain the Federal maximum GVW of 80,000 pounds and there are no ISTEA provisions in these states

The TS&W regulations in states along the Detroit-Miami and Chicago-New York corridors are not granfatehered and do not have ISTEA provisions. The maximum GVW for operations on the interstate highway system on these corridors is the Federal 80,000-pound limit. Along the Detroit-Miami (I-75) coridor, Michigan allows higher GVWs and Florida allows higher axle weight limits. Similarly, along the Chicago-New York corridor (I-80), Pennsylvania and New York allow higher axle weights. Tire load restrictions apply in all states. This is specified in terms of pounds per inch of thread

width or wheel load. Single axle weight limit of 20,000 pounds and tandem axle weight limit of 34,000 pounds in maintained in most states. Steering axle limit varies from 12,000 pounds to 20,000 pounds. Tridem axle weight is determined by the Federal bridge formula B.

The maximum width is 8.5 feet in all states. Maximum vehicle height is 14 feet in Washington, Idaho, Montana, the Dakotas and Wyoming. In all other states, the maximum vehicle height is 13.5 feet. Maximum semitrailer length is 53 feet in all except Wyoming where 60-foot semitrailers are allowed. Overall vehicle lengths are not regulated in most states.

4.0 TRANSPORT GENERATORS

The Seattle-Chicago (I-90/I-94) corridor can be considered to consist of two main regions in terms of the truck traffic generation. The west is dominated by agricultural products whereas the east is predominantly industrial and retail activity. The major economic activities identified are agriculture, forestry, mining and allied industries. For example, in Washington state, food and kindred products account for nearly 20% of all freight movements followed by agricultural products with 5%, lumber, wood products and general freight with 10%. West bound commodities are mainly processed beef (for export) and general freight while east bound freight is dominated by fruits, potatoes and imported equipment. Excluding retail, manufacturing dominates commercial activity accounting for about 35% in Illinois. Chicago is a trade gateway with an estimated 61% of the state's industrial and commercial activities are located in the greater Chicago area (1).

Freight generation activities along the Detroit-Miami (I-75) and Chicago-New York (I-80) corridors are very similar. The major economic activities are manufacturing and chemical industries. Processed food and kindred products are the predominant commodities originating from the states along these corridors. These products account for 20-25% of all freight from each state. In New York state, for example, as much as 33% of the freight generated are processed food products. This is followed by chemical products accounting for 20% of total freight tonnage. Along the Detroit-Miami corridor, mining, forestry and paper and print products also generate a substantial amount of freight, in the range of 10-15% of total freight originating from the corridor states (2, 3).

5.0 TRUCK TRAFFIC CHARACTERISTICS

Field traffic data was collected randomly during the daylight hours in both directions of travel by driving along each corridor. The objective was to capture as much spatial and temporal variation in truck traffic characteristics as possible. Information on the body types is expected to provide useful insights into the likely commodity or groups of commodities that are transported along each corridor or are generated from or attracted to the various centers of commercial activity.

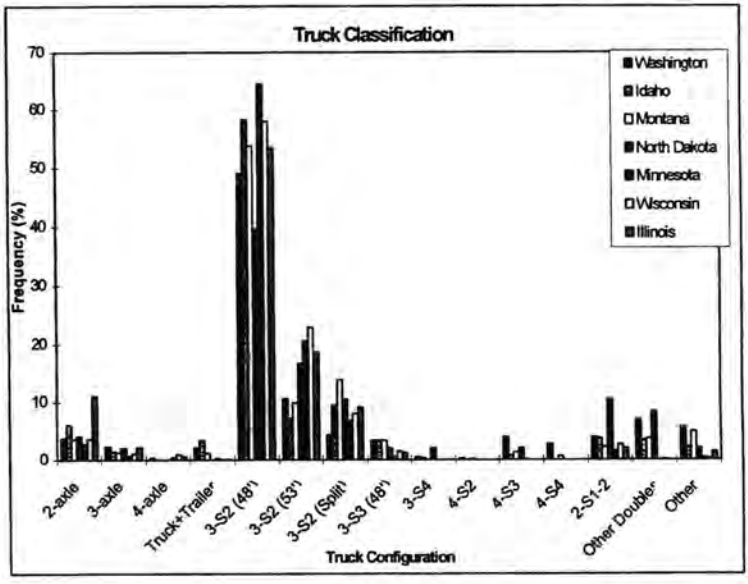
Figures 1 through 3 show the composition by configuration and body type along the corridors. These figures represent the average truck fleet mix in both directions of travel. It is important to note that in terms of statistical representativeness, although the field data was collected for the two directions of travel, it is considered a snapshot of the actual trend of truck traffic flow. The discussion in the following sections emphasize the influence of the size and weight regulation and the freight characteristics on the truck configurations, body types and origin-destination flow patterns.

5.1 Variation in Truck Configuration

In the western states, Washington, Montana, Idaho and North Dakota where the TS&W regulations have grandfather rights and ISTEA provisions and the BFB governs the gross vehicle weights, heavier and multiaxle vehicles are common. The maximum allowable GVW in these states ranges from 105,500 to 131,000 pounds and the Federal bridge formula B is used. Seven and eight-axle tractor semitrailer with airbag equipped liftable axles, and rocky mountain double configurations can be found. In the other states, semitrailer configurations with seven or more axles are virtually non-existent. This is a clear reflection of the differences in the TS&W regulations. In these other states, the maximum GVW is 80,000 pounds and there are no ISTEA provisions. Clearly, the choices available to carriers and shippers is limited.

Truck traffic composition varies along the Seattle-Chicago (I-90/I-94) corridor from East to West. Nonetheless, the five axle tractor semitrailer (3-S2) is the most common configuration in the states along the corridor. The 3-S2 represents 64% - 80% of all truck traffic with higher percentages occurring in the east end of the corridor. Double trailer configurations, 3-S4, 4-S4, container traffic and other specialized body types e.g., for woodchip, found in Washington, Montana and Idaho are not found east of North Dakota. This observation reflects the differences in the governing TS&W regulations in the states served by the corridor and the changes in

Figure 1 Variation of Truck Composition and Body Type by State - I-90/I-94



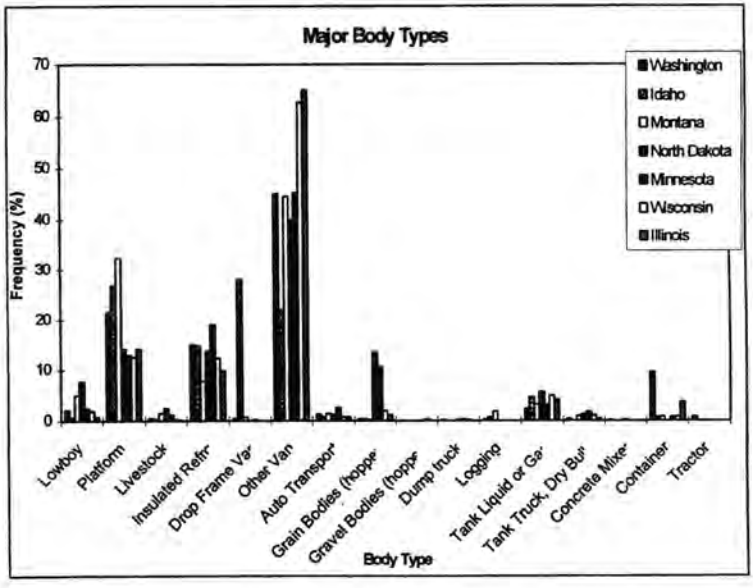
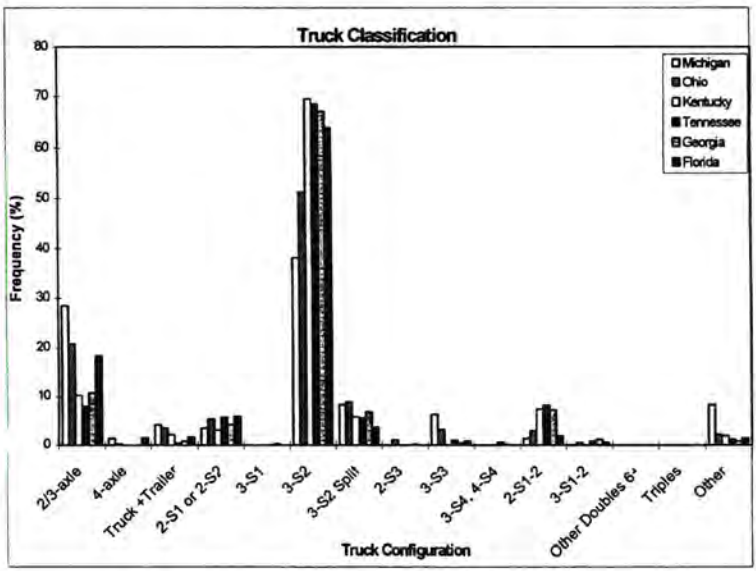


Figure 2 Variation of Truck Composition and Body Type by State -I -75



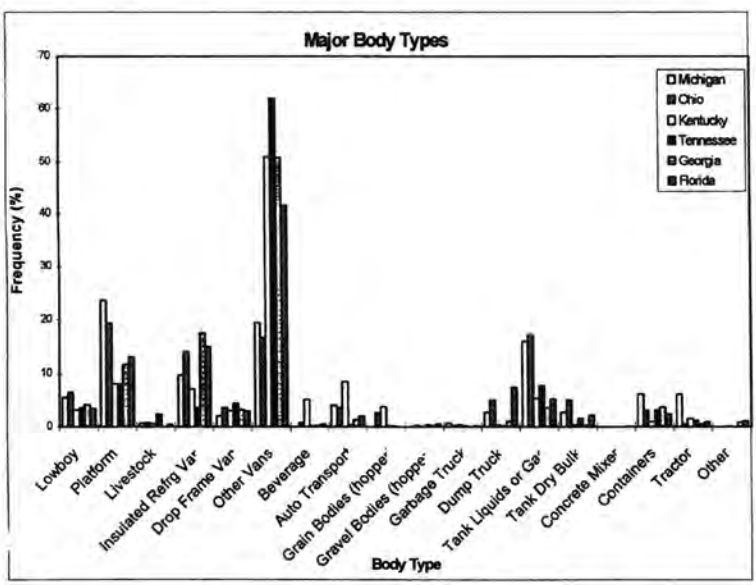
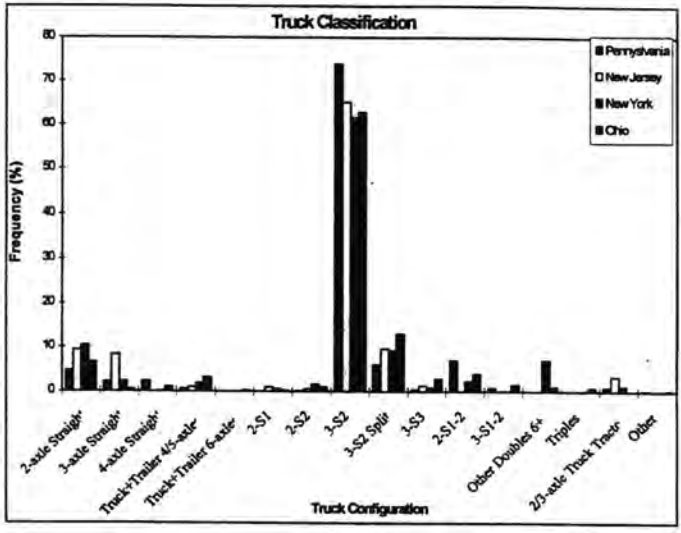
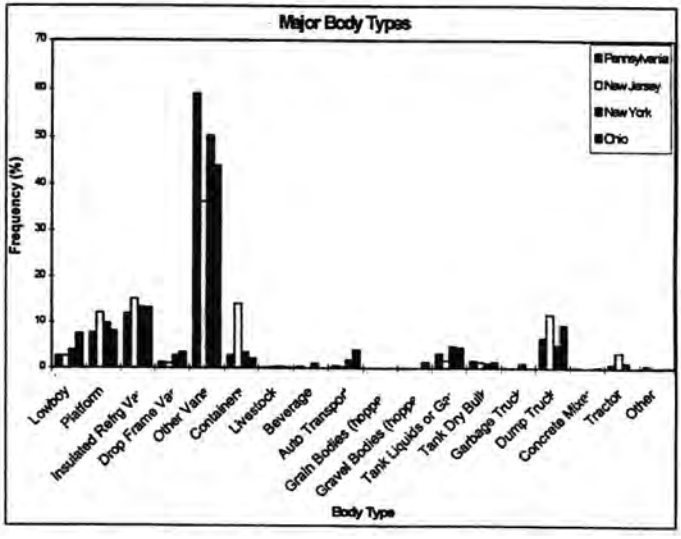


Figure 3 Variation of Truck Composition and Body Type by State - I-80/I-90





predominant freight generating activities along the corridor. The agriculture and forestry industries in the west generate freight that are usually bulky and given the relatively generous weight and dimensional allowances provided by the large doubles, multiaxled tractor semitrailers, these configurations tend to be more common in the west.

Truck traffic composition along the Detroit-Miami (I-75) and Chicago-New York (I-80) corridors are similar and remain fairly uniform. The similarity between these two corridors can be attributed largely to the similarity in the TS&W regulations and the economic activities in the states along these corridors. The 3-S2 configuration is the most common along these corridors accounting for at least 75% of all truck traffic.

On average, 3-S2 with split tandem axles constitute about 10% of truck traffic on each of the three corridors. Higher percentages are found in states with no grandfather or ISTEA provisions. This is probably because of the restriction of GVW to 80,000 pounds where the distribution of loads on the trailer is important in order to satisfy the axle weight limit requirements. The relatively low percentage of split tandems in the western states can be explained by the availability of competing heavier semitrailer configurations.

The six-axle tractor semitrailer configuration (3-S3) is relatively less common representing less than 4% of heavy truck traffic. Lower percentages are observed for states with no grandfather and ISTEA provisions. In these states, there seems to be no real advantage in switching from 3-S2 to 3-S3 because it does not appear cost-efficient to configure a trailer with a tridem axle to operate at the same GVW as a tandem axle semitrailer.

5.2 Truck Body Types

The enclosed van is the most common body type particularly for the 3-S2 trucks. This body type represents 22% to 63% of all trucks on all three corridors depending on the state. These trucks may be transporting a variety of commodities that are both volume-based and weight-based. Platform body types constitute 8% to 12% of all trucks on Chicago-New York corridor; 13% to 27% on Seattle-Chicago corridor and 8% to 17% on Detroit-Miami corridor. It is observed that states with a low percentage of van body types tend to have a high percentage of platform body type. This suggests that more weight-based freight originate and are moved along the Seattle-Chicago corridor compared to the other two corridors. This observation is consistent with the freight generation activities along these corridors as noted earlier.

The insulated refrigerated van body type is visibly common on all three corridors. This body type represents about 15% of all trucks observed on each corridor and is usually used for transporting perishable food products. Commodities that are moved in such body types may be common to all three corridors, however those in the western states of the Seattle-Chicago (I-90/I-

94) corridor can be operated at a much higher GVWs. This observation is supported by the high percentage of processed food products generated particularly, the Detroit-Miami and Chicago-New York corridors. It is also observed that liquid tankers are quite common on the North-South Detroit-Miami (I-75) corridor relative the two East-West corridors. Again, this reflects the high percentage of chemical and allied products generated along the Detroit-Miami corridor as noted earlier.

About 10% of all trucks in Washington and 4% in Illinois transport international containers. These containers are used for import and export commodities including hay, beef, automobiles and parts and other types of equipment. On the Chicago-New York corridor, container traffic is highest in the New Jersey where over 14% of all truck traffic observed in New Jersey transport containers and these could be both domestic and international containers. This can be explained by the location of sea port. On the Detroit-Miami corridor, container traffic represents 3% of the truck traffic in Georgia, Florida and Ohio; and 5% in Michigan. The sea ports in Georgia and Florida and the Great Lake ports in Ohio and Michigan are engaged in international trade.

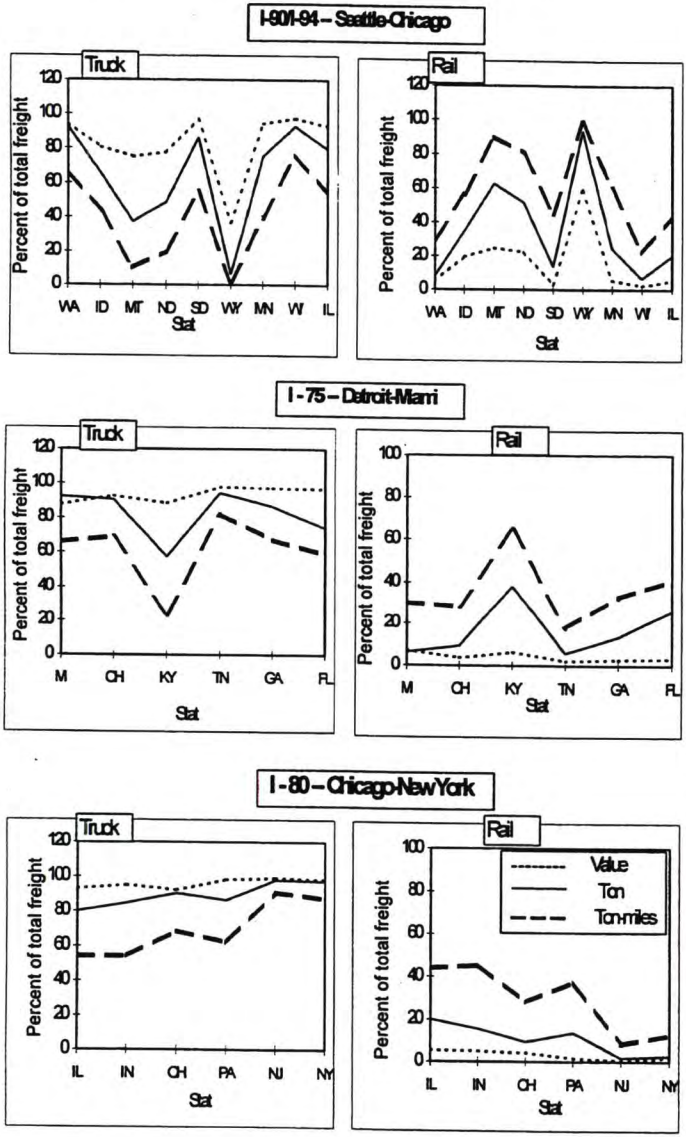
6.0 FREIGHT FLOW AND MODAL COMPETITION

Data from commodity flow surveys (4) for individual corridor states are analyzed to determine the degree of competition between truck and rail in terms of tonnage, value of commodity, and activity measured in ton-miles. Figure 4 shows the variation in modal split in the corridor states.

It is noted in Figure 4 that in terms of tonnage of freight, trucks are used to transport at least 75% of all commodities in states other than the western states for all three corridors. Modal share between truck and rail is mixed in the western states of the Seattle-Chicago corridor. For example, rail dominates in Montana (63%) and Wyoming (94%) whereas trucks dominate in Washington (92%) and South Dakota (86%). Along the Detroit-Miami (I-75) corridor, the role of rail transportation is strong in Kentucky only. This could be attributed in part to the commodity exemption provisions of the TS&W regulations in Kentucky and coal as a major commodity from the state. Interstate freight movement by rail is limited along the Chicago-New York corridor.

In terms of commodity value, trucks are used for the movement high value commodities on all three corridors. The relationship between tonnage and value varies from state to state depending on the dominant mode. For example, in North Dakota tonnage by truck is 48% representing 78% of the value of commodities; and in Wyoming, tonnage by rail is 94% representing only 59% of the value of commodities originating from the state.

Fig. 4 Modal Split between Truck and Rail in terms of Volume, Value and Activity



The overall modal activity measured by ton-miles for rail is much higher than by truck. For example, in Washington, tonnage of freight moved by rail is only 8% representing 30% of the ton-miles whereas tonnage moved by trucks is 92% representing 66% of the ton-miles of total freight originating from the state. Similarly, in Illinois, the freight volume moved by rail is 20% representing only 44% of the ton-miles whereas tonnage moved by trucks is 80% representing 54% of the ton-miles of total freight.

The volumes of commodity movement between origin-destination pairs along the corridors are such that, the highest flows occur between the adjacent states. Among commodities that are considered competitive to both truck and rail, food products are the most common commodities moved along these corridors. Farm products are transported mainly by rail and food products are transported mainly by trucks. This demonstrates the influence of the nature of the commodity in mode choice. Farm products are generally bulky and low value while food products include processed foods and perishables and these may require door to door, and on-time delivery, a service offered by trucks.

From the above discussions, it is clear that there is hardly any modal competition between truck and rail along any of these three corridors. Most commodities are transported by trucks .It can deduced that rail is the preferred mode for long distance low-value commodity movements. Trucks are however used to transport a wider range of commodities and distances

7.0 IMPLICATIONS OF TRANSPORT POLICY

For the purposes of illustration, the likely implications of regulating the use 3-S3 on the interstate system at GVW of 97,000 pounds as a possible solution to the international container overweight problem are discussed. The implications for truck fleet mix, flow patterns and modal competition are based on the results of the corridor analyses presented in previous sections.

7.1 Seattle-Chicago (I-90/I-94) Corridor

Along the Seattle-Chicago (I-90/I-94) corridor, international container movements were observed to be concentrated in Washington and Illinois. In Washington, trucks transporting international containers constitute about 10% of the truck traffic observed. About 80% of these trucks are tractor semitrailers with six or more axles. These trucks are configured to satisfy the Federal bridge formula B and operated on the Interstate System at GVW that are much higher than 97,000 pounds. It was noted (5) that imports are currently several times more valuable than exports because imports are typically finished consumer products while exports are typically semi-processed resources or lower value products. Import growth is expected to drive TransPacific trade and exports will continue to serve as backhaul.

Allowing 3-S3 to operate at 97,000 pounds may not have a marked effect on

the truck fleet for international container movements in the states with grandfathered regulations and ISTEA provisions because (i) trucks currently used for container movement are 3-S4 and 4-S4; (ii) 3-S3 currently operates in Washington at GVWs determined according to the bridge formula B and less than 1% of the 3-S3s observed transported international containers. In terms of modal share, rail is used for large containerized imports destined for Chicago and New York, (i.e., generally for distances greater than 500 miles). Therefore this policy option is likely to affect truck fleet mix in areas close to the sea ports of Seattle and Tacoma. More international containers for export are found to be overweight than those in-bound; and also given the level of competition between the Tacoma and Seattle ports on one hand, and Long Beach and Los Angeles ports on the other, it is probable that this option might encourage the use of 3-S3 configurations but not necessarily providing a permanent solution to the international container overweight problem.

7.2 Detroit-Miami (I-75) and Chicago-New York (I-80) Corridors

Along the Detroit-Miami (1-75) corridor, four of the six states are engaged in foreign trade involving waterborne transportation. In Florida, 37 percent of the tonnage of waterborne commerce involved foreign trade, and 80 percent in Georgia are related to overseas trade. These overseas trade relies on international container movements. Major overseas exports are typically semi-processed resources or low value products such as, chemical fertilizers, sand, shells, lumber, logs, wood chips, salt, coal. Examples of imports are petroleum products and manufactured goods. Truck classification results indicate that the percent of all trucks that have container body type varies from 3% percent in Florida to 5 % in Michigan. Obviously, export commodities are dense, bulky and weight-based compared to the imports. The likelihood for out-bound containers to be overweight is therefore high.

The situation along the Chicago-New York corridor is similar to the Detroit-Miami corridor in terms of the existing TS&W regulations and freight generating activities as well as international trade. As noted earlier, container traffic is limited almost exclusively to the interstate system in New Jersey where 14% of all truck traffic observed transport containers. In the other states along the corridor, Illinois, Ohio, Pennsylvania and New York container traffic is less than 4% of all trucks.

Thus, on the Detroit-Miami and Chicago-New York corridors where the maximum GVW limited to 80,000 pounds and given that major exports are dense and bulky products, allowing 3-S3 to operate at 97,000-pounds on the interstate system is likely to encourage their use for transporting international containers. It may also result in some shifts in the truck fleet mix particularly from 3-S2 to 3-S3. This is principally because, the 3-S3 offers a relative payload advantage compared to the 3-S2.

Restricting the operation to the interstate highway system however would

require adequate access from other highways and intermodal facilities at appropriate locations. In addition, when the policy applied without restricting to international containers, it is likely to encourage usage and a shift from 3-S2 to 3-S3 for weight-out operations in particular. This is because of the relative productivity advantage of the 3-S3 and less potential pavement damage over the 3-S2. Moreover, both the five and six-axle tractor semitrailer configurations have comparable safety related dynamic performance properties.

8.0 CONCLUDING REMARKS

This paper highlights the value of disaggregate level analysis of a complex phenomenon and emphasized the influence of both truck size and weight regulations and the nature of freight on truck fleet composition (configuration and body type), and modal competition in freight transportation.

Coarse aggregation of states with similar TS&W regulations tend to obscure important differences in the truck operating characteristics. Such aggregation tends to ignore the effect of freight generation activities on truck fleet and operating characteristics. Even though disaggregate level analyses attempts to identify and consider these differences in evaluating policy initiatives, it is important to note that most of these differences are inherent and not easily reconciled. A national policy will have different effects in different regulatory regimes. The disaggregate level analysis is nonetheless useful in determining the degree of variability in freight movement characteristics. The question of how to formulate national policies that can be applied to all regulatory regimes and yet flexible enough to accommodate existing differences both in the regulations and the freight generation activities remains a challenge.

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MODELLING A TRIP INTERACTIVE PLANNER (TIP) TO MANAGE AND MONITOR TOURIST TRAFFIC IN A REGIONALLY BASED GIS

Stefania Bertazzon
Tel: (403) 220-4889 e-mail: sbertazz@acs.ucalgary.ca
and
Nigel Waters
Tel: (403) 220-6398 e-mail: nwaters@acs.ucalgary.ca
Department of Geography, University of Calgary
2500 University Dr. NW, Calgary, Alberta, Canada T2N 1N4
Fax: (403) 282-6561

1. Introduction

In this paper we extend our previous trip interactive planner (TIP) that is discussed in section 2, below. The purpose of TIP, as we develop and describe it in this paper, is not only to provide interactively shortest path routines, but also to suggest a number of best paths, as opposed to traditional shortest paths. The idea that there may be more than one best path was suggested many years ago by Bunge (1962; see also the discussion in Haggett, et al., 1977, p.73). These best paths calculated in TIP are based on criteria that go beyond the simple minimization of travelling distance. Our aim is to suggest ways to harmonize the needs of tourist traffic flows with the various needs of the province where the travelling takes place. One of the main concerns for the Province of Alberta is the presence of several important national parks and protected areas (see Figure 1 from the TIP web site). We intend to suggest alternative paths for tourist traffic, which will minimize the negative consequences of traffic flow on such areas. We obtain these paths by using a weighted measure of distance that we incorporate within the shortest path algorithm. A second concern is that in this province most of the roads leading to tourist destinations coincide with roads used by heavy commercial traffic. By suggesting alternative paths, away from these roads, we seek to harmonize the tourist flows with the movement needs of the province. Our third suggested path is in fact a longest path, that leads tourists through the maximum number of attractions along their way, the so-called scenic route which we have dubbed the ecological route.



Fig. 1: Alberta's Main Protected Areas and Major Highways

2. The Existing TIP

Trip planners have become a popular travel tool in the information age. One of the best known is the TRIPlanner developed for the ROMANSE (ROad MANagement System for Europe) by Hampshire County Council, Southampton City Council, Siemens Plessey Controls Limited, the Transportation Research Group of the University of Southampton, the Ordnance Survey and the UK Transport Research Laboratory. TRIPlanner provides information at terminals which are installed at key transportation locations. Information is provided both for public transportation services (in English, French or German) and for private car travel. In both cases the terminal provides hard copy output giving the user a permanent record of their route and travel details.

An attractive alternative to the ROMANSE solution is an Internet based interactive trip planner accessible from the comfort of the user's

own home or office on a computer or Internet enabled television. Indeed, many cities already provide static, non-interactive traffic information in this manner for journey-to-work or journey-from-work transportation planning. Examples may be found at the CalTrans web site (URL: http://www.scubed.com/caltrans/) which also has links to many other traffic maps. Moreover, ROMANSE II, a follow-up to the original project has now developed an Internet based trip advisor (URL: http://romanse.soto.ac.uk/) which asks for origins and destinations and informs users of the best route to take. This system still has many inadequacies. First, it does not include any maps to show the user the best route graphically (see Figure 2 from the ROMANSE II web site). Second, the lack of maps makes some instructions cryptic such as "walk from the bus stop to the train station" when this is not a short or straightforward journey. Finally, it does not make use of spatial or GIS functions such as shortest path routines or buffering operations to determine interactively nearby attractions, for example.

As part of the present research, an on-line, trip interactive planner (TIP) has been functioning for several months at the URL: http://www.ucalgary.ca/~sbertazz/maps/main.html. The site has been designed around the concept of a spatial metaphor (see Schrage's comments cited in Waters, 1997), which not only uses GIS capabilities, but brings such capabilities within the users' reach, acting as a dynamic interface between the remote system and its users. The site makes extensive use of maps and visual graphics and more and more GIS functionality is being added.

In the present instance, TIP's main focus is on ski resorts, although the method is easily capable of being generalized to other tourist features and indeed to non-tourist applications such as are used in the ROMANSE project. Tourist attractions are attractive and useful because so many of the users of the transportation system may well be unaware of the transportation services and resort facilities that are available to them simply because they do not use the system on a daily basis or may not be from the local area.

TIP provides descriptions of each resort, along with information on the resort's facilities and attractions. This is the type of information deemed to be of importance in advertising and newspaper promotions. However, TIP is able to present all of the information spatially, through

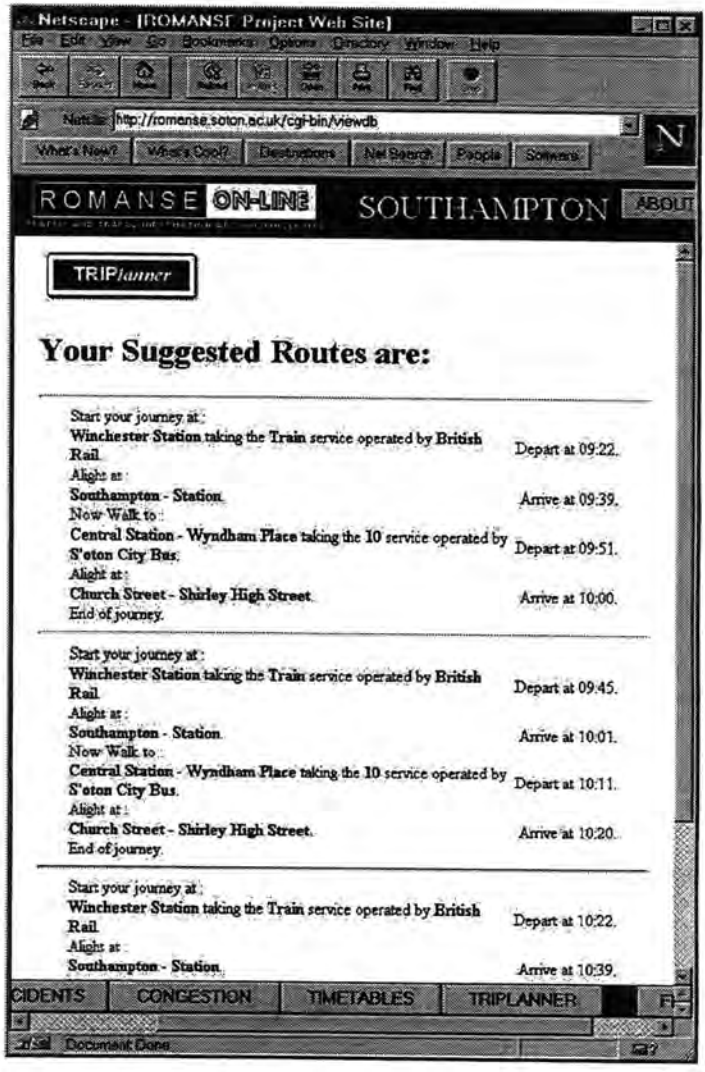


Fig. 2: The Romanse Initiative.

maps and images which allow for the visualization of distances, links and connections among tourist destinations and between these and urban areas. TIP also provides real-time links to weather and road conditions for the entire province (Bertazzon et al., 1996).

In addition, the original version of TIP included operations research (OR) routines for calculating the shortest paths from major urban centers to each resort. These OR algorithms used an implicit road distance matrix based on network nodes abstracted from explicit geographic coordinates. TIP used the CGI (Common Gateway Interface) to communicate the users' input to the GIS and to output the GIS product in a simple and appealing form (Bertazzon and Waters, 1996).

3. Expanding TIP: Background and Scope

Tourist movements represent a significant percentage of the automobile traffic in the province of Alberta. Among the main tourist attractions of the province are the Rocky Mountains, which attract a large percentage of the total traffic flow. Mountain tourism, both in the winter and in the summer, occurs in particular times of the year and of the day, and mainly along a few, very important communication routes. Winter tourism, related to skiing and to other sports activities, often takes place in harsh weather and road conditions. Disquieting levels of traffic congestion are frequently reached along the main highways (particularly Highway 1, the TransCanada) during weekends over the peak winter and summer seasons, especially at certain hours of the morning and evening. The tourist component is the main reason for such cyclical congestion.

Traffic congestion on rural roads and highways tends to increase the probability of accidents, as well as the pollution and noise levels. All of these factors are of particular concern in and around the boundaries of national parks, provincial parks and other protected areas which are numerous in the southwestern part of the province. Although such rural traffic congestion in Alberta is not as much of a concern as elsewhere (for example, in Ontario on Highways 400 and 401) it is likely to assume greater proportions as the number of local, national, and international tourists grows.

The above considerations suggest that a positive objective, tourist expansion, should not be pursued unless an effort is made to reduce its negative consequences in terms of rural traffic levels. One solution,

experienced elsewhere, might be to reduce the number of circulating vehicles by imposing time-based regulations, e.g. no commercial traffic during weekends, or time shifts based on plate numbers. Such traffic limitation strategies are common in many cities (Thomson, 1977; Newman and Kenworthy, 1989).

TIP aims at proposing an alternative solution, based on the intrinsic characteristics of tourist traffic. The needs of tourist traffic are often qualitatively different from those of commercial traffic. The need for parking facilities at scenic outlooks, signs for restaurant and accommodation facilities and information on detours to other attractions are just a few examples. The seasonality and periodicity of tourism traffic makes it fairly predictable, both in terms of the time when it is likely to occur and in terms of the roads on which it is likely to travel. In light of these and the above considerations, TIP becomes a useful tool to manage a spatial separation of different components of automobile traffic on the existing road network in the province (similar to the rationale behind Highway 407 in southern Ontario). Our objective is akin to that of Mackay Yarnal (1979) who proposed using hiking maps to help protect trails in the Lake O'Hara region. She suggested that trails which were suffering from over use should simply be dropped from the following season's maps. If the trail did not appear on the map it would tend not to be used by the hikers. Philosophically the TIP proposal differs from that of Mackay Yarnal in that we emphasize positive reinforcement to try and entice the tourist away from heavily congested routes (though, of course, Mackay Yarnal's more manipulative approach might also be used within the TIP). Operationally TIP differs in that it moves away from the paper map and uses an interactive, Internet-based map.

4. Technical Implementation

The original TIP was expanded to provide would-be, mountain tourists with accurate and updated road information, as well as explicit "best path" recommendations. Such expansion includes:

- An explicit, geographically referenced road database.
- Traditional shortest path routines (Zhan, 1996) are replaced by paths suggested by a variety of criteria. Thus new distance matrices are specified and used within the existing program to output the "most scenic path", the "safest path", the most "environment-friendly path."

• Visual indication (using highlights, blinking symbols or strong colour contrasts) of heavily travelled roads are used for commercial and communication traffic;

• Visual indication of dangerous driving conditions, as well as expected heavy traffic flows. This was obtained by linking each road segment to its specific AMA report;

• Visual indication of roads within national and provincial parks and in buffer zones around their boundaries;

• Visual indication of alternative roads, with "clickable" features to access text files summarizing reasons behind the recommendations;

• A hyper-page would present users with a menu of the available paths, so that they could chose to "jump" to their desired choice. The use of the hyper-page concept within a GIS context is discussed extensively in Cassettari (1993) and is implemented in Raper (1991), Green (1987) and Raper and Green (1989) in an educational context.

5. Model Calibration and Distance Weighting

TIP is intended to offer the best paths from urban centers to tourist areas through on-line, customized, real-time queries. Such a feature necessitates various measures of distance that can be applied to the road network. To date we have determined a number of possible paths in which the tourist might be interested (see Figure 3 which shows the web site page presenting the various choices):

• The "Ecological" Path

What we want to do is to assign a coefficient to the distance within national parks and protected areas, which artificially increases the distance, so that alternative roads can be chosen.

Assigning such a coefficient is a relatively arbitrary process, and to the best of our knowledge there is no literature that addresses this issue. The problem is twofold: there is an actual, physical increase of the travelling time, due to lower speed limits in the parks; and there is also an actual monetary cost, represented by the park entrance fee. Such cost factors may be assessed quite objectively, based on the early economic and transportation geography literature. For example, even the first shortest path computer programs made provision for a variety of alternative cost calculations (Ostresh, 1973).

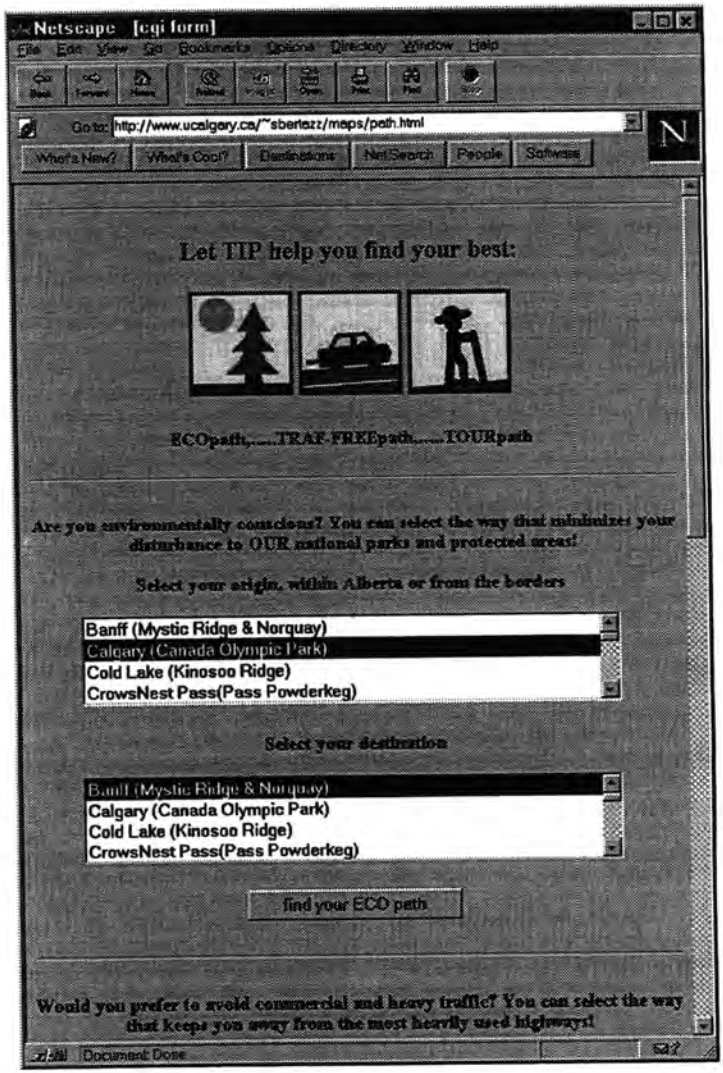


Fig. 3: TIP's Path Selection.

The assessment of an "ecological" coefficient is more arbitrary. One way to do this would be to try and assign coefficients of increasing

values, until the algorithm is able to choose an alternative road. This approach would imply different coefficients for different regions, or even for different paths within one region or even within one park. It would be necessary to calculate a few "working coefficients" and then adjust them in order to achieve a regional homogeneity.

An alternative approach would be to apply the concept of elasticity of demand to distance. This can be addressed by asking the question: how far are tourists willing to travel, to avoid the park? Questionnaire surveys are one way of answering this question, for a given sample of users (see also Keeney and Raiffa, 1976 for a discussion of methodologies associated with preferences and tradeoffs through the use of indifference curves). This approach can be combined with the one described above, and its contribution would be to set an upper limit to the set of coefficients calibrated with the above method. This second step in the determination of the coefficient should take into account the type of tourists to whom it is directed: the elasticity of downhill skiers is probably relatively low, but it would be higher for cross-country or tour-skiers, who tend to combine an interest in the sport with a greater concern for nature's integrity and preservation.

• The "Touring" Path

An alternative best path is one that leads tourists through the maximum number of attractions on their way to their destination. This suggestion is certainly not intended for skiers planning one-day trips, but rather for tourists, such as summer visitors, who plan to spend a longer time in the area and are willing to visit a number of other sites. This approach cannot be treated within a simple shortest path algorithm. It requires the specification of a constrained optimization algorithm to first scan the number of attractions on the network linking origin and destination, and then finds the shortest path through the maximum number of attractions. This more complex, or 2 step problem can be addressed in the same way as the above, by assigning a negative (<1) coefficient to arcs along which attractions are found. The problem, however, is further complicated by the type of attraction present; perhaps this may lead to the suggestion of "theme paths" offering the visitors a range of possible paths, among which they can select the one that best fits their interests. It may also be considered as a variant of the travelling salesman problem. It would appear that GIS buffering operations may be required to determine which attractions might be incorporated into the touring path.

• The "Traffic Free" Path

A full development of this principle (which is at present being considered) would require complex, dynamic traffic assignment models, which would dynamically determine the traffic flow on different days and times on a given road network. TIP would be capable of offering general guidelines and advice. This advice would be based on the above criteria of weighted distance: roads with heavy commercial traffic would be assigned a higher coefficient, meant to discourage tourists from using those roads. At the same time the dynamic features available in TIP would allow a real-time link to the traffic conditions, as assessed by the local AAs; the final judgment is thus left to the traveller. Moreover, some links might be "flagged" as impassable if they had been blocked by avalanches or mud slides, the electronic equivalent of closing the gate on that portion of a given route.

6. TIP Evaluation

TIP is a tool that is on-line and available around-the-clock. It can and should be used before a trip, as a planning tool. Thus, while planning their trip ahead of time, travelers are encouraged to use their e-mail to inform AAs of the path they intend to travel and the day(s) they intend to do it. An automatic e-mail contact is provided directly by TIP, which can thus establish a feed-back which will be helpful in traffic monitoring and dynamically updating the best alternatives. The number and frequency of e-mail messages received may also provide AAs with a good basis for stochastic estimates of the total number of tourists traveling in the province.

By using transparent road selection criteria, TIP can assist tourists in selecting the route that they really prefer, allowing everybody to choose their path according to personal priorities and preferences.

TIP may help tourists realize an added advantage of avoiding commercial traffic such as trucks, which obstruct visibility, are noisy, polluting, and may slow down recreational traffic. Driving outside of the national parks can be viewed as a means of bringing down costs and allowing for higher driving speeds. National parks and protected areas are often the destination of tourist trips: TIP may improve tourist awareness of

their own disturbance of wildlife, unwillingly caused by travelling in such areas.

Highways used by tourists are commonly the main communication roads in the province, or even in the country (e.g. Highway 1). In this respect, tourist awareness of the negative consequences of their own travelling is of importance, and might be improved by TIP. In light of the periodicity of tourist movements, an adequate maintenance of the tourist network can be planned and managed by local Automobile Associations and government transportation departments so as to provide adequate tourist services over the peak season, and also to plan commercial network maintenance and service on a parallel level. The feed-back offered by TIP may represent a significant aid for these planning and monitoring functions, in addition to the advantages it provides by reinforcing and communicating feasible alternatives to the tourists.

Local governments and AAs may make direct use of TIP, since it is extremely important that they offer adequate tourist equipment and facilities on these "alternative" roads. Conversely, the supply of adequate services would be the best incentive for tourists to use the alternative network. Through TIP's interactive features, local tourist bureaus could develop roads of particular tourist interest, such as scenic or cultural landmarks. This might eventually lead to a progressive modification of traditional routes in order to open visitors' roads to developing sites, resorts, or attractions.

TIP also contains a database of existing railways. Railways can be another valuable alternative for reducing traffic congestion and the overall number of circulating vehicles. Making greater use of railways allows the further exploitation of existing facilities requiring little further development and investment. The "railway alternative" needs perhaps to be better advertised among tourists and to have more adequate schedules and connections to other transportation means. TIP offers "clickable" features, which provide information for each railway tract, which might be of use in trip planning, such as schedules, prices, and connections. Like railways, bus lines are another promising alternative to automobile traveling. TIP aims at showing where bus/coach services are available, again providing links to bus schedules, prices, seasons.

As stated in the introduction, TIP was developed mainly for winter mountain tourism (the ski resorts of southern Alberta), but it is equally useful in the summer season, since ski resorts generally coincide with summer mountain tourist destinations. Other tourist attractions in the province are located in different areas, away from the mountains. Although at the moment TIP does not include these destinations, the principles are conceptually the same, and it would be possible and easy, in the future, to further expand TIP in order to include these destinations and routes.

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PERFORMANCE MEASUREMENT IN THE PUBLIC SECTOR

Bill Raney, Mayank Rastogi, Mark Cowley
Ministry of Transportation, Ontario *

1.0 INTRODUCTION

Prudent planning and management are cornerstones of any organization's success. A well planned and managed organization, whether in the public sector or private sector, needs a clear corporate vision, purpose and mission, with associated goals and objectives. Achieving organizational objectives and goals that satisfy corporate vision and strategy needs careful planning and good management. An organization must not only be adept in identifying new opportunities and challenges, but should also be able to monitor the business, diagnose the problems and take corrective actions. Decisions should relate to and be made based on the analysis of available information.

Making efficient and effective use of resources is the key to organizational success. It is important to retain focus over time or to consciously change it if needed. Due to the nature of the services which the public sector provides, there is a tendency to create and launch programs as needed. Often these programs are not evaluated for their long term usefulness and relevance. In the absence of performance evaluation driven by actual data, programs and services like these affect the organizational efficiency and focus. In most cases '*Performance Measurement*' is a first step in diagnosing and treating this problem.

2.0 PERFORMANCE MEASUREMENT

Performance measurement is simply a method for assessing, monitoring and evaluating progress towards stated goals and objectives. It is intended to encourage organizational efficiency and effectiveness through appropriate and timely communications, and by raising management awareness of an organization's overall health and direction.

* The views expressed are those of the authors and not necessarily those of the ministry.

The private sector's bottom line of performance is defined by profits along with aspects of effective and efficient management and satisfied customers. In the public sector the focus is to return the best value for taxpayers' dollars, and to design and provide appropriate and effective public services. The public sector must also consider broader social and economic objectives whose achievement is harder to measure. Key reasons are limited control and presence of various externalities and exogenous factors.

Need and Pressures:

Performance measurement is thus crucial for both public and private sectors and follows a very similar process, although the organizations' aims differ. Today's tight fiscal environment, complicated by increasing competition, a global economy, technological changes, and increasing customer/taxpayer expectations, has put tremendous pressure on the public sector to respond in a more business-like way. The report by the Ontario Financial Review Commission entitled *Beyond the numbers: A new financial management and accountability framework for Ontario* recommends the adoption of a business planning approach and performance measurement for the Ontario government.

The Ministry of Transportation, Ontario (MTO) has responded by moving towards business planning and performance measurement reporting in line with that recommendation. MTO's priority is to focus its efforts on core businesses and to be cost-effective in day-to-day activities. Measures which are developed and selected for ongoing monitoring are indicative of what the ministry considers to be important. They help the ministry operate in a more business-like way to achieve its mandate. To be relevant, performance measures should be clearly and explicitly linked to core businesses and government priorities.

Concepts and Definitions:

Performance Measures assess the level of achievement of a goal, objective or direction. Measures can either be quantitative or qualitative. The more explicit the goals and objectives are, the easier it is to develop and operationalise measures. One can measure different performance areas by using different types of measures.

- ***Efficiency Measures*** focus on input/output relationships between the resources used and the service or product produced, i.e. the context is 'value for money' and 'doing it right'

- ***Effectiveness Measures*** describe or measure the extent to which the policy, program or administrative activity contributes to the objectives of a business, i.e. identifying the 'market' and reporting on how well the market is being served. These measures will also tell whether we are 'doing the right thing'.
- ***Impact Measures*** evaluate and assess direct/indirect impacts of policies, programs and activities on the users/public, society, economy, environment, stakeholders and interest groups.
- ***Customer Service Measures*** report on the perception and satisfaction of the 'customers' with the programs and services that are being directly provided to them.

Development and selection of performance measures depend upon a variety of factors, e.g. type and area of measurement, organizational level, measurement purpose and intended audience.

Performance measures can be used for measuring achievements, communication and public information, business process diagnosis, program evaluation, change management, establishing accountabilities for staff and partners, and benchmarking. Some of the key characteristics of a good performance measure are: timeliness, validity, reliability, clarity, accuracy, consistency, auditability, controllability, and cost effectiveness.

Performance Standards are the *"desired"* level of performance in terms of quality or quantity of a given product, service or process. Standards could be based on one or more of the following: technical criteria, policy, legislation, regulation, prudent management practice, desire for year-over-year improvement, best practices (benchmarking), or customer service expectations.

Performance Targets are the interim milestones which attempt to demonstrate the direction and speed of progress towards (long-term) standards. Setting a value for a performance target is influenced by a combination of inputs like: current achievements, available resources, business directions, and standards.

3.0 MTO'S PERFORMANCE MEASUREMENT FRAMEWORK

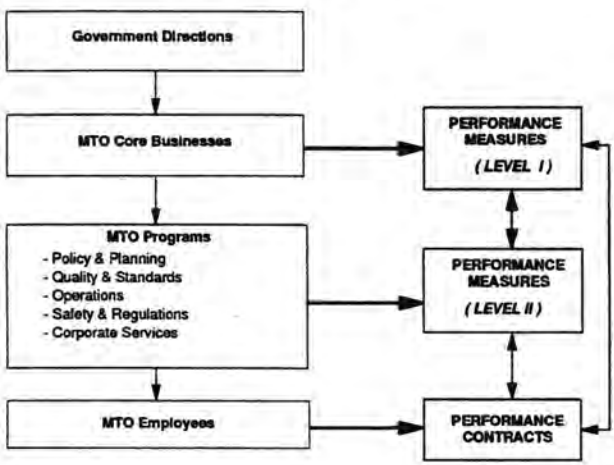
Proper tracking, measurement and accountability tools are necessary components of a good business plan. Performance-based measurement and reporting will help demonstrate to the public that we are doing the right

things, in the right way. Our performance measures will change and evolve with time as our ministry's roles, responsibilities and relationships with partners change. The performance measures we are developing will give us the ability to:

- focus on results (outcomes) rather than processes (inputs/outputs);
- use our resources wisely;
- continually assess and improve on our programs and services;
- compare ourselves with the best practices elsewhere; and
- be accountable for what we deliver and how we deliver

There are various organizational levels at which performance can be measured. These levels are: core business, program, activity, and individual employee. We may also wish to measure the performance of our partners or service providers, to the extent their actions impact on our outcomes. Figure 1 shows the performance measurement framework adopted at MTO.

Figure 1
Framework for Integrating Performance Measurement with Management Process



4.0 DEVELOPING PERFORMANCE MEASURES

This section describes the various steps in developing and practising performance measurement.

Identifying Desired Outcomes
Identifying the "Desired Outcomes" for a core business is the starting point. These are clear statements of the goals and objectives for that core business. This first step is crucial because it sets the stage to which all levels of performance measurement should relate.

Asking Key Questions
Key questions provide a link between desired outcomes and performance measures. Questions are asked for each outcome regarding: what is to be achieved, what is to be measured and what is important to that outcome? These questions are not directly answered, but they do help to break the desired outcomes down into smaller, clearer, more measurable areas for which performance measures could be developed.

Developing Performance Measures
Having asked the key questions, performance measures will help us to answer them. Only measures which are relevant and will best measure the core business or the outcome need to be developed. Ideally all performance measures chosen should have the characteristics described earlier in this paper.

Obtaining Baseline Data
Baseline information is historical information that provides an indication of past performance. Care should be taken to measure and report historical information which is collected and analyzed in a consistent way, or else the comparison is invalid. Timing of data is important when measuring system performance, i.e. all data relevant to a particular measure should be for the same year.

Determining Performance Standards and Setting Targets
As discussed in section 2.0, performance standards are determined by assessing applicable technical criteria, policies, regulations, legislation, benchmarks etc. Performance targets are then the short-term milestones which are to be achieved in order to reach the standard.

Reporting Achievements
This step involves reporting on how close we are to meeting targets. The reasons for success or failure should be highlighted and considered when developing strategies and setting future performance targets.

5.0 APPLICATION TO CORE BUSINESSES

MTO's core businesses of Provincial Highways Management, Road User Safety, and Transportation Policy & Planning will be used to illustrate how the performance measurement steps can be applied. In the next section, we outline in some detail for each core business the first three steps: 'identifying desired outcomes', 'asking key questions' and 'developing performance measures'. 'Obtaining baseline data', and 'determining performance standards and setting targets' will then be illustrated by using specific performance measures as examples. Although important, a discussion of 'reporting achievements' is not included in this paper.

5.1 Provincial Highways Management

MTO is responsible for ensuring that Ontario's provincial highways are designed, constructed, operated and maintained in a safe, efficient manner. Table 1 shows the outcome and the related key questions and performance measures.

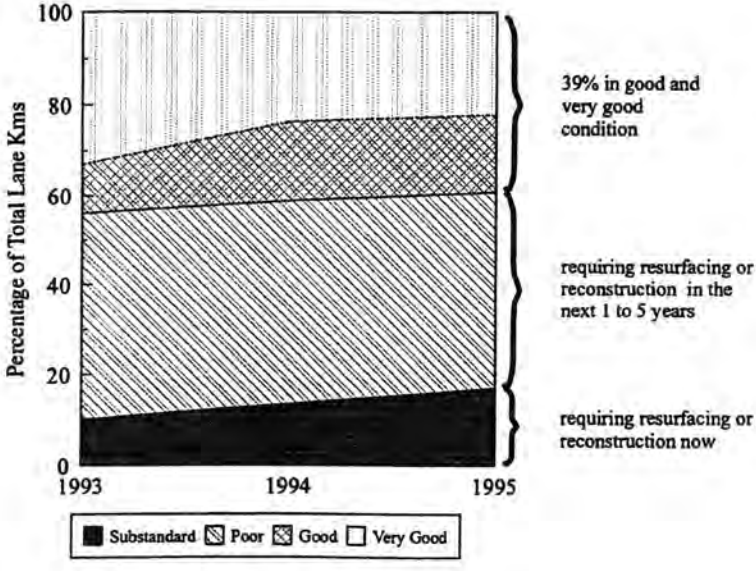
Table 1

Outcome	Key Questions	Performance Measures
Provincial highways delivered cost-efficiently that are safe, useable and in good repair.	Are we cost-efficient?	- % of total highway capital cost spent on actual construction vs. overhead and administration
	How well are we providing safe highway infrastructure?	- % of total expenditures invested in highway safety improvements
	How useable (with regard to physical condition) are our provincial highways?	- extent to which operation and maintenance service standards and targets are met
	Are our provincial highways in good repair?	- % of system length in good condition - % of bridges rehabilitated or replaced

The performance measure '% of system length in good condition' will be used to illustrate baseline data and target setting.

Baseline Data: Figure 2 provides baseline data on pavement condition for all highways in the province based on an Average Pavement Condition Index. A Pavement Condition Index (PCI) is used to rate each segment of the highway network on a scale of 0 to 100, according to ride comfort and surface conditions. For example, a MTO standard has been established that if PCI for a freeway section falls below a value of 60, it is considered to be substandard and requires immediate resurfacing, and if a segment of a freeway falls below a PCI of 75, it is considered to be in poor condition. The section in 'poor condition' needs corrective action to be taken within the next 1 to 5 years or else it will slip to the substandard category. Similar PCI trigger points are established for other functional classifications of highways.

Figure 2
Per Cent of System Length in Good Condition



It can be seen from Figure 2 that in 1995 approximately 39% of the system is in good or very good condition and will not require attention either now or in the next 1-5 years[1]. This baseline is one of the key inputs for target setting, as it provides the latest available information on system condition as well as highlighting the developing trends.

Target Setting: Since MTO has direct control in this area, it is relatively easy to establish performance targets compared to the other areas where control may be indirect and final results may depend on several other partners, e.g. the measure pertaining to 'maintenance service standards and targets', where the outcome could depend upon partners and other service providers such as contractors.

For MTO a standard of two-thirds of the highway system being in good condition has been established, based on cost-effective life-cycle management. It is recognized that in times of fiscal constraint this standard cannot be achieved easily. However, a target for next year can be set. Setting of targets depends upon the baseline data, amount of funding available, relevant benchmarks from other jurisdictions, prudent management practices and public expectations. As an illustration, in determining next year's target for this measure, we will consider the following three factors: a) Level of funding, b) Types of projects chosen, and c) Efficiency of spending, i.e., dollars spent on actual delivery versus overhead.

Level of funding is one of the key factors in setting the target for '% system length in good condition'. If more money is available, then more projects can be done and higher targets can be set.

The expected life of pavement is about 15 years after resurfacing is done to standards. Once the pavement begins to deteriorate (usually 12 -15 years) re-surfacing costing about $80,000/km is required to restore the PCI to applicable standard. However, if repairs are delayed and the pavement begins to break down, reconstruction costing $250,000/km is required. If more reconstruction projects ($250,000/km) are chosen than resurfacing projects ($80,000/km), a lower target must be set, as they are more capital intensive.

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[1]For the remainder of the system, only 17% needs immediate attention while the other 44% can be attended to in the next 1 to 5 years.

Efficiency of delivering capital program also has a bearing on how much of the highway system can be put into good condition. If more money is put into actual construction than into overhead or administration, more projects can be done to improve the condition of the system.

It is evident from the section above that there is often an inter-relationship between various performance measures. The two performance measures '% of total highway capital cost spent on actual construction versus overhead and administration' and '% of system length in good condition' are interrelated. This illustrates that there is often a need to develop more than one complimentary measure to obtain a complete picture and to identify an action plan.

One possible way of setting next year's target for '% of system in good condition' is to follow these steps: i) Prioritize the project list based on both needs and preliminary cost estimates; ii) Determine actual costs of each prioritized project; iii) Identify the projects which could be delivered based on the amount of money available from budget allocations; iv) Set targets by assuming that the projects were actually completed and the results achieved; v) Calculate the % of provincial highway system length that would then be in good condition based on the assumed completed projects. It should be noted that this approach also provides an opportunity to calculate 'the % of highway system in good condition' assuming various funding levels and scenarios.

5.2 Road User Safety

A part of MTO's Road User Safety core business is to make Ontario's roads safer by improving the effectiveness of road safety programs. This core business focuses on road users by: setting safety standards; setting policies and regulations for road users and vehicles; and inspecting and monitoring commercial carriers. Table 2 shows 'desired outcomes', related 'key questions' and 'performance measures' for the higher level outcomes of 'Safer Travel on Ontario Roads'. The desired outcome 'Safer Travel on Ontario Roads', and the key question 'Is travel on Ontario roads becoming safer' reflect the broad responsibility of the core business. The bottom line in the public's view of road safety is whether fatalities and collisions are declining.

Table 2

Outcomes	Key Questions	Performance Measures
Safer travel on Ontario roads.	Is travel in Ontario becoming safer?	- number of fatalities per 100,000 licensed drivers

Figure 3 shows baseline data using 'number of fatalities/100,000 licensed drivers' as the performance measure[2]. The steady reduction in fatalities per 100,000 licensed drivers appears to be a reasonable performance improvement over a 22-year period. Generally, a long sample period should be used for baseline information so that one has a better view of the trend, rather than short-term highs and lows. This trend line embodies all of the elements affecting road user safety, and not just MTO's contribution. Partners such as the Ministry of Attorney General, the Ministry of the Solicitor General, and factors such as weather, the economy, vehicle design, and vehicle condition also contribute to the fatality rate. Setting specific targets is difficult, given the limited amount of control MTO has on the outcome.

Figure 3
Number of Fatalities per 100,000 Licensed Drivers



[2]This is a proxy measure for road usage and exposure rate to accidents. A better measure would be fatalities per million vehicle kilometres of travel, but it is not available across all jurisdictions

In order to break the higher-level outcome down into components that MTO has more control over, a set of lower-level 'outcomes', 'key questions' and 'performance measures' is identified in Table 3. These involve programs that MTO controls or influences, such as problem drivers, commercial vehicles, and carriers.

Table 3

Outcomes	Key Questions	Performance Measures
Safe drivers, commercial vehicles and carriers.	Are drivers safe?	- fatal collision involvement rate for novice drivers - % of fatal collisions involving drinking drivers
	Are commercial vehicles safe?	- % of commercial vehicles declared out of service in random 'Road-Check' surveys - % of commercial vehicles declared out-of-service in targeted inspections

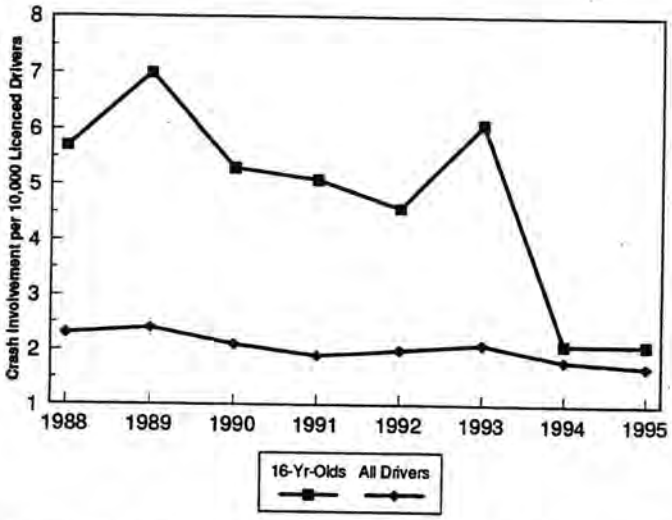
The performance measure 'fatal collision rate for novice drivers' is used below as an example to illustrate baseline data, and the performance measure '% of commercial vehicles declared out-of-service' used to discuss target setting.

Baseline Data: Figure 4 shows baseline data for the 'fatal collision rate of novice drivers'. The data demonstrate the results of introducing the graduated licensing program introduced by MTO in April 1994. The preliminary results suggest that the performance of novice drivers[3] has improved to a level almost equalling that of the total driver population. Care must be taken, however, in interpreting the data. In the lower-level outcomes, MTO has better control over the various driver programs (e.g. licensing novice drivers), but not over other factors such as vehicle and weather conditions. As a result, the data in Figure 4 includes all of the factors that affect fatal collision involvement rate for novice drivers, and not just the results of MTO's programs.

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[3] At present, we are measuring the performance of 16-year-old drivers as a proxy to define novices.

Figure 4
Fatal Crash Involvement of
16-Year-Old Drivers



Target Setting: Targets can be set in areas that MTO has control over, namely: policy, standards, regulations and enforcement. Even at this lower level MTO may only have partial control over outcomes. The '% of commercial vehicles declared out-of-service in the Road-Check program[4]' is a good example of this because carriers are responsible for maintaining their vehicles, not MTO. However, MTO can still influence carriers by conducting truck inspections that target commercial vehicles that appear to be unsafe. Since MTO has direct control over truck inspections, a target can be developed for the 'extent' and 'coverage' of the inspection program. The results of the inspection program will be reflected in the measure '% of vehicles declared out-of-service in targeted inspections'.

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4 This is a North-American-wide annual roadside survey of commercial vehicles that follows standard survey and reporting procedures and can be used to benchmark our performance with respect to other jurisdictions or to track year-over-year performance.

5.3 Transportation Policy and Planning

The goal of MTO's Transportation Policy and Planning core business is to foster a transportation system that will get people and goods to their destination. Outcomes, key questions and performance measures for this core business are found in Table 4.

A considerable amount of work is still required to collect baseline data for the measures shown in Table 4. It is expected that the number of potential measures shown will be reduced significantly once data availability is determined or other more suitable and appropriate measures are developed. In some cases, where measures are socio-economic in nature, special ad hoc studies will be required to acquire baseline data. Frequency of reporting in these cases would be periodic rather than annual.

Baseline Data: The performance measure '% change in average travel time for transportation system users' illustrates the development of baseline data when several different partners are involved.

Table 4

Outcomes	Key Questions	Performance Measures
A transportation system providing social and economic benefits to Ontario	Has the cost of travel on the transportation network changed?	- % change in freight cost/tonne km - % change in cost/ passenger km or trip
	What are the impacts of Ontario's transportation system on costs of goods and personal mobility?	- cost of transportation as a % of total commodity cost - % of disposable income spent on transportation
	Does the transportation system allow Ontario to compete?	- % change in transportation productivity for key sectors

Outcomes	Key Questions	Performance Measures
A transportation system that is safe, reliable, efficient, accessible and integrated.	Is the transportation system integrated?	- % of time lost due to transfer
	Is the transportation system safe?	- number of fatal collisions by mode
	Is the transportation system reliable and efficient?	- % change in average travel time for transportation system users (by trip characteristics)
	Is the transportation system accessible?	- % change in coverage (geography, hours of operation, proximity, frequency of service)

Transportation system users are concerned with the total trip time between A and B (which could include more than one mode in more than one jurisdiction) and are not concerned with who provides the infrastructure (municipal, regional, provincial or federal governments) or who provides the service (public or private carriers).

From a user's perspective, % change in average travel time would be best determined by recording changes in total trip times. However, different modes and transportation providers usually produce information that only pertains to their sphere of responsibility. As a result, data on total system performance are not usually available.

Under these circumstances, it may be worthwhile for the various partners to explore the possibility of collecting information on total system performance. If data collection costs are prohibitive or various partners are not interested, information on only the individual components of the system will be available. In the case of provincial highways, where MTO has a clear responsibility, measuring level of congestion will provide the basic information to assess '% change in travel time'.

Target Setting: It will be useful to set targets for total system performance only if the various partners involved agree to set the targets together. In the absence of mutual target-setting, it will be unrealistic for individual

components of the system to set targets for overall system performance. Individual jurisdictions do not want to be held accountable for the performance of the total system, for which they do not have total control.

A possible solution may be to simply monitor system performance trends and only establish targets or make commitments in areas that an individual jurisdiction controls. For example, MTO could monitor the 'cost of transportation as a % of total commodity costs' and only make commitments on specific deliverables that will affect transportation costs, such as preparing legislation to implement intercity bus deregulation, repeal the Truck Transportation Act or amend the Ontario Railways Act.

6.0 CONCLUSION

Developing performance measures helps the business process by clarifying and focussing efforts towards key core business objectives. It assists an organization become more business-like and results oriented. However, developing performance measures for public-sector core businesses is time-consuming and challenging. The examples in this paper illustrate some of the issues that must be resolved. Target setting still remains a sensitive and critical area.

RECENT ESTIMATES OF TRUCK TRAVEL IN ONTARIO

Joseph Jones (Boon, Jones and Associates, Inc.) and
Greg Little (Ministry of Transportation, Ontario)*

1. Introduction

Estimates of truck activity are essential for a variety of analysis and policy purposes, including development of accident rates, management of the road system, monitoring of trade corridors and estimation of emissions. However, reliable, comprehensive estimates of truck activity — vehicle-kilometres travelled (vkt) or tonne-kilometres (tkm) — are hard to come by.

The purpose of this paper is two-fold: a) to describe approaches to estimating provincial truck activity, taking Ontario as an example, and b) to present some recent empirical estimates of Ontario truck vkt, both for the provincial highway network and for all roads. The core of the paper is an analysis of the results of the 1995 Commercial Vehicle Survey, an intercept survey of over 30,000 observations conducted on provincial roads. The provincial truck fleet is broken out into various categories. Estimates of vkt are then developed for the categories.

2. Estimates of Total Truck Travel: Fuel Consumption Method

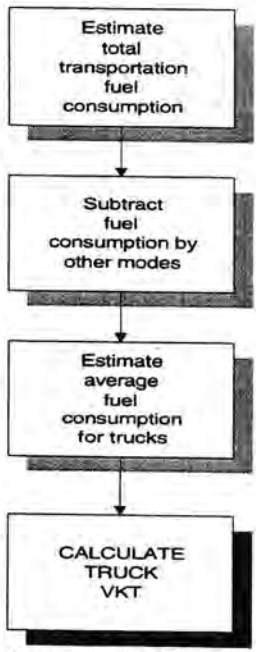


Figure 1: Fuel Method

Total truck travel in Ontario (i.e. on all roads) was estimated on the basis of fuel consumption and assumed fuel efficiency, as illustrated in Figure 1.

Road vehicle fuel consumption (all modes) was derived from Statistics Canada's *Quarterly Report on Energy Supply-Demand in Canada.* This was used in preference to *Road Motor Vehicle Fuel Sales* because the

* The views expressed are those of the authors and not necessarily those of the ministry.

data for Ontario in the latter publication are based on in-house Statistics Canada estimates, rather than data supplied by the Government of Ontario[1].

The main issues in developing road fuel estimates is to filter out non-road consumption, while including consumption by private trucking fleets. This was approximated by including diesel and gasoline consumption by the manufacturing and "commercial & other" sectors, as shown in Table 1. Consumption by the "mining, forestry and consumption" sector was excluded on the grounds that most of this consisted of consumption by off-road vehicles.

Table 1: Estimate of Road Vehicle Fuel Sales: 1994
Millions of Litres

	Diesel	Gasoline	Total
Retail Sales	846.3	11,789.1	12,635.4
Road transport & urban transit	1,456.0	346.1	1,802.1
Manufacturing	180.9	—	180.9
Commercial & other institutions	608.3	392.6	1,000.9
Total	3,091.5	12,527.8	15,619.3

Source: *Quarterly Report on Energy Supply-Demand in Canada* (Statistics Canada, 57-2003)

Estimates of consumption by modes other than trucking are shown in Table 2, based on Statistics Canada bus consumption data and these assumptions about automobile diesel consumption: active, fit vehicles: 34,733[2] * annual distance/vehicle (17,380 km[3]) * 8 litres per 100 km.

Subtracting bus and automobile consumption from total fuel consumption yields the following estimates of truck fuel consumption:

- diesel = 2.802 billion litres [3.092 bn l. minus (241.2 million l. + 48.3 million l.)];

[1] Communication from C.Beauregard, Transport Canada

[2] From Ontario vehicle registration file.

[3] Based on Nix et al. (1992), table A1, p. 1017.

- gasoline = 732.9 million litres [gasoline sales to road transport and urban transit plus commercial less 5.8 million litres in bus gasoline sales].

Table 2: Fuel Consumption by Other Modes: Ontario, 1994
Millions of Litres

	Diesel	Gasoline	Total
Intercity Bus	13.9	not calc.	13.9
Urban Transit	155.3	0.2	155.5
School Buses	61.2	3.7	64.9
Charter Buses	10.8	1.9	12.7
Bus Subtotal	241.2	5.8	247.0
Automobiles (diesel)	48.3	not calc.	not calc.

Sources: *Passenger Bus and Urban Transit Statistics* (Statistics Canada, 53-215); Ontario Vehicle Registration File

These estimates are subject to a fair degree of uncertainty, the most important being the quantity of retail gasoline which was sold for trucking purposes. Based on Table 1, retail sales of diesel probably account for over 25 per cent of total sales to truck users. It is conceivable that a similar or higher percentage of truck gasoline sales would show up in the retail subgroup if it were possible to break apart the data. To address this uncertainty, two sets of gasoline fuel consumption estimates were developed. The low case, described above, assumed zero truck gasoline under the "retail sales" subgroup, while the high case assumed that the ratio of *retail sales/road transport & urban transit sales* was the same for gasoline as for diesel.

In order to develop truck vkt estimates based on fuel consumption, it remains to estimate **fuel consumption rates**. These were based on Statistics Canada's Motor Carrier of Freight survey for diesel and on Trimac estimates for gasoline. Statistics Canada fuel consumption estimates were obtained for four segments of the industry:

- large private carriers (annual operating expenses exceeding $1 million);

- for-hire level I and II carriers (annual operating revenues exceeding $1 million);
- for-hire level III carriers (annual operating revenues from $25,000 to $1 million); and
- owner-operators.

Two issues must be addressed in using Motor Carriers of Freight (MCF) data:

- **weighting of the fuel consumption rates** to reflect the relative importance of the four Statistics Canada segments in the total Ontario fleet. In particular, a smaller (but unknown) fraction of private carriers is covered; and
- the effects of Statistics Canada's sampling procedures on the **representativeness** of the consumption rates. The MCF excludes smaller private fleets and urban fleets, which typically have lower gross vehicle weights and so travel greater distances per litre.

In recognition of the uncertainty about the importance of these factors, a range of fuel consumption rates was developed, as illustrated in Table 3. The "low" gasoline estimate was derived from Trimac values for a 2-axle straight truck of 19t GVW. It was increased by 20% for the high estimate to recognize that many gasoline-powered vehicles operate at lower GVWs and higher fuel efficiency.

Table 3: Fuel Efficiency Estimates

	Private	For-hire			Total: Weighted Average
		Level I/II	Level III	Owner-Operators	
Diesel					
Fuel Efficiency (vkt/l)	2.78	2.12	2.25	2.36	
Weight (Low)	25%	32%	9%	34%	2.38
Weight (High)	50%	21%	6%	23%	2.52
Gasoline					
Low					2.65
High					3.18

Combining the fuel consumption and efficiency assumptions yields estimates of total vkt.

Table 4: Estimates of Total Truck Vkt: Ontario, 1994

	Diesel	Gasoline	Total
Estimated truck consumption (million L)			
Low	2,802	733	3,535
High	2,802	859	3,771
Assumed fuel efficiency (vkt/l)			
Low	2.38	2.65	2.44
High	2.52	3.18	2.59
Estimated vkt (million)			
Low	6,672	1,940	**8,612**
High	7,047	2,728	**9,775**

3. An Alternative Approach: Average Distance Travelled Per Truck

This approach multiplies the number of trucks by the average annual distance travelled to arrive at total vkt. The implicit assumption is that the distance travelled by Ontario-domiciled trucks outside the province is offset by the activity of out-of-province trucks in Ontario. The key data requirements are:

- the **number of trucks** in the universe and the distinction between trucks used to carry freight and other trucks (e.g. personal transportation; utility/farm trucks); and
- the **average annual distance travelled** per truck.

Following Nix (1990), the cut-off point to separate freight trucks from the rest is set at 4.5 tonne GVW. In the 1995 registration file, this represented 145,538 vehicles out of 1,062,493 trucks registered as active and fit in the province[4]. It is probable that a significant percentage of the vehicles in the 3 to 4.5 tonne category carried freight, particularly urban pick up and delivery operations. This is consistent with the findings of urban goods movement surveys. As a result, the fleet estimate is conservative.

The average distance travelled per power unit is also derived from the MCF surveys referred to above. For the four industry segments, the average distances travelled were: Level I & II 91,502, Level III 69,620, owner-operators 93,418, and private 55,942. Using the same weightings as before to correct for the under-representation of private trucking, weighted averages of 72,825 km (low) and 81,266 km (high) per power unit are derived. While the fleet estimate is biased low, this average distance estimate is undoubtedly too high, given that average distance travelled for (unsurveyed) urban fleets is likely to be considerably lower than for the surveyed intercity fleets. In other words, at least to a degree, the biases in the distance-based vkt approach are self-correcting.

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[4] 876,166 had a registered gross vehicle weight of less than 3 tonnes, while 40,789 had an RGVW of 3,001 kg to 4,500 kg

The resulting estimate of total distance travelled in 1995 is 10.6 billion vehicle-kilometres. (This compares to 9.0-10.3 billion, using the fuel consumption approach.)

4.0 1995 Commercial Vehicle Survey

The focus of the Commercial Vehicle Survey Program of the Ministry of Transportation, Ontario is on-highway trucking activity. The Program comprises province-wide surveys as well as special purpose surveys which collect data on regions or specialised topics. A province-wide survey was conducted in the summer of 1995 (between May and September). The primary objective of the 1995 Commercial Vehicle Survey (CVS) was to obtain information on the characteristics of trucking activity on the Ontario intercity highway network. This section of the paper will describe the output measures for vehicle kilometres of travel which are available from the CVS.

4.1 Methodology

The CVS utilizes a combination of vehicle weights, observations and questions to obtain information on trucking characteristics. Data were collected in five broad categories: vehicle, carrier, driver, trip and commodity.

In addition, classified traffic counts were undertaken at each survey site. These provide information on total traffic. As a result, the survey data can be expanded to represent the total traffic during the survey period for each location and direction. The goal was to obtain traffic counts for a minimum of seven days, 24 hours per day, at each location.

4.2 Weighting of Survey Data

The weighting of commercial vehicle survey data is undertaken to improve data quality and to make it more representative of the total commercial vehicle traffic during survey period.

Survey weighting requires the development of expansion and bias factors. The former are used to expand the survey data so as to represent the total commercial vehicle traffic passing each survey site. The bias factors are developed to compensate for a variety of constraints. The main

constraints are over and under sampling, and trip bias (for trips which pass more than one survey). Unless expansion and bias factors are applied, estimates of traffic activity are unreliable, even when expressed as a proportion in percentage, rather than absolute, terms.

4.3 Intercity Truck Network

As noted above, the CVS is intended to obtain information on Ontario intercity trucking activity. The sites for the CVS were selected to approximate, as closely as practicable, the primary intercity trucking network in Ontario. A total of 58 sites were used, including truck inspection stations and other roadside locations.

The intercity network does not correspond with the provincial highway network. Rather, it is a subset of the provincial highway system. The intercity truck network accounts for about one-quarter of the 21,800 km which comprises the provincial highway network[5]. However, it captures a much higher proportion of long-haul trucking activity — probably more than 90%.

4.4 Output Measures

The CVS can provide output measures for both vehicle-kilometres of travel and tonne-kilometres of travel. These factors are developed from information obtained directly by weighing the vehicle, from the driver, and on the basis data enhancements carried out in the post survey period.

Information related to vehicle weight and commodity was collected during the survey. The axle weights and gross weight of the vehicle was collected in most cases (using weigh scales at truck inspection facilities). Information on the commodity, notably commodity name and weight, was obtained from the bill of lading (if available) or the driver. In addition, the driver was asked about the capacity utilization of the vehicle, i.e. full, partially loaded or empty.

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[5] The network covered by the CVS corresponds to the Strategic Network of MTO which comprises 27.6% of the provincial highway network as defined in *Strategic Review and Outlook and Priority Investments 1996-2000.*

Information on vehicle kilometers of travel was not collected directly in the survey, but was derived from vehicle trip information. Extensive data on the vehicle trip were collected from the driver: origin and destination, last stop and next stop (relative to survey location), and border crossings (if applicable). The trip distance was calculated from this information after the fact by using PC*Miler®, a commercially available routing software which was developed for use by the trucking industry. This software was also used in the 1995 CVS to determine the station passed bias (section 4.2). Trip distances were calculated for each record for the total trip in addition to components of the trip such as distance in Ontario and distance outside Ontario.

4.5 Vehicle Kilometres of Travel

The output measure of vehicle kilometres of travel (VKT) can be obtained from the CVS in two different ways, direct and indirect. The direct method is from the trip distance calculated for each record as described in the preceding section. This enables calculation to be undertaken on the total kilometres of travel for the vehicles surveyed. In addition, VKT can be calculated on any category of data collected in the survey e.g. vehicle configuration, body style, carrier type etc.

The indirect method of calculating VKT is in conjunction with traffic counts which are collected by the Ontario Ministry of Transportation (MTO) on a regular, ongoing basis on the provincial highway network. MTO has developed a data base[6] which combines the vehicle configuration data from periodic CVS's and the traffic count data. The information on VKT is combined with information on collisions involving commercial vehicles from the Accident Data System (ADS) to calculated commercial vehicle exposure to accident risk. Both the direct and indirect methods are discussed in detail below.

4.6 CVS Vehicle Kilometers of Travel

As noted in section 4.0, the CVS is designed to measure commercial vehicle activity on the provincial intercity network which amounts to approximately 25% of the total provincial highway system. Therefore, it is not possible to measure directly the VKT on the provincial highway

[6] Developed by IBI Group for MTO Road Safety Research Office

system or, consequently, the total VKT on all Ontario roads (provincial plus municipal). However, as noted above, the CVS does measure almost all intercity trucking activity. Consequently, it can provide VKT information on that important segment of commercial vehicle activity. In addition, it provides detailed characteristics of trucking activity which are not available elsewhere.

The CVS results have been weighted to represent an average day for the survey period (May to September, 1995) using the traffic volumes and bias factors. On this basis, it was estimated that average traffic on the provincial intercity network for an average 24 hour period was 11.9 million VTK. If this is expanded to an annual number (without correcting for any weekly or seasonal variations in commercial vehicle volumes), it yields a total of 4.3 billion VKT on the same network. This compares to the 7 billion VKT calculated for diesel trucks **on all roads** (Table 4, above). This appears reasonable as most travel by heavy commercial vehicles occurs on the provincial highway system in intercity trips.

As noted above, VKT estimates can be developed from the CVS for various vehicle subgroups. Table 5 provides a breakdown of CVS total distance traveled inside and outside Ontario for various vehicle configurations. Tractor and one semi-trailer configurations predominate for the Ontario portion of the trips. They are even more dominant for total distance, indicating that the longer the trip, the greater the use of that configuration. Conversely, the share of tractor-2 semi configurations is lower for total distance travelled than for travel within Ontario. This is possibly due to incompatibilities in the weights and dimension regulations for these configurations between Ontario and neighbouring jurisdictions.

Table 5 also estimates the number of vehicles on the network on an average day, again based on an expansion of the number of vehicles surveyed. If we compare these results to the results of distance travelled, we see that the tractor-1 semi is less predominant while the straight truck takes on greater prominence. This result is consistent with the use of tractor one-semi's in long haul trips and straight trucks in local trips.

Table 5: Distance Travelled and Truck Configuration
Provincial Intercity Network, Average Summer Day, 1995

Configuration	Ontario Km		Total Km		Vehicles	
Tractor-1 semi	9,487,590	79.8%	17,975,001	86.1%	38,265	70.3%
Tractor-2 semi	742,113	6.2%	978,998	4.7%	2,533	4.7%
Straight truck	1,429,259	12.0%	1,649,350	7.9%	12,073	22.2%
Truck-trailer	152,126	1.3%	179,693	0.9%	977	1.8%
Tractor only	73,421	0.6%	91,446	0.4%	578	1.1%
Other	5,252	0.0%	8,252	0.0%	17	0.0%
All	11,896,324	100.0%	20,882,739	100.0%	54,443	100.0%

Similarly, VKT was estimated on the basis of commercial vehicle body style. Information on the total distance in Ontario for the body styles utilized in the CVS is provided in Table 6. This indicates that there is not much difference in the distribution of total VKT and vehicle numbers. This is not surprising, as the body styles are common to different vehicle configurations, i.e. there are similar body styles for tractor-trailers and straight trucks. Consequently, there is comparatively little difference in distance travelled between trucks of different body styles.

Table 6: Distance Travelled and Body Style
Provincial Intercity Network, Average Summer Day, 1995

Body Style	Distance in Ontario		Vehicles	
Van	7,985,026	67.2%	33487	61.5%
Container	330,581	2.8%	1557	2.9%
Soft Side	63,593	0.5%	302	0.6%
Flatbed	1,351,049	11.4%	5665	10.4%
Stake/Rack	386,781	3.3%	1927	3.5%
Float	146,731	1.2%	634	1.2%
Tanker	650,085	5.5%	3376	6.2%
Hopper	136,874	1.2%	874	1.6%
Dump	438,487	3.7%	4424	8.1%
Other	400,553	3.4%	2197	4.0%
Total	11,889,760	100.0%	54,443	100.0%

Another significant characteristic of trucking activity is the carrier type, i.e., for-hire or private. The for-hire carrier is a trucking company which

carries other people's freight for compensation. A private carrier is a company that primarily carries its own goods. The distance travelled in Ontario for each type of carrier is indicated in Table 7.

Table 7: Distance Travelled and Carrier Type
Provincial Intercity Network, Average Summer Day, 1995

Carrier Type	Kms in Ontario	Percent	Vehicle	Percent
For-hire	93,311,042,537	78.6%	3,658,915,04	70.9%
Private	,876	21.4%	8	29.1%
Total	11,868,980	100%	51,637	100%

For-hire trucking accounts for almost 80% of the total distance travelled, but for only 71% of the number of vehicles. This is consistent with for-hire carriers being more prevalent in long-haul trucking.

Looking at the type of driver, the CVS distinguished between employee drivers and owner-operators, i.e., the owner of a commercial vehicle who leases his/her vehicle and driving services to a carrier. The employee driver generated three-quarters of the distance travelled in Ontario as shown in Table 8. This compares to a slightly higher proportion (79%) based on vehicles surveyed. This indicates that the average distance travelled per day was somewhat higher for owner operators than for company drivers.

Table 8: Distance Travelled and Driver Employment
Provincial Intercity Network, Average Summer Day, 1995

Driver Employment	Km in Ontario	Percent	Vehicles	Percent
Employee	88,590,213,020,	74.6%	4,060,411,0	78.6%
Owner-operator	413	25.4%	82	21.4%
Total	11,879,434	100%	51,686	100%

4.7 Other Characteristics

The preceding sections have provided examples of some of the analysis possible from a few of the key characteristics included in the CVS. It is,

also possible to analyse the data for any of the other characteristics included in the survey. Characteristics of interest could include vehicle base, trailer length, and dangerous goods, to name a few. As noted above it is also possible to provide the primary output measure of tonne-kilometres of travel by these same characteristics. Space does not permit an exploration of these measures. However, there is fertile ground for future analysis, as discussed in section 4.8.

4.8 Exposure Data Base

The CVS is a key component of the MTO exposure data base (EDB) which is used to measure the exposure of heavy commercial vehicles to risk. The EDB combines data on traffic counts (from the MTO highway inventory file) and vehicle characteristics (configuration and body style) from the CVS to produce total vehicle kilometres of travel for 24 categories of heavy commercial vehicles on the provincial highway system. Information on heavy commercial vehicle collisions is then obtained from the MTO Accident Data System (ADS) to produce collision rates (number of collisions per million km) for each category of heavy commercial vehicle[7].

The EDB improves on the VKT information developed directly from the CVS in two ways: it provides information on the total provincial highway system and is calculated annually. However, it currently provides information only on configuration and body style, compared to the broad range possible from the CVS.

The EDB is currently being updated with data from the 1995 CVS and the Highway Inventory File. This will then update VKT data for the categories of heavy commercial vehicles on the provincial highway system. This in turn can be updated to produce collision rates from the current ADS.

Table 9 shows the type of data available from the EDB, using an example from the 1988 CVS and the 1989 Highway Inventory File.

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[7] For a detailed description of the study see *Exposure and Collision Rates of Trucks in Ontario*, Safety Research Office, Ministry of Transportation, 1993

The EDB for 1989 provides a calculation of 5.6 billion VTK for the provincial highway system. If we add an inflation factor to that data, it is possible to update this figure on a preliminary basis. Based on sales of diesel fuel for road use, commercial vehicle travel increased by a factor of approximately 15% between 1989 and 1995[8]. This produces estimates of 6.4 billion VKT of travel on the provincial highway network for 1995 (compared to 4.3 billion VKT on the smaller provincial intercity network).

Table 9: Total Kilometres Traveled by Trucks
Ontario Provincial Highways, 1989 (million kilometres)

Truck Configuration	Body Type				
	Van	Flatbed/ Stake	Tanker	Other	Total
Straight truck	540.7	140.5	39.3	297.2	1,017.7
Truck-trailer	18.9	24.0	3.2	30.0	76.1
Tractor only					21.1
Tractor-1 semi	2,407.0	658.7	318.2	710.0	4,093.9
A/C train	79.4	42.7	13.3	64.3	199.7
B train	22.8	102.5	25.4	20.0	170.7
Other	0.4	0.2	1.4	2.2	4.2
Total	3,069.1	968.6	400.9	1,123.7	5,583.5

It is also noteworthy that the tractor-1 semi configuration is not quite as dominant in the EDB as in the CVS. It accounts for 73% of total distance travelled compared to 80% in the CVS (80%), as was noted in Table 5. This is nearer to the proportion for vehicles surveyed (70%). This is likely due to the greater representation of local activity in the total provincial highway network which is captured by the EDB.

4.9 Enhancements to Exposure Data Base

The EDS provides detailed information on the VKT of heavy commercial vehicles on the provincial highway system. The data base provides information on VTK for heavy commercial vehicles based on direct commercial vehicle activity. However, there are some limitations in the system. Many of these can be addressed with relative ease, while others

[8] Source Transport Canada

will require more time and resources. These limitations and potential enhancements to address them are discussed below.

i) Comparisons of Vehicle Classes:

The exposure data base deals only with heavy commercial vehicles. It does not provide for direct comparisons of VKT (or exposure to risk) for different classes of vehicles, e.g. heavy commercial vehicles and passenger vehicles. Exposure rates for total vehicles are reported in the Ontario Road Safety Annual Reports (ORSAR) published by MTO. These are calculated on a different basis, by using fuel consumption data. As a result, they do not provide a direct comparison between trucks and passenger vehicles, which is of primary interest in comparisons of safety performance.

A direct comparison of passenger and commercial VKT could be accomplished quite easily by modifying the Exposure Data Base to incorporate total vehicles (instead of just commercial vehicles) using the count data on the provincial highway system. This would provide a measure of total VKT and enable comparison of exposure to risk for heavy commercial vehicles compared to other vehicles.

ii) Other Commercial Vehicle Characteristics

Currently the Exposure Data Base only utilizes the vehicle configuration and body style data from the CVS to develop exposure data on heavy commercial vehicles. Other characteristics from the CVS e.g. carrier type (for-hire, private) or driver type (employee, owner-operator) could be utilized in updating the Exposure Data Base. It would require modification of the EDB and the effort required to accomplish this is not known at this time. It should not, however, be a major undertaking.

A preliminary review of the CVS data elements which would be of interest for inclusion in the EDB are: carrier type, driver type, vehicle base, capacity utilization, number of axles, trailer length, gross vehicle weight, commodity type, commodity weight, dangerous goods.

Not all of these characteristics can be applied in analysis of risk exposure as some do not feature on the accident report form and are, therefore, not

included in the Accident Data System. However, further exploration could be undertaken in analysis of these factors as exposure to risk.

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An Industry With Many Faces : Balance Sheets Analysis of For-hire Trucking Companies

Robert Masse, Statistics Canada,
Transportation Division

I - Context of the research

The for-hire trucking industry is characterized by a wide range of activities. Trucking companies are carrying a variety of goods ranging from basic raw materials to semi-processed and finished goods, including cars and household goods. These goods are shipped to a large variety of markets and clients, from a nearby retail store to a manufacturing plant located in United States. Trucking companies are also operating in different legal environments from one province to another, from one country to another. Alone, an aggregation of balance sheets data would fall short of providing a meaningful indication on the degree of differentiation between the various segments of the for-hire trucking industry. This research proposes a systematic approach and also looks into the relationship between the degree of differentiation and the financial performance of for-hire trucking companies.

II - Purposes of the research

This research has two main purposes :

- to measure the extent to which the variety of activities conducted by for-hire trucking companies may have an impact on their financial structure;
- to measure the extent to which different financial structures may have an impact on the financial performance of for-hire trucking companies.

III - Plan of the paper

We will first describe the statistical tools used to make these measurements. We will then present the results obtained by applying these tools to the 1993 financial database derived from the Annual Motor Carriers of Freight Survey, conducted by Transportation Division of Statistics Canada. In conclusion, we will summarize the main results obtained and we will give some insights on future applications of the statistical tools developed.

IV - Statistical Tools

A - the statistical decomposition method

The point of departure of this method[1] is the decomposition of a company's balance sheet into four components : short-term asset (STA), long-term asset (LTA), short-term liabilities (STL) and long-term liabilities, including shareholders' equity (LTL). In table 1 below, the values reported by a given company for these four components of the balance sheet are denoted a, b, c and d.

Table 1
Decomposition of the Balance Sheet

	Value	Company	Group of companies
Resources used			
Short-Term Assets	a	p(a)	P(a)
Long-Term Assets	b	p(b)	P(b)
Obligations and Owners Investment			
Short-Term Liabilities	c	p(c)	P(c)
Long-Term Liabilities and	d	p(d)	P(d)

[1] For more information on the method, please consult : 1) **H. Theil**, *Statistical Decomposition Analysis*, North-Holland Publishing Co., 1972 and 2) **B. Lev**, *Financial Statement Analysis : A New Approach*, Prentice-Hall, 1974.

Owners Equity			
	Total	100 %	100 %

The first step in measuring the financial structure of companies consists in computing the relative importance or the proportion of these four components of the balance sheet out of the sum of total assets, total liabilities and owner equity. In table 1, these proportions are denoted "p". These proportions can be computed, not only at the company level, but also for a group of company or for all trucking companies. For instance, we can derive the balance sheet of all general freight carriers by summing up their individual balance sheet information. The same way, we can compute the proportions of the four components for trucking companies grouped by domain such as region (all trucking companies domiciled in Ontario), size (all trucking companies having annual operating revenues larger than $ 1 million), or any other characteristics deemed relevant to the trucking industry. In the table below, the proportions of STA, LTA, STL and LTL computed for a group of trucking companies are denoted "P".

The statistical decomposition method allows for the computation of an indicator, called index, that will provide a measure of the difference in the financial structure of trucking companies by comparing pair by pair these proportions computed at various levels of grouping. In its general form, the statistical decomposition method can be shown as follows :

Index = Sum p(i) x Ln [p(i) / P(i)], for i = a, b, c and d

The general formula has three components :

- the pair by pair comparison : p(i) / P(i)
- the mathematical function : Ln
- the weight : p(i)

For instance, we may want to measure the extent to which the financial structure of the general freight companies differs in comparison to the overall trucking industry. Under the statistical decomposition method, the proportions of STA, LTA, STL and LTL for general freight companies and for all trucking companies will first be compared pair by pair. The results of this comparison will then be transformed using the natural logarithm function. Finally, the results of this comparison will be weighted according to the relative importance of each element.

The results provided by the statistical decomposition method in this case can be interpreted as follows :

- the larger the index value, the more important the difference in the financial structure of the general freight companies as compared to the overall trucking industry;

- the lower the index value, the less important the difference in the financial structure of the general freight companies as compared to the overall trucking industry;

- if the index equals zero, the financial structure of general freight companies is exactly comparable to the overall trucking industry.

The statistical decomposition method allows first for the computation of a *global balance sheet index*. This index will inform us on the degree to which the financial structure of a given company or group of companies differ as a whole when compared to another company or group of companies. This global balance sheet index can be decomposed into three sub-indexes, namely assets, liabilities and time-horizon. These three sub-indexes allow for a more detailed analysis of the difference in the financial structure of companies or groupings of companies either in terms of their use of short-term and long-term resources (*assets index*), or of their organization of short-term and long-term obligations and financing (*liabilities index*), or in the way they both use their resources and organize their obligations and financing in the short-term as compared to the long term (*time horizon index*).

B - <u>the financial ratios</u>

The financial performance of trucking companies will be measured both in terms of solvency and profitability. In term of solvency, the short-term and the long-term solvency will be evaluated using respectively the *working capital ratio* and the *long-term debt to equity ratio.* Profitability will be evaluated both in term of revenues, using the *operating profit margin*, and in term of assets, using the *rate of return on assets.*

V - Domains of the research

For the purpose of this research, trucking companies are grouped into 3 domains :

- by industry, using the 1980 Standard Industrial Classification;
- by size, ranking companies on the basis of their annual operating revenues;
- by employment characteristics, classifying companies on the basis of whether or not they employ owner operators;

VI - Analysis of results

The purpose of this section is to analyze the main results obtained from the use of the statistical decomposition method in the framework of the 1993 *Annual Motor Carriers of Freight*[2] survey. More specifically, the global balance sheet index and the assets, liabilities and time horizon sub-indexes will be calculated using 1993 financial data as reported by 1,160 Canadian for-hire trucking companies with annual revenues of $ 1 million or more. The results are presented according to three domains : by industry, by size and by type of employer.

A) By Industry

The table 2 below shows the results of the balance sheet analysis by industry. The global balance sheet index indicates the existence of major differences in the financial structure of trucking companies when

[2] Summary data were released in Statistics Canada publication *Trucking in Canada, 1993* (catalogue 53-222-XPB).

classified by industry. First, the general freight, the dry bulk and the other trucking segments of the industry exhibit a global balance sheet index close to zero (equal to or less than 0.3), indicating that the financial structure of these industries do not differ significantly as compared to the overall trucking industry. By comparison, companies belonging to household goods and to liquid bulk industries, with a global balance sheet index of 1.6 and 1.9 respectively, have a different financial structure from the industry as a whole. Lastly, the forest products industry also stands out from the industry as a whole, with a global balance sheet index of 0.7. In the following paragraphs, we will examine in more detail the results obtained for the household goods, the liquid bulk and the forest products industries.

Table 2
Balance Sheet Analysis by Industry

Industry	Global Balance Sheet Index	Decomposition indexes		
		Assets	Liabilities	Time Horizon
General Freight	0.3	0.4	0.3	0.3
Household Goods	1.6	0.1	3.2	1.0
Liquid Bulk	1.9	2.6	1.2	1.8
Dry Bulk	0.2	0.2	0.2	0.2
Forest Products	0.7	0.3	1.1	0.6
Other	0.1	0.0	0.1	0.0

Many analysts contend that the household goods moving industry has characteristics that set it apart from the rest of the for-hire trucking sector. The results obtained, namely a global balance sheet index significantly higher than most trucking companies, tend to support this contention. The results also explain in greater detail the distinctiveness of household goods movers from the standpoint of their financial structure. The assets structure of household goods movers compares favorably with that of other truckers, as shown by an assets index of 0.1.

By contrast, their liabilities structure, with a liabilities index of 3.2, stands out sharply as compared to the overall trucking industry. The financial structure of household goods movers also differs in terms of time horizon. With a time horizon index of 1.0, household goods movers have an overall assets and liabilities structure more oriented toward the long term compared to the trucking industry as a whole.

The case of the bulk liquids trucking industry is one of the most interesting. First, this industry stands out sharply from the overall trucking industry with the highest global balance sheet index at 1.9. This result is surprising in that traditionally, the dry bulk materials and the bulk liquids trucking industries are combined together for analytical purposes. The bulk liquids trucking industry stands out especially with respect to its assets structure, with an assets index of 2.6. A more detailed analysis of the data shows that bulk liquids truckers have a much higher proportion of long-term assets than the industry as a whole. The liabilities index of 1.2 indicates that their liabilities structure also stands out from the industry as a whole. Lastly, the time horizon index of 1.8 serves to confirm that the time horizon of bulk liquids truckers is considerably different compared to the overall trucking industry.

The forest products trucking industry also shows interesting results. The global balance sheet index, at 0.7, shows that this industry also stands out, although to a lesser extent than the bulk liquids and the household goods movers industries. With a liabilities index at 1.1, as compared to an assets index at 0.3, this distinctiveness is mainly on the liabilities side of the balance sheet, highlighting the fact that forest products truckers have proportionally more long-term liabilities than the industry as a whole.

What is the impact of these differences in the financial structure of household goods movers, bulk liquids and forest products industries on their financial performance, as measured by financial ratios ? Table 3 below shows the solvency and the profitability ratios computed by industry for the year 1993. From a general point of view, these financial ratios tend to demonstrate that those distinct trucking industries in terms of financial structure also exhibit distinct financial performance in terms of solvency (short-term and long-term) and of asset profitability. For instance, household goods movers industry has the highest short-term solvency ratio (working capital ratio = 1.377), the highest long-term

solvency ratio (long-term debt to equity ratio = 0.572) and the lowest asset profitability (rate of return on assets = 0.44 %). Bulk liquids industry has the lowest short-term solvency ratio (0.886) and the second highest asset profitability (4.96 %). Finally, the forest products industry has the lowest long-term solvency ratio (0.403) and the highest asset profitability (5.31 %).

Table 3
Solvency and Profitability Ratios by Industry

Industry	Solvency		Profitability	
	Short-term	Long-term	Revenues (%)	Assets (%)
General Freight	1.005	0.548	2.09	1.72
Household Goods	1.377	0.572	4.18	0.44
Liquid Bulk	0.886	0.545	5.86	4.96
Dry Bulk	1.009	0.485	4.62	3.24
Forest Products	1.092	0.403	4.02	5.31
Other	0.942	0.468	4.18	3.84
Total Industry	0.992	0.518	3.28	2.90

By classifying trucking companies according to their industrial classification, the results obtained by using the statistical decomposition method on the 1993 financial database tend to demonstrate that the wide range of activities conducted by the trucking companies do have an impact on their financial structure and that these different financial structures do have an impact on their financial performance in terms of solvency and asset profitability.

B) By Size

The 1,160 trucking companies on the 1993 financial database were classified by size according to their total annual operating revenues. The intervals were defined so that the number of trucking companies would be sufficiently high in each class. As illustrated in table 4 below, only trucking companies with annual revenues of more than $ 25 million displays a financial structure significantly different from the overall trucking industry. This is evident for trucking companies with annual revenues between $ 25 and $ 50 million, with a global balance sheet index of 1.3. The assets and liabilities structures are both significantly different as compared to the industry as a whole, reaching levels of 1.2 and 1.4 respectively. Trucking companies with annual revenues of $ 50 million or more also stand out from the industry as a whole, although to a

lesser extent than companies between $ 25 and $ 50 million. Their distinctiveness originates almost exclusively on the assets side, with an index relatively high at 0.9. The time horizon index of 1.3 and 0.5 respectively for companies between $ 25 and $ 50 million and for companies with $ 50 million or more in annual revenues tend to show that these larger companies have a different time perspective, that is more oriented toward the long term.

Table 4
Balance Sheet Analysis by Size

Size (Annual Revenues)	Global Balance Sheet Index	Decomposition Indexes		
		Assets	Liabilities	Time Horizon
Smaller than 2 $M	0.1	0.0	0.3	0.1
2 to 5 $ M	0.1	0.2	0.1	0.0
5 to 10 $ M	0.2	0.2	0.1	0.2
10 to 15 $ M	0.1	0.0	0.1	0.0
15 to 25 $ M	0.1	0.1	0.1	0.0
25 to 50 $ M	1.3	1.2	1.4	1.3
Larger than 50 $ M	0.5	0.9	0.2	0.5

The analysis of the financial ratios computed by size (table 5 below) indicates that the differences observed in the financial structure of trucking companies do not have any significant impact on their financial performance, except for the long-term solvency. Companies classified in the two classes of highest revenues also have the two largest long-term debt to equity ratios.

Table 5
Solvency and Profitability Ratios by Size

Size (Annual Revenues)	Solvency		Profitability	
	Short-term	Long-term	Revenues (%)	Assets (%)
Smaller than 2 $M	1.062	0.386	4.81	5.00
2 to 5 $ M	1.106	0.429	5.34	6.07
5 to 10 $ M	1.006	0.491	4.56	4.47
10 to 15 $ M	0.922	0.566	3.35	2.82
15 to 25 $ M	1.108	0.526	4.11	3.58
25 to 50 $ M	0.980	0.579	3.61	3.84
Larger than 50 $ M	0.893	0.578	0.42	-0.85
Total Industry	0.992	0.518	3.28	2.90

In conclusion, the analysis of the balance sheet according to the size of trucking companies tends to show that there are differences in their financial structure only insofar as these companies are grouped into two classes of annual revenues : smaller and larger with the line of demarcation between the two at $ 25 million. These differences in the financial structure do not have any significant impact on the financial performance of trucking companies measured both in terms of solvency and profitability.

C) By Type of Employer

The balance sheet analysis also enables us to verify the assumption that trucking companies differ depending on whether or not they employ owner operators, a factor considered increasingly important for data analysis of trucking industry. The 1,160 trucking companies were therefore classified according to whether or not they reported expenditures for the hiring of owner operators. The table 6 below summarizes the results obtained.

With a global balance sheet index of 0.7, the 360 trucking companies that reported no expenditures for the use of owner operators exhibit a significantly different financial structure as compared to the overall industry. Their distinctiveness is mainly originating on the liabilities side, with an index of 1.0.

Table 6
Balance Sheet Analysis by Type of Employer

Employment Characteristics	Global Balance Sheet Index	Decomposition Indexes		
		Assets	Liabilities	Time Horizon
With Owner Operators	0.1	0.0	0.1	0.1
Without Owner Operators	0.7	0.4	1.0	0.7

The time horizon index value of 0.7 suggests that companies without owner operators have a significantly different time perspective from the industry as a whole.

Based upon the computation of the financial ratios by type of employer, as in table 7 below, we can conclude that differences in the financial structure of trucking companies, as classified by type of employer, do have an impact on their financial performance in terms of solvency. Both the short-term and long-term solvency ratios are significantly different compared to the overall industry. The results also indicate that the differences in the financial structure do not have any significant impact on profitability.

Table 7
Solvency and Profitability Ratios by Type of Employer

Employment Characteristics	Solvency		Profitability	
	Short-term	Long-term	Revenues (%)	Assets (%)
With Owner Operators	0.974	0.564	3.02	2.78
Without Owner Operators	1.070	0.386	4.39	3.33
Total Industry	0.992	0.518	3.28	2.90

VII - Conclusion

The primary purpose of this research was to measure to what extent the wide range of activities conducted by the trucking companies may have an impact on their financial structure. According to the statistical method and the financial database used, we have observed that trucking companies do differ in their financial structure when classified by industry and by type of employer. In addition, the financial structure of trucking companies, when classified by size, differs only insofar as the companies are classified into two groups, with the line of demarcation between them being $ 25 million in annual revenues.

Another objective of this research was to measure the extent to which differences in financial structure may have an impact on the financial performance of trucking companies. The evidence gathered in this paper suggests that the differences observed in financial structure have an impact on the financial performance of trucking companies more in terms of solvency as opposed to profitability. The impact seems to be significant on short-term and long-term solvency ratios, but much less

significant on profitability in terms of assets. The impact does not seem to be significant at all on profitability in terms of revenues.

The statistical decomposition method used for this research opens the way to a number of future applications :

- this method can help us determine the best way to group together trucking companies for analysis and publication purposes;
- in addition to cross-sectional analysis, this method can also be used for longitudinal analysis, that is to track changes in the financial structure of a company or group of companies over time;
- this method can be applied to the financial analysis of all companies in the transportation field.

MORAL ASPECTS OF ROAD PRICING POLICY

Dr. Mark Bunting
P.M. Bunting & Associates, Kingston, Canada

Despite improved toll-collection technology, potential economic and financial benefits[1] and acceptance of user charges for other transport facilities, governments are rarely enthusiastic about road pricing. Toll roads are usually found where road users have free access to parallel routes (ie., user pricing is only partly accepted) and urban tolling is still something of a novelty.

This lack of enthusiasm is partly due to the ubiquity of roads which assures a large constituency of users who will object to new user charges. Moreover, a history of *free* access gives rise to a sense of *moral* entitlement. Proposals to abridge this arrangement invite, not rational discussion, but moral outrage.

Anticipating this reaction, governments are reluctant even to show *interest*. Thus, far from enhancing debate, moral issues block consideration of potentially valuable policy options. This implies that road pricing should only be pursued where its advantages are so obvious as to be uncontroversial. Yet, this strategy seems to preclude many (if not all) useful applications.

This paper considers another approach: to improve public debate by clarifying (and sometimes challenging) moral objections to road pricing and by placing its claimed merits more clearly within the framework of a moral argument, thus encouraging a more balanced and integrated discussion of road pricing options.

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[1] Eg., see Road Work: A New Highway Pricing & Investment Policy, K.A. Small et al., The Brookings Institution (Washington, 1989).

Moral Issues Raised by Road Pricing

I have mentioned the sense of entitlement attached to *customary usage*. Another potential concern is the effect road pricing might have on *mobility*, which is sometimes seen as a moral right or freedom[2]. Tolls may also be condemned as *unfair* where they duplicate *road taxes* or treat road users *unequally*. The latter complaint, and *privacy* concerns, were among reasons for the 1985 failure of Hong Kong's electronic road pricing system[3].

Financial and economic impacts of road pricing also are morally relevant, but not often seen as such. Related issues will be reviewed once more obvious moral issues have been considered.

The Role of Moral Analysis

In making moral claims, we not only express approval or disapproval, but also imply we have *good reasons* for what we say[4]. Moral analysis is the process by which such reasons are examined, or advanced as a positive moral basis for action.

Of course, one need not question obviously correct or incorrect claims. Moreover, moral claims appeal to *personal* commitments, so a call for reasons could be taken as a personal attack; where views are stongly held, such a call may only serve to antagonize.

However, we *are* justified in testing claims of *professionals*, whose commitment to objectivity entails readiness to engage in reasoned debate. In other cases, indirect probing may help shift the policy spotlight from flawed claims to alternative views.

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[2] Traffic growth is often given as the main (or only) justification for road expansion; this makes sense only if mobility has special priority over other considerations.

[3] Hau, T, Electronic Road Pricing: Developments in Hong Kong 1983-1989, Journal of Transport Economics and Policy, no. 2, v. XXIV, May, 1990.

[4] One would not take seriously someone who, when asked to justify a moral claim, replied, "Oh, no reason at all".

Characterizing Moral Issues

A useful first step is to determine what *kind* of moral judgement a particular issue calls for. Policy issues mainly call for *action* (vs. character) assessments, including the following types:

Type 1: an action's conformity with accepted or justifiable principles or rules of behaviour;

Type 2: an action's overall consequences (a balance of benefits and harms); and,

Type 3: the distribution of an action's consequences between individuals or groups within society.

Type 1 judgements appeal to principles (eg., ten commandments, rights/freedoms), customs, or 'do's and don'ts', and often underlie claims that actions are 'right' or 'wrong'. Type 2 judgements appeal to *values* (and to an ordering or weighting of values which makes possible an *overall* reaction to diverse outcomes); actions so judged may be considered 'good' or 'bad'.

Distributive standards are the basis for Type 3 judgements that actions are 'fair' or 'unfair', 'just' or 'unjust'. These judgements usually concern *relative* changes in societal or inter-party distributions; thus, an action may be considered fair even though it has little effect on pre-existing inequities in society.

Presumed entitlements to free roads and rights issues are likely to be presented in Type 1 fashion, while fairness claims reflect Type 3 concerns. Mobility concerns could be raised as Type 2 or 3 issues, but not if mobility is seen as a Type 1 right or freedom.

In policy debates, the moral 'high ground' is often taken with Type 1 claims, seen as *absolute* prohibitions or duties which *pre-empt* other considerations. Unchallenged, these claims can block action on potentially important options. Complaints that policies are 'unfair' (which I classified as Type 3) may also function in a Type 1 way, as an absolutist assertion of the status quo.

The balancing of harms and benefits implicit in Type 2 and 3 judgements may be complex (requiring technical support) but, compared with Type 1 judgements, is more open to discussion. For this reason, opponents of road pricing will prefer Type 1 expressions, even if the real issues are of Type 2 or 3; in this event, progress may depend on drawing attention to this fact.

This said, *genuine* Type 1 concerns are not reducible to other types; they cannot be satisfied by a simple balance of competing moral claims (as is implicit in cost-benefit analysis), nor by a fairer distribution of benefits and costs. Thus, an important challenge for moral analysis is to show how such concerns may be respected, yet reconciled with other moral considerations.

The Structure and Standards of Moral Reasoning

Moral judgements of actions or policies depend on values or principles *and* statements of fact. For example, the privacy objection to electronic pricing entails a principle (respect personal privacy) *and* the claim that this form of road pricing would invade privacy. *Two* questions arise: (1) whether this principle (or the priority we give it) is appropriate and (2) whether this principle would in fact be offended.

Questions of the first kind may raise difficult philosophical issues, but sometimes a clear statement of accepted values and principles suffices. Also, where moral differences arise from disagreements over matters of fact, one need not grapple with principles or values, but can focus on factual claims testable by familiar logical and empirical criteria (as in science, law, etc.).

While factual statements differ from assertions of values or principles, both function as reasons for moral claims. As such, they, and the claims they support, may be assessed in terms of common standards of rational discussion, including:

Intelligibility

To have standing, moral claims must be understood, not just by the speaker, but by others; terms and statements must have definite public meanings. For example, we may say mobility is important, but cannot say *how* important or what policies would promote it unless we understand *precisely* what 'mobility' means.

Moreover, these claims must be expressed in the language of those who make policy, or are affected by it. For democratic societies, this implies use of ordinary terms and grammatical forms, despite the ambiguities of ordinary discourse[5].

While familiar, the call for clear expression is rarely popular. Few people warm to the idea that their speech lacks meaning and one should expect active hostility from those who benefit from ambiguity. As with any rationality standard, clarity is practical only among those committed to open and meaningful discussion.

Relevance

Intelligible or not, statements are useless unless relevant to the matter at hand. For example, revenues from short run pricing of a congested toll road might help repay the toll authority's debt, but this *financial* consideration would not be relevant in an *economic* argument concerned with efficient road use.

Consistency

Moral claims are influential because they are grounded in principles and values that are *accepted* and *general* in scope. This fact obliges us to apply principles and values consistently, or to explain why circumstances justify an alternative approach.

It is often said that "consistency is the hobgoblin of small minds"[6], an apt warning against mechanical application, but not a licence for *any* inconsistency. While creativity and a readiness to depart from convention are admirable qualities, unexplained inconsistency is prima facie evidence of mistake or deceit.

Policies may be thought inconsistent for several reasons. They may diverge

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[5] For example, I use 'fair' to refer to Type 3 interests in distributive outcomes but this term may mean conformity to established procedure (eg., a legal process).

[6] Emerson actually said: "A *foolish* consistency is the hobgoblin of little minds, adored by little statesmen and philosophers and divines".

from past solutions to similar issues. Or, policies in one area (eg., accessible transport) may fail to respect a principle (eg., help those in need) to the same extent as in other areas (eg., health care). Finally, a policy might be *internally* inconsistent because arguments for it contain logical contradictions.

Respect for Evidence

Moral claims are based on facts and values/principles which can be tested *empirically* by asking whether what is claimed or assumed accords with reality (factual claims) or with what is accepted in the community (value/principle claims). Thorough empirical tests may not be feasible, but one can at least ask whether fact and value claims are *plausible* and *supported* by some evidence. Where moral claims are based on what people *assume* to be true, without *any* regard for available evidence, bringing these assumptions to the surface may be sufficient to raise doubts about their plausibility.

The foregoing standards, while necessary, are not *sufficient.* Meaningful, relevant, consistent, and empirically sound claims are stronger, but do not guarantee that the policies they support are good policies. However, by excluding bad arguments, one at least makes room for more defensible alternatives. With this in mind, these standards will now be used to assess potential moral objections to road pricing, as identified earlier in this paper.

Moral Objections to Road Pricing

Moral claims often are 'place-keepers' for less readily expressed concerns, so should only be rejected, even if unsound, after we have tried to identify underlying concerns. The aim of moral analysis is not to knock down expressed concerns (thus polarizing opinion), but to gain understanding and facilitate discussion. The following, which focuses on *stated or implied* objections, should thus be seen a *point of departure* for further analysis.

Customary Usage

Most roads have been free of direct charges for many years, so road users are accustomed to free access. However, to say roads *are* free is not to claim that they *should* be free; we would further need a general principle that we *should* continue doing as we have become accustomed to doing in the past.

If we *really* thought this way, we would be obliged to accept any sufficiently entrenched behaviour, even quite nasty conduct such as wife and child abuse. So, as it stands, the customary usage principle is implausible. Moreover, if we try to repair this principle by saying it only applies to morally desirable acts, we reduce the free-roads argument to a useless tautology[7].

This said, customary usage should not be dismissed out of hand; after all, usage is relevant in law, often justifiably. If my hedge infringes my neighbour's lot, but she has not complained (say for 10 years), I might well feel aggrieved (and perhaps gain legal support) if she, without reason, demands that I cut it down.

The qualification - *without reason* - is crucial. Usage is morally compelling, not as customary, but because of the harms that may follow change (eg., a less attractive garden); if there are more pressing concerns (eg., my neighbour's allergic reaction to my hedge), I ought to discuss the options.

Putting the matter this way shifts the focus from *usage* to its *effects*. In the case of road pricing, this shift highlights:

(1) harms (eg., increased costs) to people who have chosen where to live and work based on access to free roads;

(2) the efficiency of a road pricing regime (eg., the claim that current practice 'works well, so why change it?')

So, customary usage need not be seen as a barrier to change, but rather as a reason for careful assessment of benefits and harms.

Mobility

[7] If the customary usage argument hinges on a prior assumption that free road access is morally desirable, it adds nothing more than the empty claim that free roads are morally desirable because they are morally desirable.

Road pricing could reduce travel by road[8] and thus could be said to impair mobility. However, this can be a *moral* objection only if, and to the extent that, mobility is morally significant.

For example, in 1988, the President of the American Association of State Highway Officials (AASHO) alluded to "our freedom of mobility", declaring that "Americans have always been free to live, work and travel where they wish"[9]. This appeared in a document supporting funding for transport facilities (mainly roads) but would apply against any policy which, directly or indirectly, constrains movement.

The *moral* appeal is to the U.S. Constitution which grants Americans the right to move within the U.S. (or to emigrate) unhindered by government. But this is a *negative* freedom from interference, not a *positive* right to resources needed to move.

Apart from the apparent inconsistency, it seems highly unlikely that the second sense of 'mobility' is an accepted *moral* norm. If it were, government would be obliged to ensure that *all* citizens have equal ability to travel, achievable only if the poor were guaranteed large subsidies to purchase and operate cars.

This does not mean that mobility is unworthy, but rather that its moral relevance derives from the benefits it conveys (which must be balanced, in a Type 2 or 3 manner, with benefits of other policy objectives). The foregoing simply asserts that value lies in what mobility makes possible, not mobility itself.

Privacy Rights

An objection to *some* road pricing schemes is that they require collection of personal information contrary to rights of privacy. In examining this claim, we might ask three questions.

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[8] Charges would have to be quite high to significantly affect road usage, though *direct* charges should have greater effect than indirect road taxation.

[9] Foreword to "Beyond Gridlock" (Highway Users Federation, Washington, 1988)

First, what do we mean by 'privacy'? Surely, it does not mean that others not know *anything* about us. If so, only hermits could be private. So, what information is private, and what makes it private? And, does privacy consist in not *collecting* information or in ensuring acceptable *use* (in which case, the issue is how to ensure accountable controls on data retention and distribution)?

Second, the principle of respect for privacy should be applied consistently. So, why is information collected for road pricing problematic, but not so for other commercial transactions (credit card payments at stores, etc.)?

A third question concerns the status of privacy as a *right*. If invasion of privacy is strictly prohibited, how are conflicts with other rights to be settled? For example, protection of *my* right to security may depend on police wiretapping of the phones of potential criminals, but this is an invasion of *their* privacy.

Space does not permit detailed analysis. However, to suggest one direction for such an analysis, one might think of privacy rights as presumptive, rebuttable standards. Interpreted in this way, privacy has priority, but not such that it excludes other moral concerns. In this light, policies that serve valuable social or economic ends without *seriously* infringing privacy might well be considered morally acceptable.

Is Road Pricing Fair?

Focusing on road provision as a *transaction*, we may judge road prices as fair or unfair according to whether they *compensate* road providers for their costs and for the way in which they *share benefits* between users and providers. Looking beyond individual transactions, one may also judge road pricing in terms of *third-party* or wider *distributive* impacts.

Compensation

In support of road pricing, it could be argued (in Type 1 fashion) that users should *compensate* road providers (governments or toll companies) for costs incurred on their behalf. As a *moral* claim, this might be seen as a form of restitution: a duty to compensate for burdens imposed on others. To illustrate the application of this claim, one might point to 'cost responsibility' studies conducted by many U.S. states as a basis for road user

charges.

While the compensation *principle* may be accepted, estimation of costs is problematic, not just for technical reasons, but also from a moral standpoint. Strictly interpreted, compensation is a duty of *individuals* to pay costs due to *them*, and only those costs. Yet, it is rarely possible to estimate costs so specifically; in practice, the best one can do is to estimate for a road user class representative of the individual. In practice, this approach will result in less than complete assignment of road costs to users.

Perhaps individuals should be responsible, not as such, but as *group members*. Then, the way costs are assigned to individuals becomes less important than the way they are assigned to groups. For the largest group, road users as a whole, this would be seen as an argument for *full* recovery of all road costs, as is the aim of many road cost responsibility and allocation studies.

However, this view raises difficult questions. What makes me a group member? Must I *choose* to belong, or does acceptance of benefits of group membership suffice? How are my moral duties affected by such membership? These questions are especially troubling where a group has acted wrongly (eg., Canada's wartime internment of Japanese-Canadians), but may also be present in mundane cases, for example when transport operators argue that they should only bear costs *specific* to their needs.

Sharing Costs

A less problematic way to explain assignment of costs to groups may be to suggest that fairness consists in *sharing* responsibility for costs. The outcome may be the same, but the focus is on the individual's positive duty to contribute to costs incurred by the group as a whole. The individual is seen as choosing to do what is morally right, rather than accepting, in a negative way, costs imposed by others (ie., the state). While this may seem a subtle distinction, it is not uncommon for participants in user charge debates to assert that they are willing to pay a 'fair share'.

Sharing Benefits

While capturing *something* of what we mean by 'fair price', the duty to compensate or to accept a fair share falls short of a *complete* account.

Companies routinely price products to recover more than their costs, and few of us see this as a moral problem. Putting it another way, our moral intuition is that businesses should be able to recover their costs and a 'fair return' for invested capital and effort.

Within the limited world of utility regulation and cost recovery policy, 'fair return' is often defined in comparative financial terms, for example as a return on invested capital commensurate with that achieved comparable businesses. But does this capture what is ordinarily meant by a fair return?

Several factors may be considered, but one is the way benefits are shared between parties to transactions. Consider the sale of a car costing a dealer $10,000, but for which the buyer would pay up to $20,000. Both buyer and seller might see $15,000 as a 'fair price', but what if the buyer, having settled for $19,000, became aware of the dealer's cost? In similar circumstances, how would the dealer feel about a price of $11,000?

The benefit-sharing principle implies that road user charges need not be limited to cost recovery. Where the *value* of roads exceeds their costs, it may be morally acceptable (and perhaps desirable) for user charges to incorporate some share of this excess. As with profits earned by shareholders of private undertakings, this rewards the public (through their government) for their role in developing and maintaining a valuable economic asset.

The Road Tax Objection

While not *directly* relevant to an account of fair road pricing, I would be remiss if I did not acknowledge the substantial vehicle, licence and fuel taxes paid by road users. Road tax revenues are often claimed to generate revenues in excess of road costs, and thus one should anticipate the objection that road pricing would duplicate these taxes and, for that reason, would be unfair.

This objection assumes taxes and prices are both ways to repay costs. Yet, while taxes may function as prices (financing roads or regulating usage), their main purpose is to raise funds for general government or to pursue broad economic goals. Perhaps road pricing would unfairly duplicate road taxes, but to assess this complaint, one needs a much clearer picture of the

role of taxes as pricing, funding or macroeconomic instruments[10].

Third-Party and Distributive Impacts

Road pricing may be judged fair or unfair in a wider sense with reference to effects on particular persons or groups or the way benefits and costs are distributed within society. For example, it might be said that road tolls would harm isolated communities or result in a less even distribution of society's wealth.

Apart from the *factual* question whether particular road pricing proposals are fair or unfair in this sense, one may ask whether wider fairness standards are relevant to road pricing. That is, while *some* policies (tax policy, welfare programs, etc.) should be judged in this way, do these standards apply here?

In this regard, we should distinguish between *social* services provided to meet *needs* and *commercial* services responsive to market *demand.* If road programs mainly respond to transport demand (as I suggest elsewhere[11]) commercial principles should be emphasized. So, the moral focus for road pricing is on user-provider transactions; wider issues are of secondary importance.

Financial and Economic Arguments

Financial and economic arguments, whether for or against road pricing, involve Type 1, 2 or 3 moral claims. Bringing this moral content to the surface is especially important to balanced discussion of road pricing options.

Financial Arguments

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[10] However, if this clarification supported the complaint, road pricing might still be justified for other reasons. Also, the complaint might be addressed by adjusting taxes or prices, for example by arranging for tolling systems to deduct a portion of estimated fuel tax charges from road tolls, or by allowing tax rebates for toll highway travel.

[11] Implications of the social/commercial distinction are discussed in Bunting, P.M., The Basis for Highway User Charges: A Discussion Report, for Transport Canada, 1991.

As well as pointing to Type 1 duties to repay road costs, one might argue (in a Type 2 way) that road pricing would help raise funds to maintain and improve roads. Thus, despite feeling they meet their obligation to pay for roads (through taxes), road users may favour tolls for their positive effect. This argument has similar moral content to economic arguments discussed below.

Economic Arguments

It is often argued that road pricing would increase economic efficiency by regulating traffic on *congested* roads and by encouraging heavy truck operators to minimize road *damage costs*. On the other hand, uncongested roads are typically seen as *public goods* which are most efficiently used if free of charge.

I will not examine the merits of these arguments[12], but rather make two comments on their *moral* dimension. First, though it should be obvious, economic judgements *are* moral judgements, specifically Type 2 assessments of economic outcomes. In deference to policymakers, economists may say their work is 'value neutral', but outcomes are measured by standards that presuppose moral judgements; regular appeal to such standards only serves to underline this moral position.

For example, marginal cost pricing is premised on maximization of aggregate welfare by expanding production until the economic value (willingness to pay) of one extra unit is the same as the extra cost of producing it. This 'efficient' outcome entails a specific interpretation of welfare as an aggregate of satisfied consumer preferences. In turn, it is implied that there is some value (good) in maximizing welfare so-interpreted and accepting its associated distribution of resources.

Normative (eg., welfare) economics gains its moral force from utilitarian moral theory. While the philosophical flaws of this theory prevent us from saying that economics provides *the* moral answer, it is not unreasonable to

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[12] As an aside, I suspect the typical 'first-best' treatment of road pricing understates its economic value, given that roads are provided in competition with transport and non-transport goods and services governed by quite different pricing rules. This 'second best' concern is briefly explored in Bunting (op. cit.), but not to the extent it deserves.

suggest that economics contributes *part* of this answer.

Second, if economic judgements are *internal* to moral judgement, giving them space with other moral concerns need not be seen as an unholy trade of morality for money. One might have moral doubts about a road pricing proposal (eg., because some users would pay more than their 'fair share') but a decision to proceed need not be unprincipled. It may simply reflect a judgement that the unfairness is tolerable, from a moral standpoint, given the proposal's economic value for the community as a whole.

Concluding Remarks

Moral concerns are often seen as *external* to policy, as constraints or as objections to be 'got round'. Yet, moral assessment should be the heart of the policy process; after all, to justify a policy is to say that government *ought* to act in some way, and this 'ought' cannot be construed as other than a *moral* demand.

In policy debates, the moral 'high ground' is often secured, and discussion blocked, by objections expressed in terms of moral rules or principles which seem to *pre-empt* other considerations. However, an assessment of such objections often reveals logical or other flaws, and frequently reveals underlying concerns that are more amenable to a balance of moral considerations.

In the case of road pricing, concerns with loss of customary free access, impairment of mobility and invasion of privacy may give rise to pre-emptive claims. However, only privacy concerns are reasonably addressed as pre-emptive and even here it is unlikely that they preclude consideration of other factors.

For example, consider how privacy concerns might interact with an economic argument for pricing congested roads. If privacy has *absolute* standing, *any* infringement must be ruled out. However, if privacy is valued but not pre-emptive, one may properly ask how *serious* an infringement of privacy would be justified given the benefits of efficient road use.

While policy analyses highlight diverse moral issues, a policy decision, for example to implement road pricing despite its impact on privacy, *integrates*

moral concerns. This integration typically rules out some policy options as unacceptable, while choosing, from other options, one that acceptably balances all relevant moral claims; ultimately this is the policymaker's judgement that it is the best option 'all things considered'.

In support of this process, moral analysis can help draw together, and encourage comparison of, seemingly distinct policy concerns. While correct moral answers are not assured, moral analysis can help us avoid incorrect or less helpful answers, and promote open and balanced discussion of policy options.

ACKNOWLEDGEMENTS

Thanks are due to Prof. Don MacNiven, Director, Centre for Practical Ethics (York University), and Prof. William Waters II (University of British Columbia) for helpful comments on an earlier draft of this paper.

Private Fleet Competitiveness: Is Backhauling an Opportunity?

A. Introduction

In North America private fleets deliver approximately 54% of total trucking tonnes shipped and account for approximately 47% of general freight revenues[1]. There are increasing pressures for total cost reductions through the logistics process, which includes costs and performance of private fleet operations.

Significant changes in transportation regulation have developed as provinces deregulated and reduced barriers to new carrier entry. Private fleets can now consider becoming a common carrier. Before a company makes the decision to either enter this business in some format or to continue as a strictly private fleet, there are a number of important considerations.

The objective of this paper is to review the feasibility of private fleet backhaul operations, and to outline a practical method for initiating a backhaul program.

This paper reviews the historical rationale for private fleets, outlines reasons to consider a backhaul program, compares costs and benefits for consideration, and presents an approach to help establish a backhaul program. In conclusion we present the key findings of our survey of current private fleets operating external backhaul services.

B. Historical private fleet rationale

Many North American manufacturers and distributors have operated private fleets to move products to intermediate and final customer destinations. The common rationale for private fleets include:

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[1] U.S. Freight Transportaion Forecast ...to 2004. DRI/McGraw-Hill. Second Annual Report - February 1996.

- increased control, perceived service level and dependability of delivery;
- consistent lower cost product returns and empty container pickup; and
- increased product marketing through billboard trailer advertising.

This rationale is being challenged in recent years because of factors such as:

- increased company evaluation of core competencies.
- increased pressure for better asset utilization; and
- competition from contract logistics firms.

These trends are challenging whether private fleets are part of a company's core business.

C. Economic impacts from backhauling

The Private Fleet Management Institute (PFMI) benchmarking study provides data on private fleet operations. This study provides data on trip length, costs per mile, revenues per mile and percent empty miles. The average mid-range round trip for dry van tractor trailer fleets is estimated at 430 miles. Using the KPMG truck costing model we estimated trip costs for movements with zero backhaul and with a backhaul load for a sample mid range round trip. See exhibit 1.

Exhibit 1
Backhaul vs. Non-backhaul Trip Costs

Trip Type	Miles Roundtrip	Cost Per Trip	Incremental Backhaul $	Cost Per Mile	Revenues Backhaul	Net Tip Cost
One way loaded	430	$642.65	$0	$1.55	$0	$624.65
Loaded both ways	440	$693.49	$68.84	$1.58	$215.00	$478.49

D. Estimating round trip costs

Round trip costs with no backhaul are estimated at $624.95. Completion of a backhaul for the return trip generates $68.84 in additional costs for a round trip cost of $693.49. Backhaul revenue should cover the additional costs of $68.84 and make a significant contribution to cover $333.25 of empty mile costs ($1.55/mile x 215 miles). Based on the PFMI average of $1.30 per mile for backhaul revenue, a best-case revenue scenario would be $279.50 based on 215 miles. Worst-case would be $215.00 based pn revenues of $1.00 per mile.

Assuming a backhaul revenue of $215.00 for the trip, the competitive common carrier cost must be at or below a cost of $478.49 and provide the identical level of required services.

PFMI estimates 25% empty miles for mid-range trips compared to the American Trucking Associations estimate of 12% empty miles for all truckload carriers. Well-organized private fleets can work towards achieving this 13% reduction in empty miles by re-evaluating outbound movements and considering a third party common carrier backhaul program.

E. Estimating backhaul opportunities and benefits

The Private Fleet Management Institute (PFMI) estimates 25% empty miles for mid-range trips. Truckload common carrier's are estimated to operate with 12% empty miles according to the American Trucking Associations (ATA). This comparison indicates a conservative opportunity to achieve a 13% reduction in empty miles for a private fleet.

Based on these assumptions, a private fleet operating one million miles per year there may be an opportunity to add approximately 130,000 loaded miles annually. PFMI estimates average inbound revenue at $1.30 per mile. This translates into an opportunity to earn an estimated $169,000 in additional revenues for the fleet. Increased operating and administrative costs directly related to completion of backhaul loads are estimated at $31,000 annually. The net result is a return to cover operating costs of $138,000 in a best-case scenario. In a worst-case scenario, backhaul revenues at $1.00 per mile generate a net return of $99,000 for the fleet.

Exhibit 2
Private fleet backhauling cost-benefit review

Current Empty %	25%	25%	25%
Annual Miles	1,000,000	2,000,000	4,000,000
Empty Miles	250,000	500,000	1,000,000
Best Common Carrier Practice % Empty Miles	12%	12%	12%
Best Common Carrier Practice Empty Miles	120,000	240,000	480,000
Backhaul Opportunity Miles	130,000	260,000	520,000
Estimated Revenues ($1.30 / mile)	$169,000	$338,000	$676,000
Pessimistic View ($1.00 / mile)	$130,000	$260,000	$520,000
Incremental Costs Trip Costs ($0.02 / mile)	$20,000	$40,000	$80,000
Administrative costs			
Administrative $	$5,000	$5,000	$10,000
Insurance Licensing / Pro Rate	$6,000	$6,000	$12,000
	$11,000	$11,000	$22,000
Estimated Net Benefits Best Case	$138,000	$287,000	$574,000
Pessimistic Case	$99,000	$209,000	$418,000

Non-tangible risks and liabilities need to be discussed, together with a realistic estimate of the actual costs to administer the program, including sales calls, increased licensing costs and potential bad debts. In addition, there is a required management commitment and involvement that may take direction and attention away from the core business. Companies need to be careful not to be drawn into a business within a business and begin to operate the fleet as a full-fledged trucking company. Changes in business structure and distribution can affect final product delivery methods.

Other factors that need to be included in the cost-benefit analysis are impacts on asset utilization and equipment availability. If a fleet's equipment is available to complete movements after a regular work period, utilization will increase. However, if a fleet is already tightly scheduled, tractors and drivers involved in the completion of backhaul trips may not be available for outbound dispatch compared to returning

empty. The fleet may begin to increase staffing and potentially power units to meet a total fleet requirement that accounts for backhaul impacts.

An additional example of increased investment is when customers may require empty drop trailers at their site for loading efficiency. This would reduce valuable tractor and driver hours required for loading. It also increases the number of assets required for the fleet. Marginal costs for the fleet operation will increase.

As these issues and questions arise, management must determine if the resource investment involved is worth the effort and risk.

F. Trends for current backhauling fleets

Our survey focused solely on private fleets that were already conducting third party backhauling services.

Fleets completing backhaul include small fleets operating less than 10 tractors to fleets of more than 50 tractors. Similarly, distance traveled varied from one million to five million miles. Fleet backhaul revenue and number of customers varied directly with fleet size and distance traveled as these factors increased the opportunity to complete backhaul loads. The majority of the fleets reported less than 20 backhaul customers, which is a manageable number of accounts to communicate with and visit on a periodic basis.

Exhibit 3
Approximate Total Annual Revenue from External Backhaul Customers



Private fleets were consistent in their estimation of additional fixed and variable costs to operate the backhaul component of the fleet. The majority of fleets believed that additional administrative costs were less than $5,000 per year and that additional fixed costs were comparable at $5,000 per year. Similarly, fleets reported that limited expenditures were required to provide additional rental trailers or tractors to service backhaul accounts.

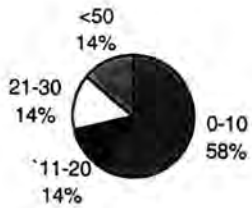
Exhibit 4
Total Incremental Costs



Private fleets have indicated that no additional administration or separate staff were required for backhaul operations. The majority (58% of fleets estimated administrative time each week to complete backhaul procedures at less than 10 hours per week. This is a difficult area to

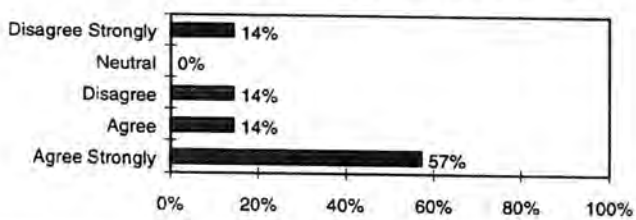
estimate, as additional management and dispatch time for backhaul operations should be included.

Exhibit 5
Estimated Hours Per Week to Complete all Backhaul Related Procedures



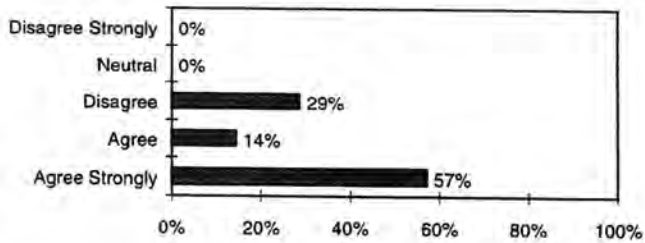
Strong consensus exists that executive support is an important factor in developing a successful backhaul program. In addition, pre-selling the program to drivers was highlighted as a critical step to making the program work. External success was best achieved through visits to the customer locations.

Exhibit 6
Pre-selling the Program to Drivers and Fleet Administration Personnel is Important in Making the Program Work



The most encouraging sign was that over 70% of the fleets surveyed indicated that they agreed or agreed strongly that backhaul is a viable and growing component of their private fleet operations.

Exhibit 7
Your Firm Considers Backhaul as a Viable Growing Component of Your Private Fleet's Operations



G. Why do you want to consider a backhaul program?

Each empty kilometer is an opportunity to reduce total trip costs through revenue generation. This sounds simple in theory, however there are a number of significant and smaller steps that need to be considered in a business plan.

Private fleet costs per mile for mid-range dry van movements are estimated at $1.16 per mile. These costs can be higher than comparable common carrier costs due to increased empty miles to loaded miles ratio and some specialized equipment costs. Large common carrier truckload fleets operate with a 12% empty mile percentage. Estimates for private fleets without external third party backhaul programs ranges between 25 and 40%. The PFMI benchmarking study indicates that private fleets can achieve 15% empty mile levels through a specific commitment to productivity.

A well-organized backhaul program can be a positive part of private fleet operation. Revenues directly offset operating costs associated with the return miles and improve fleet performance. Drivers and administrative staff can experience the improved operating results for the fleet, and have an opportunity to develop and expand the program. It is important that backhaul results be communicated and acknowledged to the fleet employees and company management.

The key reasons for establishing a backhaul operation for a private fleet are to:

- increase fleet "revenues" from raw materials backhauls and inter-company purchases;
- offset fleet operating costs; and
- provide fleet stability.

H A proposed private fleet backhaul program - from planning to startup and operation

This section outlines steps required to evaluate, establish and operate a backhaul program. Private fleet managers can use this outline as a checklist in their evaluation and potential implementation process.

Identifying opportunity

1. Review existing outbound shipment lanes.
2. Identify all empty miles in the system.
3. Review current outbound movements via common carrier.
4. Identify potential outbound lanes for conversion to private fleet where possible backhauls would exist for fleet.
5. Review current inbound raw and packaging materials or supplier delivered finished products to all company facilities.
6. Compare current lane costs to potential private fleet backhaul alternative.
7. Evaluate each outbound lane for potential backhauls.
8. Research potential backhaul shippers within each return lane.
9. Identify opportunities to coordinate fleet backhaul opportunities with other private fleet delivery or interplant movements.
10. Identify opportunities to use equipment over weekends to earn incremental third party revenues, combined with inbound reverse raw materials or third party freight.
11. Asses whether outbound loads have space for less than truckload (LTL) freight.

Pre-plan the backhaul program

To successfully start a backhaul program means being organized. Apply for required permits and licences early so that you can work on the remaining items below, as well as those listed in the human resource section.

- Set up separate files (computer and paper) for each tractor to record all new common carrier document requirements.
- Identify jurisdictions the "new common carrier" operation will operate in and through.
- Contact each jurisdiction, and request application for common carrier license.
- Maintain contact listing for each jurisdiction.
- Contact fleet base province to determine increased licensing costs per tractor.
- Contact the fleet insurance company and determine insurance cost impacts.
- Provide estimates of third party volumes and shipment values to insurance company.
- Confirm required tractor and equipment identification.
- Contact US departments to request an Interstate Commerce Commission (ICC) registration number and Department of Transport (DOT) number.
- Confirm location and placement of required identification on tractor units.

Plan human resource items

Evaluate the required compensation methods and rates for the following items:

- Pickup and delivery time (loading and unloading);
- Potential for increased weights versus regular fronthaul weights;
- Driver backhaul leads for new backhaul business and;
- Increased number of axles for identified backhaul lanes.

Write up a section for the driver manual and truck "books" that outlines in detail how backhauls should be handled, driver compensation, and handling shipper and customer issues.

Draft an introduction to the backhaul program for distribution to the drivers and administrative staff for the private fleet and company management. Invite driver involvement in the development of this material so that key driver concerns are addressed before bringing the program to the larger group. The introduction should address:

- Current performance of the fleet and key performance indicators.
- Backhaul revenue levels and impacts on key performance indicators.
- Reasons for considering being a backhaul carrier.
- Opportunity lanes and target customer, product and load profiles.
- Proposed compensation by activity.
- Paperwork and processing of trip paperwork.
- Samples and references of backhauls completed by other private fleets.
- Provide an outline on process timing.

The driver group should review the backhauling program and provide feedback as a group and as individuals. Provide a handout at the meeting to all drivers. Managers may consider including this material in the driver handbook and in the orientation of new employees.

Drivers want consistent maintenance and communication of backhaul customer information. This ensures that drivers have the correct location information, contact names and numbers and hours of operation for backhaul customers. This information should include customer specific data such as requirements for purchase order numbers or other unique items. This information should be maintained in each tractor and all drivers should receive updates as needed. Avoiding unnecessary delays and driver confusion are key factors in maintaining driver support. Celebrate successes such as new customer wins and positive feedback from existing customers with the drivers.

Backhaul administration

Backhaul administration can be a clean and simple process. Administration covers the following areas:

- Bills of lading and proof of delivery.
- Driver trip sheets.
- Customer invoicing, customer statements, and filing.
- Maintaining up to date copies of all required licenses, insurance, rate quotations and equipment registrations.

Typically, each backhaul account should have a separate file to collect copies of each document on a monthly basis. Good record keeping at this level provides clear and quick reference material for customer inquiries

and as backup for on site-audits and inspections. Where possible, companies should use their accounts receivable functions to complete all invoicing and backhaul accounting requirements.

When accounting for backhaul revenues and incremental costs associated with the completion of backhaul loads, some firms have set up separate accounts for internal and external backhaul in their transportation general ledger. These accounts allow revenues from external third party backhauls to be recorded separately from internal and inter-company backhaul revenues.

Similarly, the fleet could set up an external backhaul cost account to capture incremental backhaul costs for increased licensing and insurance costs, additional driver labour for loading and unloading and specific maintenance costs identified with backhauls. Completing these allocations provides a good estimate of actual returns generated from external third party backhauls and provides additional justification for supporting the program.

Selling the backhaul business

A private fleet can sell effectively by following a few basic steps. The good news is that the fleet is already operating and a few initial downturns can occur without any disruption to your operation. The operator should go out well prepared, with a clear plan on the type of freight and the services that will be provided. Management should not commit to business that will jeopardize the fronthaul commitments or business that does not fir the fleet capabilities.

A good set of principles to follow in operating a backhaul business include.

1. Understand your fleet's capabilities and the type of loads you are targeting.
2. Do not oversell when making an initial business commitment.
3. Be "easy to do business with". Let your customer know that you are responsive and have integrity.
4. Be prepared to say no when an opportunity becomes too large or begins to move away from your original understanding of the freight patterns.

Supporting documentation in the initial stages of setting up your backhaul business can include a fleet profile outlining driver experience, fleet equipment power and trailers, current distribution network and frequency of availability. In addition, firms have developed a formal quotation sheet and letter format to clearly outline rates and services to be provided. This letter and quote is sent together with copies of operating authorities and proof of insurance to the customer, similar to requirements from full common carriers performing services for companies.

Some firms have also included a toll free 800 number for customers to call to ensure quick access to dispatch and fleet administration. It is important to set a good first impression with new clients. The first contact with customers needs to highlight how well prepared the backhaul carrier is to begin business immediately.

Identifying backhaul opportunities

Actively soliciting backhaul business needs to be done systematically. There is no mystery to building a good base volume for the fleet. The basic steps include:

1. Identify those firms that are bringing in raw materials inbound into the location. Call on these firms and identify commodities, frequency and source locations. Determine if these movements make sense for the fleet to bid on.

2. Identify local retailers bringing in finished retail products. Complete the same process with these shippers. Determine if there is an opportunity to bid.

3. Identify national or regional freight brokers that could provide loads for the fleet on a regular and spot basis.

4. Network with other company transportation managers and continue to communicate the fleet's new service to these companies. Referrals are a good sales method.

5. Network internally with sales and operations for opportunities.

6. Stay in touch with customers as the fleet grows. Ensure awareness of how their business is changing and how they feel the fleet is performing.

Some opportunities may require assurances to a customer that the fleet can handle peak volume movements that occur for seasonal periods, or a customer may need delivery to one or two points not serviced by the fleet. In these cases, fleet strategy can include partnering with a common carrier to provide these services with the fleet. One strategy is to align with a carrier already providing outbound business to the private fleet's parent operations.

Newer services include a the National Transportation Exchange (NTE). The NTE is the PFMI's national load exchange program for private fleets. The NTE handles all load matching, invoicing and additional requirements including insurance. These services may provide leads for more remote terminating lanes for your fleet. However, the largest opportunities are probably closer to home.

I. Conclusions

Private fleet backhauling can be a sound business decision and generate significant cost recovery for the fleet with minimum expenditures on a fixed and ongoing basis. Fleet management must review and determine carefully the type of loads, customers and lanes to target. Introduction of a backhaul program should be completed as one part of a constant evaluation of lanes and alternative delivery service methods.

The focus must remain on the core purpose of the fleet - to deliver product to their customer with highest service and lowest cost combination. Introduction of a backhaul program should not interfere with service or restrict the company's strategic directions. Private fleets are increasing their evaluation of backhaul as one means to reduce overall operating costs. The key will be to proceed carefully, maintaining flexibility and delivering on consistent service quality.

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Shipment of Grain to Mexico: Sea Routes vs. The Mid-Continent Corridor

Dr. Barry E. Prentice, Director,
Transport Institute, University of Manitoba

The Mid-Continent Corridor is more a notional idea, with indistinct boundaries, than a physical reality. It encompasses the geographic area that is tributary to the interstate highway's I29 and I35 west of the Mississippi River to somewhere in the mid western plains. Winnipeg, Manitoba forms the northern gateway that links connecting highway and rail routes east and west in Canada, and as far north as the Port of Churchill on Hudson Bay. The southern portion of the Mid-Continent Corridor passes through the border communities of Tamaulipas State and the Mexican ports on the Gulf of Mexico.

Figure 1 presents a diagram of the railway network in the United States. Few north/south rail connections exist west of the Mississippi River. If products are going to move north/south by rail, they will likely take the Mid-Continent Corridor.

Figure 1: Mid-Continent Corridor Rail Linkages



Route Choices for Grain Shipments to Mexico

The purpose of this paper is to examine competition for grain movements to Mexico between sea routes and the Mid-Continent Corridor. Figure 2 illustrates the possible route choices for Canadian grain shipments from Winnipeg to Mexico. Grain shipments can proceed directly south to Mexico overland by rail, or by barge on the Mississippi River. Barge shipment to Mexico on the Mid-Continent corridor involves rail/truck shipments to transloading points on the Mississippi River (e.g., Minneapolis) for shipment to New Orleans. From the Port of New Orleans, barge loads can move along the inland barge canal to Matamores, Mexico. Alternatively the barges may be transloaded at New Orleans to small ships for movement across the Gulf of Mexico to ports such as Vera Cruz and Tampico. Three sea routes compete with the Mid-Continent corridor. Grain is moved by rail

Figure 2: Major Transportation Routes for Canada-Mexico Grain Trade



to the Pacific coast, Hudson Bay or the Great Lakes Seaway for transshipment to ocean going vessels.

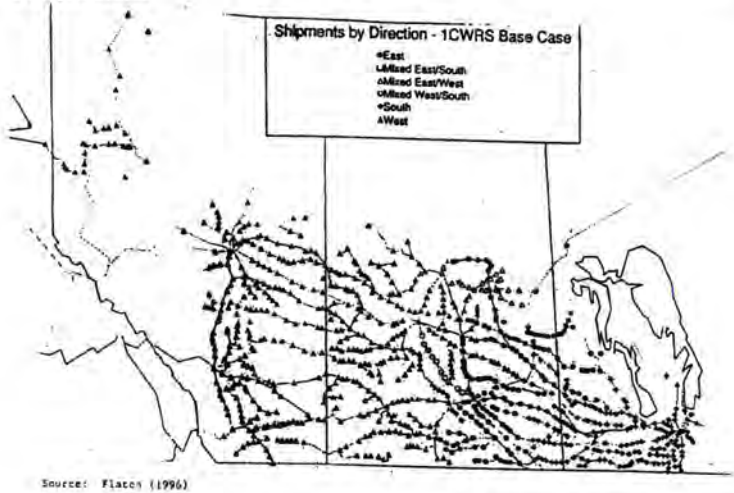
The most direct route should have the lowest cost. Given that the rail distance to eastern and western seaports from Winnipeg is almost as long as the southern route to the Mexican border, the additional costs of marine transport should make them uncompetitive. The closest sea route from Winnipeg would be through the northern end of the mid-continent corridor into Hudson Bay. Ironically, most Canadian grain moves by rail to eastern or western ports for shipment to Mexico. Only minor volumes are shipped along the Mid-Continent Corridor.

Subsidies under the Western Grain Transportation Act (WGTA) biased the route choice for grain exports to Mexico. Until 1995, the Government of Canada paid about two-thirds of the cost of moving product east or west by rail. Flaten (1996) used a linear programming model to examine the impact of eliminating the WGTA. His analysis is based on where the 1994/95 crop of Canadian Red Spring Wheat (1CRSW) would logically move given freight rates and prices at the ports. Flaten concludes that about half of southern Manitoba was tributary to the Mid-Continent Corridor despite the subsidies paid for the rail shipment of grain under the WGTA. However, most Manitoba grain actually moved east or west. Even grain destined for U.S. markets moved east to Thunder Bay to collect the WGTA subsidy before heading south. (Rutter, 1994).

More grain was predicted to go south with the end of the WGTA. Figure 3 depicts the "base case," in which the $600 million WGTA subsidy is eliminated. Flaten's model shows that the catchment area of the Mid-Continent Corridor expands into the mid-east half of Saskatchewan, when full cost freight rates are applied.

The change in freight rates is beginning to affect the direction of trade. September 1996 marks the first time that the Canadian Wheat Board ever shipped wheat down the Mississippi River for export through New Orleans. (Contact, 1996) This was a relatively small (3,000 tonnes) shipment destined for Panama and Costa Rica. The success of this transaction suggests that future movements to Mexico could follow this route.

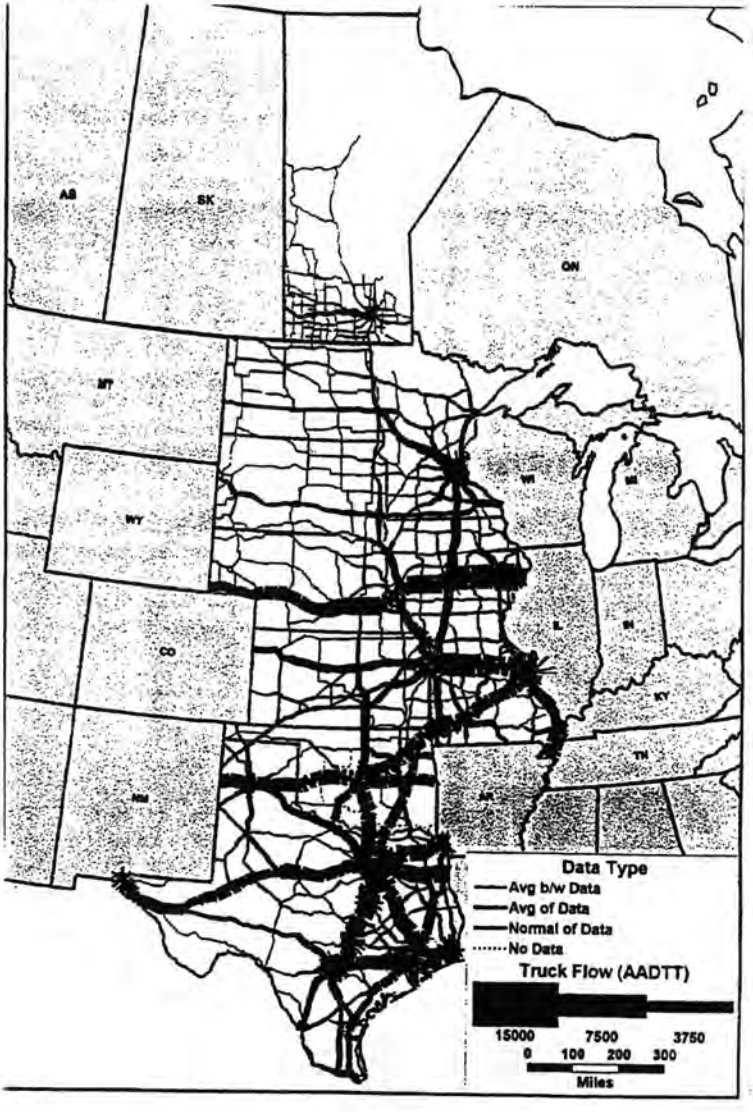
Figure 3: Catchment Areas for Exports of Canadian Wheat under full Freight Rates



Grain Movements by Truck

Montufar (1996) has completed a comprehensive analysis of truck-based traffic on the Mid-Continent Corridor. Figure 4 illustrates the average daily traffic by trucks on the I29/I35 routes. Truck traffic within the corridor greatly exceeds the movements through the corridor. There are 739 trucks moving north/south across the Canadian border. At the Texas/Mexico border however, there are 4,416 crossing daily. Traffic at the southern end of the corridor is seven times the volume at the north end.

Figure 4: Heavy Commercial Vehicle Flows in the Mid-Continent Corridor



North/south traffic along the corridor is important, but certainly not the mainstay of the route. For example, traffic that occurs between Dallas and San Antonio is several times the combined volume into Canada and Mexico. Greater still are east/west truck flows that move a short distance north/south on the corridor to find better transportation connections.

Figures 5a and 5b document the origin and destination of grain trucks crossing the Canadian border (Montufar, 1996). The black circles are the origins, and the empty circles are the destinations. Most of the grain coming to Canada is from Minnesota, North Dakota, Iowa and South Dakota. Grain exports from western Canada are destined primarily for Minnesota and North Dakota. Essentially, the transborder grain trade involves short moves to adjacent areas. Products like flax and canola are going south, while soymeal and corn are shipped north.

Figure 5a: Origin-Destination of Grain Bodies Through Emerson, MB

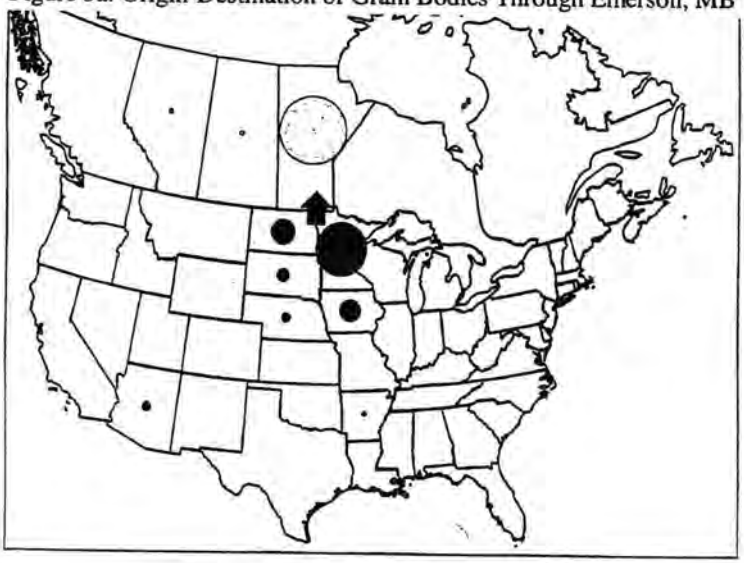


Figure 5b: Origin-Destination of Grain Bodies Through Emerson, MB

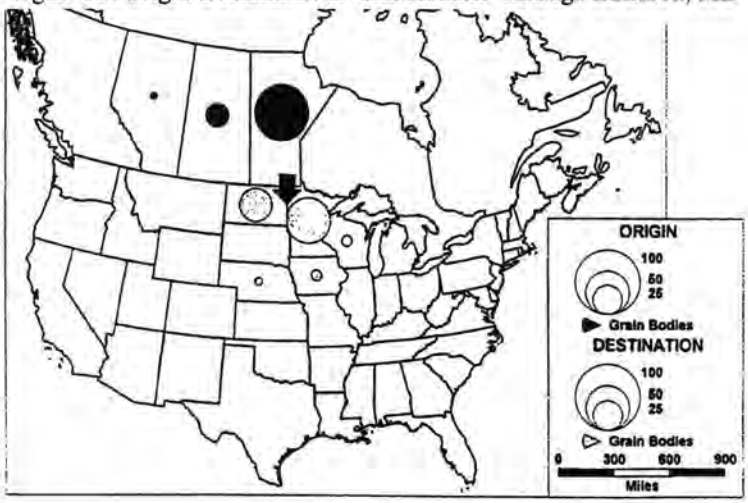


Figure 6 describes grain moves along the I35 segment of the corridor. These data refer to movements that were more than ten truckloads per day. The general impression is that U.S. grain flows from north to south. As the moves get longer, the proportion carried by rail increases. In Texas, three quarters of the shipments from Iowa and Kansas are by rail, whereas only 5 percent of the deliveries from Oklahoma are by rail. This pattern exists because at longer distances, costs are lower to ship by rail, rather than truck. However, this is not the full story. Regulations on truck size, weights and configurations inhibit truck moves between jurisdictions within the U.S. and between the NAFTA partners.

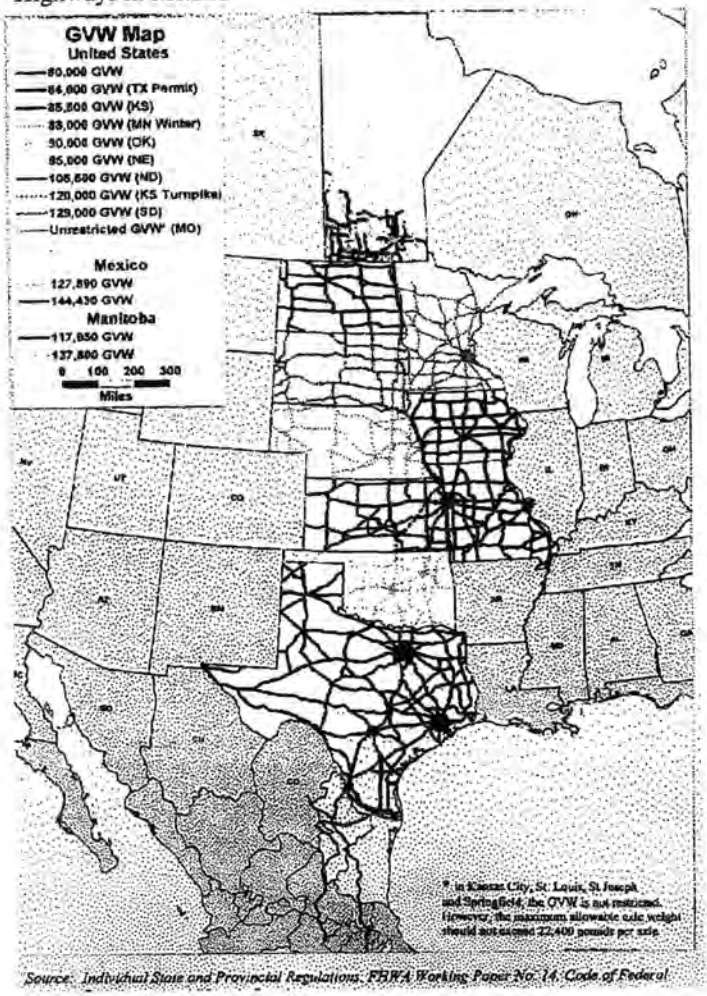
Figure 6: Food Shipments by Truck and Rail, Movements Greater than 10 Vehicles/Day



Weight limits are the most important impediment of longhaul trucking. The higher the weight limits the more effective the competition of trucks with rail. Figure 7 illustrates the weight limits for the various states and the border crossings into Canada and Mexico. Iowa and Missouri have the most restrictive regulations, 80,000 pounds of gross vehicle weight maximum. Mexico has the most liberal weight limits, where no effective enforcement exists. Manitoba is the next most liberal jurisdiction at 137,000 pounds of gross vehicle weight (GVW).

Besides differences in weight limits, the various jurisdictions may have incompatible regulations regarding the configurations of trucks. Very heavy trucks are permitted in Manitoba, but lighter U.S. trucks may not enter depending on their configuration. Though these trucks may meet all the height, weight, and length regulations, depending on where the axles are positioned or whether they have a lift axle, they may be prohibited (or be required to purchase a "special permit").

Figure 7: Maximum Specified GVW on NHS Highways in the Corridor States, on the PTH System in Manitoba and on Federal Highways in Mexico



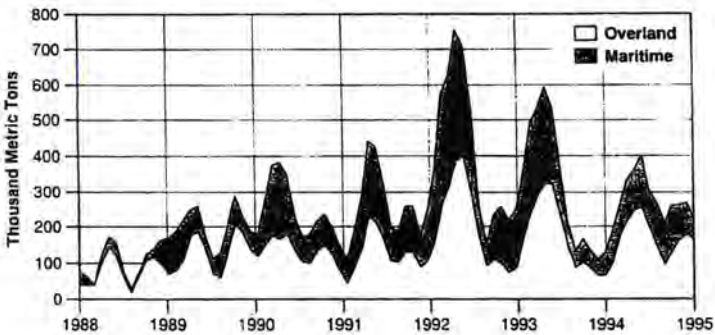
Differences in truck weights and dimensions pose a great problem for coordinating movements. Canadian carriers who serve the transborder market have separate fleets of trucks that meet the 80,000 pounds, eighteen wheel, standard vehicle for U.S. movements. The most efficient means of

trucking grain across the Canadian prairies is in a B-train. At 137,000 pounds GVW, this vehicle cannot enter the U.S. Obviously, shippers bear a higher cost than would exist if the Mid-Continent Corridor had uniform vehicle regulations. Canadian exports of grain to Mexico by truck are limited to higher value pulse crops, like lentils and beans.

Grain Movements to Mexico

Figure 8 illustrates the movements of U.S. grain to Mexico by surface and marine modes of transport. Klindworth and Martinsen (1995) observe an upward trend in exports between 1988 and 1994. As interesting however, is the change in the market share between overland and sea. The market share of truck and rail increased from 32 percent in 1990 to 50 percent in 1994.

Figure 8: Monthly U.S. Grain Exports to Mexico by Route, 1988-94



Corn and wheat dominate imports through the Gulf coast (2.4 million of the 4.2 million tonnes) in 1994. Sorghum and soybeans dominate the overland movements across the border (2.9 million of the 5.2 million tonnes). Soybeans dominate movements via the west coast (0.4 million of the 0.9 million tonnes).

The Gulf ports of Vera Cruz and Tampico each handled about a million tonnes of grain annually in 1990. While Vera Cruz has grown to 1.8 million tonnes, Tampico has declined to 0.4 million tonnes. This may reflect the

impact of more overland competition in Northern Mexico. Guaymas and Manzanillo are the major ports on the west coast (0.4 million tonnes each). The border crossing at Laredo, TX is the dominant overland route with over 4.5 million tonnes of grain per year. This is more than double the volume at Laredo in 1990.

Although the seaports handle half the grain, it is not necessarily because they are efficient. For example, the "clamshell" is still a common discharge method at the ports (Klindworth and Martinsen, 1995). Trucks are used to move a high proportion of the grain from port because there are insufficient railcars. The railcars that are available are boxcars which are inconvenient to load. The Mexican railway does have some hopper cars but these tend to be reserved for the longer domestic traffic lanes.

The modern history of the Mexican railway begins with the 1910-1920 revolution. A large amount of rolling stock, locomotives and track was destroyed in that period. Following the revolution, the foreign-owned rail lines were nationalized and amalgamated into the Ferrocarriles Nacionales (FNM). A strong union movement also emerged from the revolution and has burdened the FNM with over staffing and low labour productivity. State ownership contributed to ineffective management and capital starvation. Poor equipment maintenance and obsolete yards created low quality inconsistent service. Finally, the coordination of the four former railways was hampered by separate administrations and obsolete communications. In most recent years, the expectation of privatization has contributed to the problem because the government has been reluctant to invest new capital (Prentice and Guzman, 1994).

The FNM was further hampered by the "political" rate setting that made it unprofitable and uncompetitive with trucking. The rail rates in Mexico were set on a distance basis despite the terrain. Consequently, the rate per mile of shipping grain from Vera Cruz was the same as from Laredo. The Vera Cruz route entails a very difficult climb from sea level to Mexico City with many tight corners and trains that were only some 35 cars long. The Laredo route to Mexico City can be traversed with 90 car unit trains across a gently sloping plateau. The economic incentive for the railway was to move grain across the plateau. Of course shippers want to use the coastal route that is much cheaper.

The weights that the Mexican rail line can support are lighter than in the U.S. and Canada. Only the link from the U.S. border to Monterrey has standards equal to the North American railways. Beyond Monterrey, maximum car weights are 10 to 20 tonnes lower. The principal problem in Mexico is the bridges, which need to be strengthened to carry heavier weights. The lower weight limits in Mexico mean that the unit costs are higher for the entire trip.

Old Problems and New Opportunities

The current pattern of grain trade between Canada and Mexico is a function of past political decisions. The history of grain transportation in western Canada was shaped by the public involvement that led to the construction of three transcontinental railways. The railways were only made viable by regulations and subsidies that guaranteed grain traffic would flow east and west over the Canadian lines. These policies also provided incentives for investment by the private grain sector at the eastern and western ports.

Economic forces and new trade agreements (NAFTA and WTO) provided impetus for the government to restructure the system. Since 1995, the Canadian government has privatized the Canadian National Railway, liberalized the rail regulations, and eliminated the $600 million annual transportation subsidy for grain movements (WGTA). Ultimately, these polices will affect the grain transportation system but for now it retains significant inertia.

The private grain interests in Canada have no incentive to use the southern route because it bypasses their handling system. Until the Canadian operations acquire facilities in the U.S. (or U.S. grain companies become more active in Canada), it is not in their interest to move grain on the Mid-Continent Corridor. They make more money moving grain east/west. Similarly, the Canadian railways are not interested in handing off railcars of grain after 100 miles of movement when they can carry similar loads 1500 miles to the Canadian seaports. CP Rail could move grain to Kansas City via the Soo Line but the future of this link is in doubt. If CP Rail transfers this portion of the Soo Line, railcars from Canada will have to move across a U.S. interline.

Regulatory constraints still exist and some of these relate to subsidies. The Canadian Government owns a large fleet of rail hopper cars. They are provided without cost for Canadian routes, but must pay a per diem if they

are used to move products to the U.S. No record exists that any of these rail cars have ever entered Mexico. The government ownership of the rail cars biases grain movements, because the rail cars are essentially captive to the east/west routes.

Shippers are still influenced by regulations on the rail tariffs for grain shipments. Canadian freight rates for grain are capped until the Year 2000. The east/west rates are quite a bit lower than the equivalent north/south move (Stirling, 1996). These commercial and regulatory factors will inhibit north/south moves of grain from Canada for the remainder of the decade.

New opportunities are emerging that will make the Mid-Continent Corridor more attractive. One of the most important changes is the privatization of the Mexican railway. In December, the Northeastern rail concession was purchased by TMM in a joint venture with the Kansas City Southern railway (Al Grano, 1997). TMM is the largest marine transportation company in Mexico, and should have access to the capital necessary to upgrade the rail line. A single line can now move products from Kansas City to Mexico City. This would link conveniently with the BN/Santa Fe and the UP/SP. Perhaps most important, the new Mexican rail line is likely to remove the rate distortions that impeded overland shipments.

The deregulation and privatization of the Mexican ports and grain handling facilities could lead to lower costs and improved service for importers. This favours sea routes over the Mid-Continent Corridor, but the Mississippi barge system will continue to be a strong competitor. There has been discussion of a project to extend the inland barge system from Brownsville, TX to Tampico, Mexico. The financing of this extension has yet to develop, and environmental concerns have been raised. Nevertheless, the idea continues to be championed in Mexico.

Conclusions

Competition between the sea route and the Mid-Continent Corridor for grain movements to Mexico will increase. The impediments to north/south flows are commercial and regulatory, rather than technical. Efficiencies in overland routes will increase the catchment basin of the Mid-Continent corridor in western Canada.

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SHIPPING AND GOVERNMENT- A Difficult Marriage

John L. Eyre

INTRODUCTION and ABSTRACT

Governments have trouble dealing with the business of shipping, in part because the general public shows little interest in the subject. Some maritime issues are beyond the reach of any single nation,- are regulated by global units both public and private. The most active players in the political process are carriers, the providers of transport services. Only recently have shippers begun to exert customer power.

Responding to carrier and labor pressures the United States Maritime Administration has presided over the collapse of a once mighty industry. In Latin America protected government ship lines have been abandoned with immediate reduction of freight rates. In West Africa national ship lines were formed under the umbrella of government enforced cargo allocation systems. Now all but a few of these have vanished. In France a half century of subsidy and protection has left leaders contemplating "a zero maritime option".

Every government needs policies on maritime matters, if only to decide on ratification of an international convention. Lakes, rivers, and coastal waters call

for certification of vessels and seamen. Above all commerce and employment depend on efficient low cost transport.

Many nations dream of a maritime presence, but not all can be strong in shipping. Two categories of countries have different policy choices. Senegal, Canada, India, Nepal, France, Zaire, Bolivia, Paraguay, and the USA have little

present hope for carrying a large share of their exports and imports in ships of their flags. These can be considered shipper nations. In contrast Greece, Norway, and South Korea are carrier nations because their vessels carry far more than their own country's cargos. Both shipper and carrier nations take part in an international system that , to an increasing extent, replaces regulations of individual nations.

This paper touches the main issues in a subject that requires a book.

1 WHY GOVERNMENTS CARE

Governments respond to pressures from two groups with different agendas, namely the providers of transport services and their shipper customers. In seeking protection and subsidies ship owners and ship yards talk of job creation, defense, and balance of payments. Those who use shipping services care more about low rates, reliable services, the environment, and general regulatory affairs..

1. JOBS;

In 1950 a standard cargo ship cost ten million dollars and carried a crew of forty or more. Twenty longshoremen hand loaded general cargo in each of her five holds. Now a main line containership can cost a hundred million dollars sail at twice the speed, and carry twenty times the cargo aboard the older standard vessel, She can be operated with only eighteen seafarers. In 1950 a stevedoring company could brag if its gangs averaged one ton moved per man hour. Now a port would be ashamed if it could not do better than a hundred tons (ten 20 ft. containers) per man hour. Ports and shipping have become capital intensive, and will be more so in Year 2000.

One million dollars invested in a ship will produce about one job,- far less than the same amount spent on a factory or a farm. The totally automated container terminal is on the drawing boards, sure to come..

2. DEFENSE

Merchant ships were armed and vital in both World Wars. The Cunard Queens carried thousands of troops to war. Today the story is different. Troops fly to war. Super tankers and containerships are not suited for modern combat. In seeking to influence government policy maritime interests now accept the weakness of their defense argument. However, they cling to the words of one Admiral Mahan who saw sea power as essential for national power. While modern merchant ships may not be suitable for combat, they certainly are vital for logistic wartime support of both troops and civilians. The defense argument is usually combined with an appeal to patriotism and to a plea that shipping is " our fourth arm of defense" (in addition to the army, navy, and marines).

3. BALANCE OF PAYMENTS

Sensing the weakness of their defense argument, shipowner stress the balance of payment gains created by a protected home flag merchant marine. While these gains are real and measurable, losses caused by high freight costs can be greater. This is true because protected home flag ship lines are guaranteed a share (say 40 or 50%) of most cargo, and thus not worried about competition. However, outsiders carry the other half or more of all exports and imports. These in conferences and rate agreements enjoy the benefits of high rates set by the national carrier. (1.) Very little of a vessel's expenditures are influenced by her flag,. Most deep sea ships are built in Asia (Japan , South Korea or China (2.)) financed in rich OECD banks, insured in London or Bermuda. Fuel is purchased at world prices wherever the voyage requires, and port charges are paid in local currencies. Shipping can be a

plus factor in the balance of payment account of any nation but only if its vessels can earn profits without subsidy or protection,-as in Norway, Greece and Taiwan .

A strong home flag maritime industry produces side benefits in the presence of brokers, bankers, insurers, consultants, publications, and associations. It is to defend these that shipping people in London, Oslo, and Piraeus plead for favors, especially tax breaks.

4. LOW RATES

In India, Latin America, and Africa many imports and exports are constrained because door to door transport costs are too high. The United Nations Conference on Trade and Development (UNCTAD) has been a leader in identifying the relationship between shipping costs and the value of goods shipped. Their annual Review of Maritime Transport (3.) notes that developed rich countries pay freight costs that are 4.5% of import values. For developing poor countries freight costs are about double that, and for Africa they range between 11 and 13.5%. If full logistic costs (terminals, insurance, warehousing, distribution, intermodal connections, overhead, paperwork, etc.) are considered, all of the above figures could be doubled.

5. RELIABLE SERVICES

Often a shipper will pay more if his carrier gives good service, that is keeps schedules, pays claims, and carries proper insurance. In a 1993 World Bank report (4.) Creightney told a story about a government that failed to understand the importance of the carrier's service.

> "...Indian manufacturing exporters are in danger of losing their market share to other Asian competitors because of deficiencies in infrastructure and

> time-consuming procedures. India's exports of manufactured goods are targeted primarily at the North American, West European, and Japanese markets. However, importers in these markets operate on very thin inventory margins and thus require supplies to be delivered reliably and within tight time limits..... The transport of containers from the point of cargo origin to the loading port exceeds feasible transit times by over 300 percent. Also the freight rates for delivered Indian export containers in Europe exceeds those of Asian competitors by 30 percent on average".

India, Nigeria and other developing countries suffer from poor shipping services, but they are not alone.. As the USA 1996 presidential campaign closed, Midwestern farm state senators complained about a law that forces their grain growers to pay three times the world rate for exporting to Europe and Asia. This is a law that reserves certain cargos for a small number of ancient U.S.flag bulk carriers.

6. THE ENVIRONMENT

Countries that have little maritime presence still need to defend themselves against oil spills and other damage to their shores.. Thus, for example, Kenya and Tanzania are (in 1997) both setting up new maritime authorities which will concentrate on preventing pollution, inspecting vessels, also ratifying international maritime and transport conventions.

7. GENERAL AND REGULATORY

Every government, even a landlocked one, needs some official body that can license vessels and seamen, consider international conventions, and protect the interests of exporters and importers. The location and powers of this body

vary sharply depending on the degree to which maritime matters effect the national interest.

II. WHO ACTUALLY GOVERNS.

Maritime affairs are not concentrated in any single government agency. Several different executive ministries or departments are usually involved in shipping as follows;

1. Justice	Maritime Law and Courts
2. Public Works	Ports, rivers and channels
3. Transport connections	Rail, truck and intermodal
4. Maritime Transport Ministry)	Shipping, (sometimes in a
5. Commerce and Industry interests	Shipper (exporters and importers)
6. Finance	Customs and taxation of shipping
7. Foreign Affairs Conventions	Treaties and International

These perform a variety of activities such as regulating, promoting, financing, constructing , operating, and negotiating. They deal with both domestic and international issues.

It would be helpful if they communicated with each other, but they seldom do. The average maritime administration employee does not know what conventions and agreements his country has ratified. This is not surprising because there are over a hundred shipping and intermodal conventions,- each with its own separate set of amendments, protocols,

sub-divisions and negotiations. These are discussed and negotiated in Geneva, New York, London, and Brussels by foreign affairs staffers who may know little about shipping.

Adding to the confusion these ministries enforce laws and regulations which originate in legislatures. Senators and congressmen are subject to pressures from special interests .In the United States congressional maritime committees have been accused of favoring shipowner, shipyards and unions.

Every nation needs some form of maritime administration,- often as a division of the ministry of transport. As a minimum this agency is likely to have the following "housekeeping" duties.;

1. Inspecting and certifying vessels
2. Examining and certifying seamen
3. Providing maritime education
4. Informing other agencies on maritime matters

Maritime administrations, being close to their industry, tend to promote shipping interests, often in isolation from other transport modes or economic and political issues.. But shipping is a service industry. In any field a government must balance the interests of service providers against those of their customers. This balancing presents the central and most important public transport problem . If policy decisions are left to a maritime or transport agency they are likely to favor carrier interests. Thus we argue that these decisions should be made elsewhere, possibly in ministries of industry and commerce, perhaps even in a Prime Minister's office. Weighing the balance between shipper and carrier interests is difficult furthermore, once it is measured, it becomes even harder to implement corrections.

In pleading for government action or inaction both carriers and their customer shippers claim to have the public welfare on their side.. The Creightney World Bank report referred to above (4.) catalogues some of the attempts to measure the connection between transport and a nation's economic welfare.

Few public servants will read through these studies , but in Canada a different approach produced an interesting result. Canada is a nation heavily dependent on shipping, especially for the export of her grains, forest products, and ores. In 1985 the government appointed a Task Force on Deep-Sea Shipping (5.) and asked it if "the government should encourage the development of a Canadian merchant marine for deep sea shipping". Members were shipowners, shippers, academics, and labor representatives. With two labor members dissenting, the Task Force recommended

> "that the federal government not take steps toward the establishment of a core deep-sea fleet under the Canadian flag."

This was based on an expert judgement analysis of the Canadian economy and of the world shipping situation. As a result of government inaction Canadian shippers enjoy the low rates and good services subsidized by others. No other nation has shown such wisdom.

III. MATTERS BEYOND ANY NATION'S CONTROL

A growing number of maritime regulatory issues are decided by international bodies, both public and private. This is so in part because about half of all deep sea commercial ships sail under flags of convenience (FOCs),- those of

Panama, Liberia, Cyprus, Vanuatu and others. Many of these are owned in tax havens such as Bermuda. The Law of the Sea Convention (6.) states in article 87. that "the high seas are open to all states" and in article 94. that " Every state shall effectively exercize its jurisdiction and control in administrative, technical, and social matters over ships flying its flag". Few shippers or shipowners care to trust their disputes to the courts, laws, and regulations Panama or Liberia. Furthermore, the business of global trade calls for standards in equipment (containers for example) and in contracts such as bills of lading and charter parties.

A wide range of operating, safety and environmental matters are handled by the International Maritime Ogranization (IMO) a London based United Nations agency. IMO organizes international agreements or conventions on such matters as Safety of Life at Sea (SOLAS), and generally obtains concurrance by its member nations such as Panama. The International Standards Organization

(ISO) , a private organization, creates in its TC 104 Committee general agreement on container sizes. Non government classification societies such as Lloyds and the American Bureau of Shipping have long been the dominant inspectors of maritime hardwaare. Now they have advanced into the field of managerment.

Though international bodies have growing roles, individual nations still retain some powers in a confused scene. As a dominant trader the USA has long imposed its anti-trust ideas on the shipping world by outlawing tightly structured liner conference agreements. But now an international body, the European Commission, has taken the anti-combines lead as deregulation has become fashionable in North America. Tanker owners are not pleased to see the USA unilaterally demand that their new vessels have double bottoms and face almost unlimited liability for oil spills. A programme known as

"Port State Control" offers an interesting example of joint national and international action. In Paris and agreement known as the MOU (Memorandum of Understanding) set up a plan under which individual ports would inspect ships to determine their physical conditions, even the treatment of their crews. Initially derided, this well publicized MOU has shamed many shipowners and classification societies into better behaviour.

To an increasing extent international bodies will decide matters related to the environment, seamen's rights, safety, intermodal shipping and the law of the sea, to mention a few.

IV. AN UNFINISHED REVOLUTION

Government policy makers deal with an industry that is still experiencing change. At the end of World War II a standard freighter carried liquids in her deep tanks, bulk grain in her lower holds , and packaged goods everywhere else. Her owner was incorporated and paid taxes where he lived and his ship flew the home flag. Today that is seldom so. The following three are among the many developments that are reshaping the shipping business..

1. Tankers and bulk carriers are larger and traded separately

2. Containers have inspired intermodal systems

3. Nations and flags matter less

1. TANKERS AND BULK CARRIERS

These have grown in size to the limits of the ports that they serve and have come to carry all but general cargo, specialized ores, grains, and packaged petroleum products. They are traded in a well publicized open charter market which functions well and has few critics. The system is flexible in responding to demand. Here there are here no large liner type companies and no complaints about monopolies. Though declining in numbers, several fleets are owned and operated by shippers of ores and petroleum products.

2. CONTAINERS AND INTERMODAL SYSTEMS

Containers, which are generally homogeneous, tend to move in systems that include more than ocean shipping. Organizations such as Sea-Land offer door to door transport which includes terminals, inland transport, and a variety of other services. They sub contract much of their overseas feeder shipping, and share their deep sea operations with alliance partners. Some forecast that by Year 2,000 most containerships will be traded in an open market much as are tankers and bulk carriers. These would be mainly owned and operated by efficient low cost Asian shipping companies. This is part of a transport revolution which has a long way to go. While shipper customers have little to complain about, a growing surplus of vessel space makes structural industry change likely. Mergers, bankruptcies, alliances, consortia, rate and space agreements are in the shipping news every day.

with no change in sight.

3. NATIONS AND FLAGS MATTER LESS

Today a shipowner can live in Montreal or London but have all of his vessel activities elsewhere. His ships can be

owned (perhaps separately) in Bermuda, fly Liberian flags, have officers from Pakistan and sailors from the Philippines. Management can be in Cyprus, and finance can come from the USA or any one of a dozen European lenders. Taxes are easily avoided. This leaves individual government policy makers in a quandary..

V. THREE BARRIERS

Public servants struggling with shipping issues can be forgiven because they face a difficult set of barriers. We have noted that maritime decision making is usually sprinkled throughout several different agencies in any government., also that an increasing number of issues are decided by public and private international bodies. For any official the following three are barriers to progress.;

1. Public apathy
2. Labor and carrier power
3. Structural delays, time consuming procedures

1. PUBLIC APATHY

Transportation is not a vital issue for most people, seldom on the front page. Political campaigns treat shipping as a passing point, if at all. Transport politics tend to be private, settled in back room talks where well organized special interests are strongest. A port seeking a subsidy or tax break can hire a far distant consultant who claims that one job in five is port related, and few will argue. The national flag can be waved, and patriotic people respond. It is difficult to stand up

for the interests of faceless consumer shippers. These are not yet well enough organized, - their arguments too complex for general consumption..

A comical example of confusion came when shipbuilders in the USA decided to promote an international agreement outlawing subsidies to shipyards. They told the public that subsidies to German, French, Italian and Asian yards were destroying markets for USA build ships. When the European Commission agreed and took steps to implement such an agreement, the Americans sabotaged their own project. Suddenly they realized that a ban on subsidies might apply in the USA. Given this kind of performance it is easy to understand why the man in the street is confused.

2..LABOR AND CARRIER POWER

In forty short years the business of shipping has ceased to be labour intensive, but the politics have not changed as quickly. Container enthusiasts like to say that one job lost on the automated waterfront creates three in the interior, - the result of cheaper transport. But this does not convince longshoremenn's unions that wield great power in Europe, Japan and the Americas. The political power of seamens' unions have protected a three million dollar per annum price tag for the crew on a US Flag ship, this six times the world average (of US$600,000). In pleading for subsidies and protection labor unions are joined by shipowners to form strong special interest political alliances.

This is a barrier that constantly declines because shippers are better organized and have options. For example, the costs and congestion in Indian ports can be avoided by discharging cargo in Colombo, Singapore, or Dubai and thereafter using smaller cheaper feeder ships. FOCs are popular as a device for avoiding labor requirements (also taxes and regulations) in

rich OECD countries. Shippers' Councils in Europe and the USA have the ears of governments, especially when they fight against carrier cartels and conferences. However,in developing countries shipper power faces special obstacles. Often there shippers are government owned, as may be the national ship line. Big shippers deal direct with officials while small shippers lack the money to create councils. For example, in the Philippines the government must fund their "Shippercon", but big shippers such as San Miguel have their own separate organization.

3. STRUCTURAL TIME LAG

In a thoughtful paper Heggie at the World Bank (7.) explained that "policy reform takes a great deal of time. It cannot easily be completed in the five to seven years typically specified in Bank operations." . Adding that advice on technical issues is easier to implement, he says that it is almost impossible to inspire policy decisions without taking time to " understand the organizational and political framework within which such decisions take place." His conclusion is supported by a 1993 World Bank symposium on regulatory reform (8.) which recounts the long struggles for change in Chilean shipping, UK bus services, and American railroads. The time lag noted by Heggie is much more of a problem in developing countries and in North-South trades,- especially in Africa.

One result of the container revolution has been the incredibly efficient containership intermodal system that functions on an East-West axis linking Europe, Asia and North America. Off the main line Latin America and especially Africa have been left to absorb older ships, trerminology, and technology. Government policy makers in Africa feel isolated as they struggls to understand such mysteries as ASYCUDA (re Customs), EDIFACT (re terminology), and other shipping

terms which are familiar to transport people on the main line East-West axis.

The European Commision , the World Bank, Canadian AID , and others are working in West Africa to devise a new set of maritime policies. One of the African government advisors on that project (from Mali) had said that:

"We feel like logs floating in the middle of a swollen river. We once dreamed of having some influence, of having our own ships and intermodal systems. We dont accept the ideas in the Canadian Task Force report. Where and how can we be players?"

CONCLUDING COMMENTS

This paper draws on the Heggie ideas in begging forgiveness for government people. Faced with the complexity of a changing maritime industry no individual or agency is likely to make short term policy improvements. In the "political framework" there are open questions about the roles of national and international agencies, also about the roles of public and private bodies. Confirming the. Heggie comment, technical issues (safety, environment,communications, and equipment standards) have proved easier to solve than others (subsidy, protection, and cartels).

A stranger to shipping might conclude that the problems described in this paper work against the interests of traders, exporters, and importers, But the oppoosite is true. Seldom does one hear about the miracles that have been wrought by big bulk carriers, tankers and intermodal container systems. Somehow in a time of confusion, change, and semi anarchy world shipping is giving better and cheaper service to its customers.

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The Author is a former merchant marine officer who was for many years president of Canada's largest shipping company and of the Canadian Shipowners' Association. Now he consults, mainly for the World Bank, the EC., and CIDA.

E Mail: jack.eyre@acbm.qc.ca

Home page:http//acbm.qc.ca/ac_website/jack_eyre/index..htm

ISSN#
1183-2770

Designed and printed by Printing Services • University of Saskatchewan • CUPE 1975