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

19th ANNUAL MEETING

JASPER, ALBERTA
MAY 1984

PROCEEDINGS

1984 JOINT CTRF/TRF MEETING

TRANSPORTATION RESEARCH FORUM

P R O C E E D I N G S

19TH ANNUAL MEETING

CANADIAN TRANSPORTATION RESEARCH FORUM

Jasper, Alberta

May, 1984

Proceedings Printed by

University of Saskatchewan
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PRESIDENT'S MESSAGE



The 1984 CTRF annual conference is very special. Not only is it the first ever joint meeting with the U.S. TRF, but it is the first of two such conferences being held this year. The second will be October 22-24 in Boston. Our theme, Transportation Today - Issues Without Boundaries, was chosen to reflect the scope of this joint conference. The response to the call for papers exceeded our most optimistic expectations, and we hope you will agree that this year's program is one of our best ever. There were many good quality papers submitted, which we reluctantly did not accept in order that there would be time in each session for discussion and exchange of ideas. This is a vital part of the conference.

I hope you have an intellectually stimulating conference, and an enjoyable visit to the Canadian Rockies; see you in Boston.

Ray Rohr
President
Canadian Transportation Research Forum

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AN ANALYSIS OF RAIL RATES FOR GRAIN IN NORTH DAKOTA: AN ALTERNATIVE TO THE CROW'S NEST PASS RATES?

by

Dennis R. Ming and Denver D. Tolliver*

INTRODUCTION

The Canadian House of Commons recently voted to allow railroads to increase westbound grain rates nearly fivefold by the end of the decade. If the Crow's Nest Pass rate agreement does indeed fade away, it opens the door to possible alternative rail pricing by Canadian railroads. One option is a rate structure similar to what is in place in North Dakota.

OBJECTIVES

The objectives of this paper were primarily twofold. First, a descriptive analysis of rail rates for wheat from North Dakota was performed. Rates were examined for both eastbound (Duluth/Superior) and westbound (Portland) movements (see Figure 1 for locations). Rate spreads (differentials) were analyzed as well as rate/distance relationships. Second, applicable rail costs of a typical wheat movement from North Dakota were calculated. In addition, formulated rail costs were compared to rates to give a revenue/cost relationship.

RAIL RATE STRUCTURES IN NORTH DAKOTA

Eastbound

A four-tiered rail rate structure currently exists for eastbound wheat movements from North Dakota (Table 1). The four levels of service

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Figure 1. Locations of Portland Oregon, Duluth Minnesota and Superior Wisconsin and Four North Dakota Origins.

are: (1) single car, (2) 3-car, (3) 26-car and (4) 52-car. Rates for the various levels of service decrease as shippers utilize larger lot sizes. For example, the 3-car rate is lower than the single car rate, the 26-car rate is lower than the 3-car rate and the 52-car rate is lower than the 26-car rate. Thus, shippers receive an economic incentive (a lower rate) for shipping in quantities larger than a carload (single car service) at a time.

The rate spreads between the various levels of service vary little among stations, but the rates increase moderately as distance to market increases. For example, rate spreads at all locations are 4 cents per hundredweight (cwt.) for single-car versus 3-car service, 9 to 12 cents for 3-car versus 26-car service, and 5 to 7 cents for 26-car versus 52-car service. Single car rates vary from 73 cents per cwt. at Grand Forks to 161 cents per cwt. at Williston. Rates for 52-car service vary between 54 cents and 138 cents per cwt. at the two locations.

TABLE 1. WHEAT RAIL RATES TO DULUTH/SUPERIOR FROM FOUR NORTH DAKOTA ORIGINS, FEBRUARY, 1984.

Location	Service Level			
	Single-Car	3-Car	26-Car	52-Car
	(¢/cwt.)			
Grand Forks	73	69	60	54
Devils Lake	94	90	80	75
Minot	127	123	111	106
Williston	161	157	145	138

Westbound

Westbound rail rates for wheat from North Dakota to the Pacific Northwest (PNW)[1] are structured in the same manner as eastbound rates. Again, there are four levels of service (Table 2). However, the 3-car rate is replaced by a 26-car multiple origin rate (26 M.O.). The 26 M.O. rate may be loaded at two to four locations which allows smaller shippers to consolidate grain to utilize the lower rate.

Rate spreads on westbound rail rates are wider than rate spreads on eastbound rates. For example, the spread between the eastbound single-car rate and 52-car rate from Williston is 23 cents per cwt. while the spread between the two rates for westbound shipments is 36 cents per hundredweight. Therefore, a greater incentive exists for westbound shippers to ship in larger consignments.

TABLE 2. WHEAT RAIL RATES TO PORTLAND, OREGON FROM FOUR NORTH DAKOTA ORIGINS, FEBRUARY, 1984.

Location	Service Level			
	Single Car	26-Car M.O.	26-Car S.O.	52-Car
	(¢/cwt.)			
Williston	207	194	187	171
Minot	221	207	199	184
Devils Lake	221	207	199	184
Grand Forks	221	207	199	184

[1] The Pacific Northwest generally includes Portland, Oregon, and Seattle, Washington which are the two predominant areas for westbound grain shipments by rail from North Dakota. Rail rates to these two areas are typically identical for a given commodity.

Other than a few origins located in the western part of North Dakota, westbound rail rates do not fluctuate with distance. Minot, Devils Lake and Grand Forks all have identical rates, 221 cents per cwt. for single-car service, 207 cents per cwt. for 26-car M.O. service, 199 cents per cwt. for 26-car single origin (26 S.O.) service and 184 cents per cwt. for 52-car service. Rail rates from Williston are 12 to 14 cents per cwt. lower depending on the level of service.

Blanket Rates

Generally, rail rates tend to increase as distance increases. However, the group-rate system, which groups points of origin or destination, is a notable exception.[2] The group-rate system, or blanket or flat rates as they are commonly referred to, applies on westbound wheat rates from North Dakota. Thus, the same rate applies for a given level of service (i.e., single-car, 26 M.O., 26 S.O. or 52-car service) for all stations in North Dakota, with a few exceptions in the extreme western part of the state. Figure 2 depicts graphically the principle of a flat rate rail structure.[3] This rate structure may be contrasted with the eastbound 26-car single origin rate (Figure 3). The eastbound rate does not "flatten" and continues to increase uniformly. The westbound rail rate begins to flatten for origins roughly 1,200 miles from destination and continues at a zero slope to the end of the scale (about 1,650 miles).

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[2]Lieb, Robert C., Transportation: The Domestic System, 2d Edition, Reston Publishing Co., 1981, p. 174.

[3]Wheat rates from Montana were included in the analysis to give a better graphic depiction of rate/distance relationships. For a listing of westbound and eastbound wheat rates used in this paper see Appendix Tables I and II.

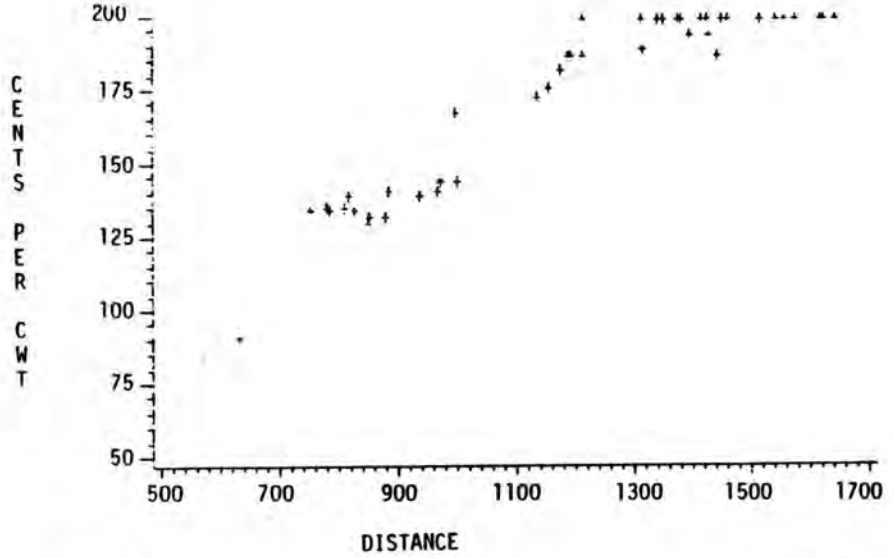


Figure 2. Illustration of Flat Rate Structure of Westbound 26-Car Single Origin Wheat Rates from 24 North Dakota Origins and 21 Montana Origins, February, 1984.

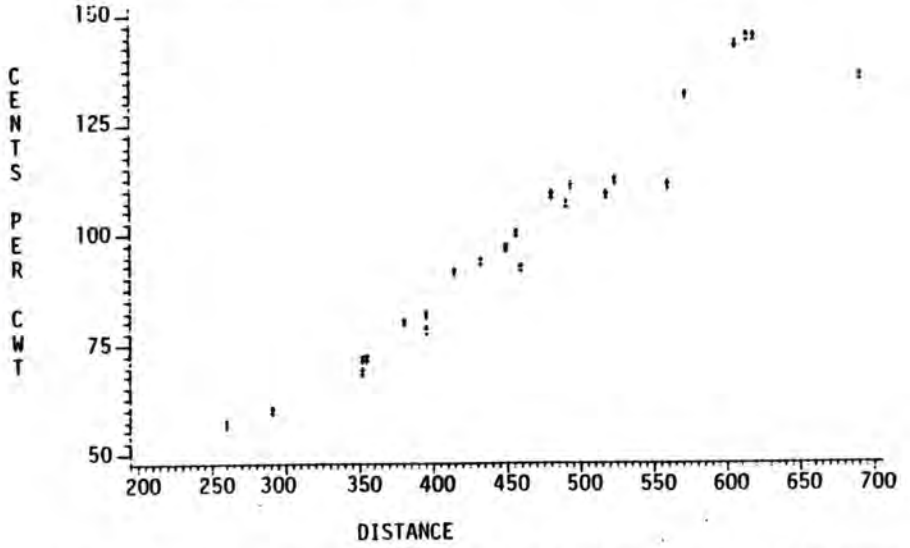


Figure 3. Illustration of Rate/Distance Relationsihps for Eastbound 26-Car Single Origin Wheat Rates from 24 North Dakota Origins. February, 1984.

Plotting both westbound (Figure 4) and eastbound (Figure 5) rates on a per cwt. per mile basis reveals a significant difference between the two rate structures. Westbound rates, on a per mile basis, tend to decline throughout two distinct ranges, 700 to 1,000 miles and 1,200 to 1,700 miles. Rates in the first range (700 to 1,000 miles) vary from about .145 cents per mile to about .180 cents per mile. Rates in the second range (1,200 to 1,700 miles) vary between .120 cents and .165 cents per mile.

Eastbound rates, on a per mile basis, exhibit widely fluctuating behavior. Rates vary from under .20 cents per cwt. per mile to over .23 cents per cwt. per mile throughout the 250 to 650 mile range. Unlike westbound rates, eastbound rates do not decline on a per mile basis, but rather are randomly dispersed regardless of distance. Thus, neither "tapered" nor "flat" rates are characteristic of eastbound wheat rates from North Dakota.

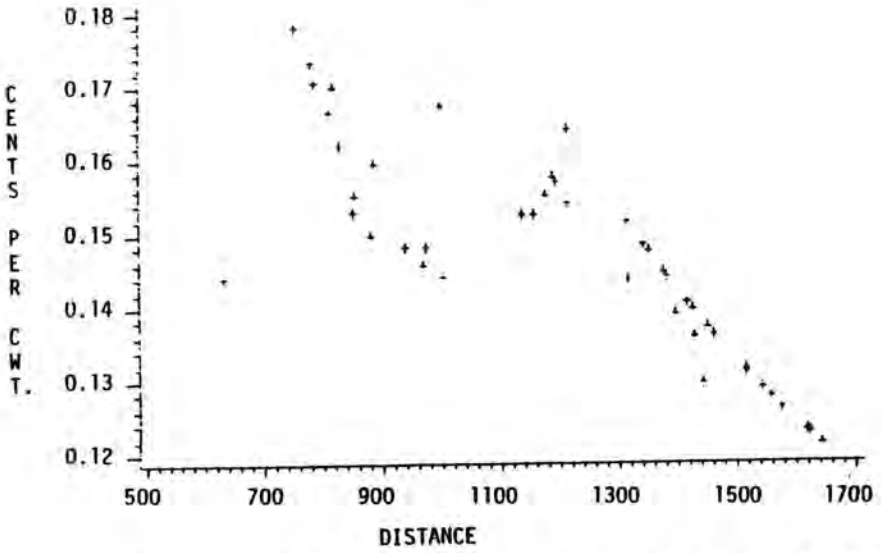


Figure 4. Plot of Westbound Wheat Rail Rates on a Per Cwt. Per Mile Basis.

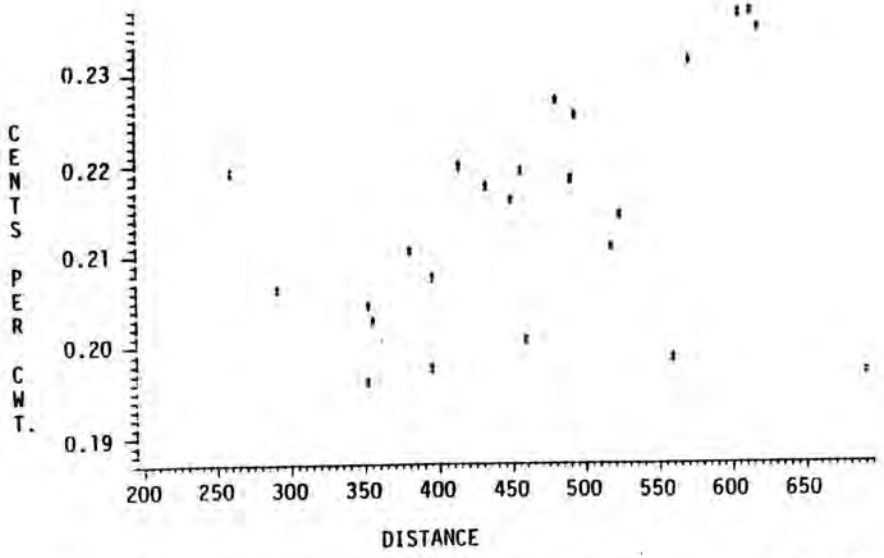


Figure 5. Plot of Eastbound Wheat Rail Rates on a Per Cwt. Per Mile Basis.

Distance is one factor contributing to the difference between eastbound and westbound rail rates from North Dakota. Grain moving to eastern markets is relatively short-haul traffic when compared to grain moving to western markets. Thus, railroads cannot economically spread their terminal costs over distance. This phenomena results in eastbound rates increasing progressively with distance and westbound rates remaining constant at some point regardless of mileage. While the flat rate rail structure overstates the theoretical pricing of a declining-cost industry, such as the railroad industry, it nonetheless accounts for both the practical realities of competitive pricing and cost of service considerations.

RAIL COSTS

Rail costs were calculated for mainline and branchline movements from selected North Dakota origins to Portland, Oregon (westbound) and Duluth, Minnesota (eastbound). Costs to the railroad were then compared to rates from the specified origins. Uniform Rail Costing System (URCS) was used to estimate rail carrier costs.[4] Costs include variable costs and line segment fixed costs, but do not include system fixed costs.

Westbound Costs

Rail carrier costs were calculated for westbound 26-car single origin wheat movements for 16 origins (Table 3). Costs varied from a low of 96 cents per cwt. from Williston to a high of 130 cents per cwt. from Turtle Lake. Rate/cost ratios varied between 1.53 and 1.95,

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[4]For a detailed description of rail costing methodology see Tolliver, Denver D., Economies of Density in Railroad Cost-Finding: Applications to Rail Form A, Proceedings, Transportation Research Forum, Volume XXIV, No. 1, 1983.

meaning that rates were 53 percent and 95 percent above estimated costs, respectively.

TABLE 3. RAIL CARRIER COSTS, AND RATES, AND DISTANCES TO PORTLAND, OREGON, FOR 26-CAR SINGLE ORIGIN WHEAT MOVEMENTS FROM SELECTED NORTH DAKOTA ORIGINS, FEBRUARY, 1984.

Origin	Line Type	Distance	Rail Carrier Cost	Rate	Rate/Cost Ratio
		(miles)	(cents per cwt.)		
Cavalier	Branch	1,588	126	199	1.58
Crosby	Branch	1,428	114	194	1.70
Devils Lake	Main	1,426	114	199	1.75
Dickinson	Main	1,314	106	189	1.78
Fargo	Main	1,543	123	199	1.62
Grand Forks	Main	1,514	120	199	1.66
Horace	Branch	1,554	123	199	1.62
Jamestown	Main	1,515	121	199	1.64
Killdeer	Branch	1,536	122	199	1.63
Lakota	Branch	1,450	116	199	1.72
Mandan	Main	1,414	113	199	1.76
Minot	Main	1,312	106	199	1.88
Mohall	Branch	1,375	110	199	1.81
Pingree	Branch	1,536	122	199	1.63
Turtle Lake	Branch	1,643	130	199	1.53
Williston	Main	1,187	96	187	1.95

Eastbound Costs

Carrier costs were also estimated for eastbound 26-car single origin shipments from the 16 origins (Table 4). Costs varied from 28 cents per cwt. to 55 cents per cwt. Rate/cost ratios varied from 1.85 to 2.65.

Ratios and costs would deviate from those contained in Tables 3 and 4 for alternative levels of service (single-car, 3-car, 52-car, etc). However, the costs and ratios calculated for eastbound and westbound 26-car wheat movements are representative of those that could be estimated for remaining service levels. That is, relative rate/cost relationships would not vary significantly between service levels.

TABLE 4. RAIL CARRIER COSTS, AND RATES, AND DISTANCES TO DULUTH, MINNESOTA, FOR 26-CAR SINGLE ORIGIN WHEAT MOVEMENTS FROM SELECTED NORTH DAKOTA ORIGINS, FEBRUARY, 1984.

Origin	Line Type	Distance	Rail Carrier Cost	Rate	Rate/Cost Ratio
		(miles)	------- (cents per cwt.)		----
Cavalier	Branch	364	36	78	2.17
Crosby	Branch	605	54	143	2.65
Devils Lake	Main	380	37	80	2.16
Dickinson	Main	559	50	111	2.22
Fargo	Main	260	28	57	2.04
Grand Forks	Main	291	31	60	1.94
Horace	Branch	270	29	57	1.97
Jamestown	Main	270	35	72	2.06
Killdeer	Branch	581	52	122	2.35
Lakota	Branch	355	39	72	1.85
Mandan	Main	459	43	92	2.14
Minot	Main	493	45	111	2.47
Mohall	Branch	523	50	112	2.24
Pingree	Branch	373	37	79	2.14
Turtle Lake	Branch	480	45	109	2.42
Williston	Main	613	55	145	2.64

SUMMARY AND CONCLUSIONS

Wheat shipments from North Dakota origins are typically bidirectional, east and west. Rail rates from the state to market destinations in these areas exist for four basic levels of service. Levels of service for eastbound rates are single-car, 3-car, 26-car and 52-car. Westbound service levels are single-car, 26-car multiple origin, 26-car single origin and 52-car. Rates generally decrease as the lot size or volume increases.

Westbound rates exhibit a structure that "flattens" as distance from market increases. Thus, wheat rail rates to the west coast from North Dakota origins are identical regardless of distance, with a few exceptions in the western fringe of the state. Eastbound rail rates do not exhibit a flattening effect and increase positively as distance from market increases.

Rail rates on westbound movements are generally about 75 percent greater than carrier's costs (not including system fixed costs). Rates on eastbound movements are typically double carrier's costs. Thus, ignoring allocation of system fixed costs, eastbound movements are more profitable to rail carriers than westbound movements.

APPENDIX TABLE I. WHEAT RAIL RATES AND DISTANCES TO PORTLAND, OREGON, FROM SELECTED NORTH DAKOTA AND MONTANA ORIGINS, FEBRUARY, 1984.

State/Origin	Distance	Level of Service			
		1-Car	26-Car M.O.[a]	26-Car S.O.[b]	52-Car
		(cents per cwt.)			
North Dakota:					
Antler	1,449	221	207	199	184
Appam	1,442	207	194	187	180
Barton	1,382	221	207	199	184
Cando	1,460	221	207	199	184
Carrington	1,558	221	207	199	184
Crosby	1,428	215	202	194	187
Deering	1,341	221	207	199	184
Devils Lake	1,426	221	207	199	184
Dickinson	1,314	211	197	189	174
Esmond	1,622	221	207	199	184
Fargo	1,543	221	207	199	184
Glasston	1,576	221	207	199	184
Grand Forks	1,514	221	207	199	184
Jamestown	1,515	221	207	199	184
Lakota	1,450	221	207	199	184
Langdon	1,618	221	207	199	184
Mandan	1,414	221	207	199	184
Minot	1,312	221	207	199	184
Mohall	1,375	221	207	199	184
Northgate	1,395	215	202	194	187
Towner	1,349	221	207	199	184
Turtle Lake	1,213	221	207	199	179
Williston	1,817	207	194	187	171
Montana:					
Bainville	1,155	196	183	176	169
Choteau	881	155	143	132	118
Conrad	811	158	146	135	120
Glendive	1,213	207	194	187	169
Great Falls	850	153	141	130	116
Havre	884	165	152	141	126
Helena	752	152	140	134	120
Huntley	1,000	167	153	144	132
Laurel	972	163	150	144	132
Lewiston	968	167	153	141	127
Manhattan	828	152	140	134	120
Miles City	1,135	200	184	173	154
Missoula	632	114	97	91	80
Moccasin	938	163	150	139	124
Power	852	155	143	132	118
Saco	998	194	179	167	149
Shelby	779	158	146	135	120
Sidney	1,192	206	194	187	169
Sweet Grass	818	163	150	139	124
Terry	1,174	206	190	182	162
Whitehall	785	152	140	134	785

[a] 26-Car multiple (2 to 4) origin.
[b] 26-Car single origin.

APPENDIX TABLE II. WHEAT RAIL RATES AND DISTANCES TO DULUTH MINNESOTA, AND SUPERIOR WISCONSIN, FROM SELECTED NORTH DAKOTA ORIGINS, FEBRUARY, 1984.

Origin	Distance	Level of Service			
		1-Car	3-Car	26-Car	52-Car
		(cents per cwt.)			
Antler	517	124	121	109	104
Appam	618	161	157	145	138
Barton	449	111	108	97	92
Cando	414	105	100	91	84
Carrington	395	96	93	82	77
Crosby	605	159	155	143	136
Deering	490	122	118	107	101
Devils Lake	380	94	90	80	75
Dickinson	559	127	123	111	106
Esmond	432	108	103	94	88
Fargo	260	71	67	57	52
Glasston	352	83	79	69	64
Grand Forks	291	73	69	60	54
Jamestown	352	86	82	72	67
Lakota	355	86	82	72	67
Langdon	395	92	87	78	72
Mandan	459	106	103	92	86
Minot	493	127	123	111	106
Mohall	523	128	124	112	107
Northgate	571	148	144	132	126
Towner	456	115	111	100	95
Turtle Lake	480	124	121	109	104
Watford City	690	153	149	136	131
Williston	613	161	157	145	138

CHANGES IN THE FARM TRUCK FLEET AS THE RESULT OF ADJUSTMENTS IN RAIL FREIGHT RATES

N.L. MEYER[1/]

I. INTRODUCTION

The objective of this paper is to assess the potential impact of recent changes in Canadian grain transport regulation on the farm truck fleet. This will be accomplished by describing the 1980 changes in the U.S. truck and railroad legislation and by looking in greater detail at changes in grain transport from a geographic area 700 miles from the nearest deep water port. Based on these changes and subject to differing incentives, possible developments in the Canadian farm truck fleet are hypothesized subject to several alternative institutional scenarios.

II. CHANGES IN U.S. GRAIN TRANSPORTATION INSTITUTIONS

U.S. grain transport deregulation has been concerned with relaxing economic regulations that had previously been imposed on trucks and railroads involved in interstate commerce. Economic regulation in this case refers to restrictions placed upon a carrier's ability to affect transport rates, routes, frequency of service, as well as freedom to enter or leave the industry or a market. The specific change made in U.S. federal law that brought about this deregulation for railroads was passage of the Staggers

Act of 1980. The intended result of reduced regulation is to place more reliance on transportation resource allocation through markets rather than government intervention and protection.

Grain Transport Prior to Deregulation

Prior to deregulation, Eastern[2/] Idaho grain transportation was characterized by declining rail service, with an increasing reliance on truck movements to Ogden, Utah or the Portland area ocean terminals. Although multicar rates existed in the U.S. midwest, these rates were not offered in Idaho until 1980. Actually the railroad serving Eastern Idaho was offering lower per unit multicar export rates to midwest shippers transporting grain to Northwest coast ports than to Eastern Idaho shippers who were subject to single car rates. One solution to the high rates was choosing truck transportation as a means of moving grain. (Cornelius, WRDC).

Raw agricultural commodity transport by truck in the U.S. has always been exempt from economic regulation, leaving rate setting to the market. Rail rates were often set only slightly below the competitive truck rate despite the fact that rail costs were much lower than trucking costs for distances beyond 300-400 miles (Koo & Drinka).

Innovative grain shipping arrangements serving Eastern Idaho in the late 1970s were largely the response to the need to move grain under less than ideal conditions. The inability of railroads to meet shipper needs was an often cited marketing problem facing grain producers and shippers.

Impacts of Deregulation

Interstate truck transport of grains has always been exempt from regulation while railroad deregulation, technically the Staggers Act of 1980, was not enacted until October 1980. Within months after enactment of the legislation, Union Pacific reduced rates and introduced 25 car rates. The 25 car single origin to single destination rates were from 20-23 percent lower per unit than single car rates. Later in May of 1982 Union Pacific also introduced a 5 car rate which was 16 percent lower per unit than the single car rate (Meyer WRDC).

Four features of grain transport are examined to assess the impact of regulatory changes. These features are: (1) service (2) rates (3) transportation infrastructure and (4) farm prices. Each will be considered separately.

Service

Grain transportation service offered in Eastern Idaho changed significantly following deregulation . The

Staggers Act gave railroads greater flexibility in setting rates, initiating mergers, abandoning branch lines and abandoning stations. With more operating freedom, railroads streamlined operations. Emphasis was put on cost savings associated with large volume point-to-point grain shipments. Thus the rate structure in rail grain transport became and continues to be much more sensitive to market supply and demand conditions. Rail service for grain transportation has improved when judged in terms of railroad operating efficiency. Subsidization of small volume or light density lines has decreased, changing the service offered branch line country elevators lacking multicar loading capabaility. Multicar rates have favored development of subterminal shipping facilities capable of loading 25 to 52 cars in 24 hours.

Rates

Transport rates are really the focal point of transportation deregulation. The most important changes in grain shippment included multicar rates and contract rates. The lower rates offered by the railroad resulted from economies gained through reduced collection and switching costs and greater equipment utilization (i.e., more loaded car miles per year). The "spread" or difference between single and multicar rates allowed a

number of elevators to invest in subterminals with 25 car sidings. These subterminals which depend on high volume to generate revenue share part of the "spread" with producers to bid grain away from other elevators. Facility improvements required to load 5 cars are generally less resulting in a narrower "spread" for 5 car loadings.

An additional change in rail rate offerings is contract rates. Contract rates result from contracts between a railroad and a shipper and are specific for an agreed upon level and volume of service. Rules for contracting rates are specifically legislated in the Staggers Act. Contracting can benefit both the carrier and the shipper, although there is concern that contract rates tend to favor large volume shippers. Larger shippers can guarantee larger volume in return for favorable rates and service.

Transportation Infrastructure

Changes in transportation service and rates have led to changes in the transportation infrastructure serving grain producers and shippers in Eastern Idaho. Favorable rates have encouraged development of subterminals. This is a significant change from the previous country elevator concept. Previously, grain was hauled from the farm to the nearest country elevator. With the advent of subterminals, grain is hauled further in larger trucks

reducing the need for country elevators and branch rail lines while putting additional demands on the rural road system.

The general trend for the grain transportation network since deregulation has been the movement towards large volume lower per unit shipment costs. Country elevators lacking multicar loading capabilities face increasing pressure to truck grain to nearby subterminal elevators. This in turn puts increasing pressure on rural roads and bridges in accommodating increased truck traffic. (Meyer CTRF)

Prices

Elevators capable of loading multicar units have generally offered higher prices for grain than local country elevators. The "spread" comes from the difference between singlecar and multicar freight rates and lower handling costs of large volume elevators. These two factors combine to create a spread of up to 15.8¢ per bushel ($5.26) at Eastern Idaho locations. For example, from American Falls, Idaho (25 miles west of Pocatello) the single car rate as of June 16, 1983 was 46.4¢/bushel ($15.48) to the Portland, Oregon area. The 5 car rate at the same time was 39.2¢/bushel ($13.08) and the 25 car rate was 35.6¢/bushel ($11.88). The resulting spread was 7.2¢/bushel

($2.40) for the 5 car rate and 10.8¢/bushel ($3.60) for the 25 car rate.(Meyer WRDC) How the spread is shared among the elevator operator and producer is a matter of competition. For large volume subterminals with contract rates the transport spread could be even greater. Consequently producers are changing their marketing patterns and hauling grain farther to take advantage of the higher prices offered by multicar loading facilities.

III. CHANGES IN IDAHO'S FARM TRUCK FLEET

This section describes post-deregulation changes which are occurring in Eastern Idaho's farm truck fleet. To show likely adjustments, direct shippers, innovators in grain production and marketing, are contrasted with non-direct shippers, who heavily use the country elevator for storage and as a market.

Comparison of direct shippers with non-direct shippers shows some definite differences. Although the direct shippers' farms average 100 acres smaller in size, they have greater production and more on farm storage. Direct shippers production average 43,705 bushels of grain per producer compared with 38,042 bushels for non-direct shippers (Table 1). That is a difference of 5,663 bushels. Direct shippers also had 39,120 bushels of on-farm storage compared to 37,038 bushels, a

difference of 2,082 bushels. Both direct and non-direct shippers had almost enough on-farm storage for one year's crop.

In recent years with development of improved roads, on-farm grain storage, and subterminal elevators, trucks have slowly replaced railroad transport for shorter hauls. Producers are hauling grain farther to markets offering higher prices as the result of multi-car rates and volume contracts. Producers with on-farm storage are hauling grain farther because they can truck to locations offering higher prices on a given day. Direct shippers by-pass the country elevators by shipping directly from their farms to subterminal elevators or final users.

Data Description

A survey mailed to Idaho grain producers in September1982 provided data for this study. This was supplemented by data from the Idaho Department of Transportation Motor Vehicle Registration Division. A 78 percent response rate was achieved using the Dillman "Total Design Method" (Dillman). Only producers of 5000 or more bushels of grain were included in the analysis. Farm truck registrations were recorded by vehicle weight for 1979 and 1982.

Grain Transport from Farm to Market

Grain production (wheat and barley) in Eastern Idaho for 1982 was 71.3 million bushels. Twenty nine percent

of shipped grain went directly to locations capable of loading 25 car unit trains or to consumers (i.e. such as a cattle feed lots). To describe grain transport, Eastern Idaho producers were asked average transport distances from fields and on-farm storage to market.

One-way average distances grain was transported over private, local/county and state/federal roads are shown in Table 2. Percentages of travel over the three segments are also tabulated along with the number of producers in each category. Data show that as transport distance increased the percentage of the trip on state and federal roads increased. However the average distance on local/county and private roads was almost constant.

Within destination categories, direct shippers transported grain farther. Field to market one way average transport distance for direct shippers was 35.3 miles while for non-direct shippers it was 27.8 miles, a difference of 7.5 miles. From on-farm storage to market the figures for transport distance were 40.2 miles for direct shippers and 26.7 miles for non-direct shippers, a difference of 13.5 miles.

Truck ownership

Evidence suggests direct shipping producers own more trucks than non-direct shippers. For the three truck types, differentiated according to number of axles, the

mean number of trucks and trucks per producer are listed for direct and non-direct shippers (Table 3).

Average numbers of trucks owned showed the direct shippers had .14 less 2 axle trucks than non-direct shippers. Conversely, direct shippers had .22 more 3 axle trucks.

Eastern Idaho non-direct shippers owned more 2 axle trucks which average 333 bushels (10 tons) per load. Direct shippers substituted by owning more, larger capacity trucks. Many 3 axle trucks carry 567 or more bushels (17 tons) per trip. The 5 axle semis carry around 900 bushels (27 tons) per load.

The above implies replacement trucks are generally larger because the direct shippers or innovators have more of the 3 axle trucks. Conversations with individual producers indicate that replacement trucks are often 3 axle. This trend is confirmed by Idaho Department of Transportation farm truck registration data. Farm truck registrations for 2 axle trucks decreased 916 or 7.5 percent from 1979 to 1983 (Table 4). Three axle farm truck registrations increased 815 or 34.8 percent during the same period.

Producer Grain Transport Costs

Eastern Idaho producers are adapting to the post Staggers reality of multi-car rates and increased prices offered to producers. They are adapting to the change by

increasing the quantity of grain shipped directly to consumers or unit train loading sites. As producers make this change they have several alternatives for transporting grain from farm to market. Four moving grain alternatives are compared. The examples are based on practices presently being used.

Two Axle Farm Truck

Case I is shipping grain in 2 axle trucks. The specific assumptions are listed in Appendix Table 1. Variable cost of transport from field to market for the non-direct shipper is 11.7¢ per bushel. (Table 5) The additional variable cost the direct shipper pays for transporting grain the extra 7 miles (14 miles round trip) is 2.9¢ per bushel. Extra total cost for transport is 6.1¢ per bushel. The situation implies it could pay to market directly if the difference between the price offered by country elevators and market destinations chosen by direct shippers exceeds 2.9¢/bushel and definitely pays if the price differential exceeds 6.1¢ per bushel.

Shipping from on-farm storage to market shows a similar relationship. The additional variable cost for direct shippers transporting grain 13 more miles is 5.4¢ per bushel. Additional total cost is 11.3¢ per bushel. Because of greater transport costs for hauling in two axle trucks, many farmers are replacing one 2 axle truck

with a 3 axle truck.

Three Axle Farm Truck

Three axle trucks offer larger payloads with handling similar to 2 axle trucks. For that reason in Case II, a producer replaces one 2 axle with a 3 axle truck. A three axle truck permits increasing payload up to 70 percent. The producer then hauls grain the longer distances in the 3 axle truck. Assuming the same one-way haul distances from field to market of 28 miles for the non-direct and 35 miles for the direct shipper, total per unit transport cost is reduced using the three axle truck. Total cost per bushel for the non-direct shipper reduces to 10.7¢ per bushel and the direct shipper's cost reduces to 13.3¢ per bushel. That is a savings of 13.6¢ and 17.1¢ respectively for non-direct and direct shippers for switching to a 3 axle truck.. Variable cost reductions for field to market hauls in a 3 axle truck compared to a 2 axle truck are 5.9¢ per bushel for the non-direct shippers and 7.3¢ per bushel for direct shippers.

On-farm storage to market hauls showed similar cost reductions using the 3 axle truck. Field to market total transport costs were 10.3¢ per bushel for non-direct shippers and 15.2¢ per bushel for direct shippers. The direct shippers transported the grain 13 miles farther for an additional total cost of 4.9¢ per bushel. Looking

at variable cost, the additional 13 miles cost 2.7¢ per bushel.

Three Axle Farm Truck with Trailer

An additional step producers can take to reduce their per unit cost of delivering grain from farm to market is to tow a grain trailer commonly called a "pup". The Case III example is for a 3 axle truck towing a pup trailer. The specific assumptions are stated in appendix Table 3. Under these assumptions total field to market transport cost per bushel is 8.5¢ for non-direct shippers and 10.6¢ per bushel for direct shippers. Estimated variable transport costs are 4.4¢/bushel for non-direct shippers and 5.4¢ per bushel for direct shippers.

In the case of on-farm storage to market, transport cost reductions are also experienced. On farm storage to market total transport costs per bushel would be 8.2¢ and 12.1¢ respectively for non-direct and direct shippers. Variable transport costs of 4.2¢ and 6.2¢ per bushel, respectively, for non-direct and direct shippers could be expected.

Five Axle Semi Truck

A very common method of moving grain from farm to market is with the five axle semi truck. Appendix Table IV shows the assumptions for a semi-trailer farm truck transporting the producer's grain plus some additional truck use during the year. Field to market total

transport costs are estimated at 6.3¢ per bushel for non-direct shippers and 7.8¢ per bushel for direct shippers. Variable per bushel costs of 3.7¢ for non-direct and 4.7¢ for direct shippers are expected.

On farm storage to market transport costs for non-direct and direct shippers are below other transport alternatives. Total costs are 6.0¢ per bushel for non-direct shippers and 8.9¢ per bushel for direct shippers. Variable costs are respectively 3.6¢ per bushel for non-direct shippers and 5.3¢ per bushel for direct shippers. These are the lowest per bushel costs of the four alternatives considered.

Producers gain economies using larger volume trucks to transport their grain from farm to market. The 3 axle, 3 axle plus trailer and semi truck per bushel transport costs, particularly the variable component are well below the "spreads" in Eastern Idaho. This explains why producers are hauling grain farther and replacing 2 axle trucks with 3 axle trucks, trailers, and semis. They are taking advantage of higher prices offered at unit train loading facilities by hauling the grain farther. By adapting to the new grain shipping situation they may actually reduce their grain transport cost and receive a higher price for their product.

Truck Use

Producers transported the majority of the grain in

trucks which they owned. Producer owned trucks (sellers) transported the grain 40 percent of the time for direct shippers. However in 34 percent of the cases, the buyer owned the trucks transporting the grain while in the remaining 26 percent of the cases, a commercial trucker transported the grain for the direct shipper.

Cost economies are permitting a larger commercial grain transport industry to develop. With producers having a years on farm storage (Table 1) an even flow of grain from farm to market is possible. Further research needs to be done to determine the opportunities and cost savings to producers of additional development of the commercial grain transport sector.

SUMMARY OF CHANGES IN IDAHO

Changes in railroad regulation have provided incentives to restructure the Eastern Idaho grain transportation system. With the offering of multicar rates, a reduction in cost of shipping grain in multicar units from a single origin to a single destination occurred. This provided incentives to construct subterminal elevators which were equipped to load multicar units in 24 hours and could charge lower put-through fees. The freight rates of up to 23 percent per unit lower and the lower put-through cost increased competition for grain in Eastern Idaho. They also

encouraged producers to ship grain directly to subterminals. As producers haul grain farther to take advantage of the higher prices offered by locations capable of loading multicar trains, country elevators are by-passed, decreasing their volume.

Producers have made changes in their grain marketing patterns since passage of the Staggers Act. They are hauling grain farther to locations capable of loading unit trains. They are purchasing more and larger capacity trucks to gain volume efficiency in grain transport. They are also using commercial trucking to move grain greater distances to unit train loading sites.

These changes put additional pressure on the road system as heavier loads are transported greater distances, particularly on state and federal highways. Presently Idaho and the U.S. are restructuring their truck taxing systems. One of the incentives for this restructuring is the need for more revenue for maintenance and construction of highways capable of supporting the larger trucks.

IV. IMPLICATIONS OF THE EASTERN IDAHO EXPERIENCE FOR WESTERN CANADA GRAIN TRANSPORTATION POLICY[3/]

While there are many differences in the institutional setting governing the marketing and transportation of grain in Western Canada from that of Eastern Idaho, there

are also similarities in the problems faced by both regions in the collection and transportation of grain for export. To assert that any inferences drawn from the Idaho experience were completely applicable to the Canadian situation would require a detailed examination of institutional differences. This is clearly beyond the scope of this paper. Nevertheless, the Idaho experience provides some insights of interest with respect to various concerns arising from recent and possible future changes in Western grain transportation policy.

Prior to January 1, 1984, when the Western Grain Transportation Act came into effect, the freight rate paid by prairie grain producers to ship their grain by rail to port had remained virtually unchanged since 1897[4/] This low, fixed (Crow's Nest Pass)freight rate averaged approximately $5.00 per metric ton. Beginning in the 1950's it resulted in an ever increasing rail revenue shortfall for the movement of grain. This, in turn, resulted in deterioration of branchline service and, more recently, a threat to mainline capacity investment. Branchline abandonment was either precluded or highly constrained by federal government regulation. During the 1970's the federal government introduced a series of subsidies and infrastructure investment programs to address the problems arising from the railways' grain revenue shortfall. By the early 1980's

it became increasingly obvious that this ad hoc approach was inadequate.

Under the Crow regime, system rationalization proceeded very slowly.[5/] Branchline abandonment was minimal and, although financial pressures of the past decade have led to a significant reduction in elevator numbers, the prairie grain collection system remains a widespread system of small country elevators located along thousands of miles of branchlines. With few exceptions, prairie grain producers deliver their grain to these elevators with their own two axle trucks. Average farm to country elevator hauling distance was 14 miles in 1981-82 [6/].

Under the recently enacted Western Grain Transportation Act, the total cost of moving Western grain by rail is shared between the federal government and prairie grain producers. The government's share involves an essentially fixed annual contribution equal to the 1981/82 rail revenue shortfall. This approximately $658 million "Crow benefit" payment is made direclty to the railways. Subject to prescribed maximums, producers are responsible for inflationary and volume related cost increases. Because the government's contribution goes directly to the railways the increases in freight rates faced by producers will be quite gradual. They increased by $.80 per metric ton on

January 1, 1984 and are projected to rise to $8.48 per metric ton by 1985/86 and reach $25.77 a ton by 1991/92. This represents approximately 28 percent of the estimated total costs of moving grain by 1985/86 and 56 percent by 1991/92.7/

The gradual increase in freight rates provides little scope for "incentive" or "variable" rates (e.g., multicar rates) in the near term. In addition, the statutory rules for rate setting restrict their use to weekend loadings and off-peak movements until, at least, 1986-87. It appears that the decision to pay the Crow benefit to the railways (rather than producers) and the restrictions placed on the use of variable rates means that neither the scope nor the mechanism exists for using market forces to encouraging significant cost saving system rationalization at the present time.

Looking to the future, two further features of the Act hold some prospect for a change in these arrangements. The legislation calls for the establishment of a Commission of Inquiry to give further study to the method of payment issue during the period April 1984 to March 1985. A review in 1985/86 of all aspects of the new legislation is also called for. The possibility therefore exists for a revision in the rules governing rate setting that would encourage cost saving system rationalization.

The method of payment and variable rates issues are highly controversial. Many believe that paying the Crow benefit to producers (accompanied by higher gross freight rates) and/or allowing for greater freedom in variable rate setting would result in system changes that would not be in the best interests of prairie grain producers. Concerns include: how cost savings might be shared among the railways, elevator companies and producers, and the impacts of longer farm to elevator hauling distances and associated costs.

Formal estimates of the speed and magnitude of system rationalization under alternative future policy scenarios have not been made. Given the high degree of regulation governing the prairie grain handling and transportation system, it seems reasonable to assume that even if both payment to producers and less restrictive variable rates were adopted it would be a long time, before the prairie grain collection system would begin to resemble the system currently in place in Eastern Idaho. Assuming it did, the East Idaho experience provides some useful insights with respect to the concerns raised above.

The Idaho experience since deregulation indicates the cost savings associated with multi-car movements from sub-terminals are substantial. It further indicated that in a competitive environment a significant share of the cost savings from system rationalization are passed back

to producers thereby encouragaing them to haul longer distances in order to capture a higher price for their grain. They are doing so willingly.

The Idaho experience also shows that producers are able to benefit from the higher prices offered by the sub-terminals by utilizing larger trucks for farm to elevator hauling. By shifting to larger trucks with higher annual utilization rates, the per unit cost of hauling significantly longer distances is not as onerous as many believe. It may actually be less per unit hauled. The larger producers own their own large trucks while the smaller producers have access to the same opportunities by employing the services of a neighbor or commercial grain hauler.

The preceding implications of system rationalization drawn from the Idaho experience are necessarily very general. Given the paucity of analysis regarding the impacts of rationalization on the farm to elevator hauling component of the prairie grain handling and transportation system, a more detailed comparative analysis of the two regions would be useful in order to ascertain what additional insights the Idaho experience might provide for Western grain handling and transportation policy purposes.

Footnotes

1/ Associate Professor Agricultural Economics at the University of Idaho, Moscow, Idaho

2/ Eastern Idaho is defined as Bannock, Bear Lake, Bingham, Bonneville, Butte, Caribou, Clark, Custer, Franklin, Fremont, Jefferson, Lemhi, Madison, Oneida, Power and Teton Counties.

3/ In writing this section I consulted with James Atcheson and James Lowe of Agriculture Canada. Comments are the responsibility of the author.

4/ From the Western Grain Transportations Act, C-155 As passed by House of Commons Ottawa Canada, November 14, 1983.

5/ For a detailed history of the evolution of the Western Grain handling and transportation system to 1973 see, Canada Grains Council, Grain Handling and Transportation: State of the Industry Report, 1973 and, A Discussion Paper On Current Issues in Grain Handling and Transportation Alberta Economic Development and Alberta Agriculture, Edmonton Alberta, 1980.

6/ Estimate obtained received from Freight Studies Directorate Research Branch, Canadian Transport Commission, Ottawa.

7/ Estimates prepared by Transportation Unit, Food Markets Analysis Division, Marketing and Economics Branch, Agriculture Canada, Ottawa.

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Table 1. Characteristics of Average Eastern Idaho Direct and Non Direct Shippers

	Direct	# of Respondents	Non Direct	# of Respondents
Farmsize (Acres)	1,413	(98)	1,513	(163)
Production (Bu)	43,705	(98)	38,042	(166)
Storage (Bu)	39,120	(87)	37,038	(146)

Table 2. Mean Mileages Grain[a] was Transported One-way by Idaho Producers in 1981 Shipping Direct or Non-direct over Private Roads, County/Local Roads, and State/Federal Highways.

	Eastern Idaho				
	Private Road	County/ Local Road	State/ Federal Highway	Total Distance	Number of Respondents
Field to Market					
Non-direct					
Mean miles[b]	0.7	6.4	20.7	27.8	127
% of total[c]	3	23	74		(78%)[d]
Direct					
Mean miles[b]	0.8	5.6	28.8	35.3	77
% of total[c]	2	16	82		(78%)[e]
Producer Owned Storage to Market					
Non-direct					
Mean miles[b]	0.2	6.8	19.7	26.7	114
% of total[c]	1	26	74		(70%)[d]
Direct					
Mean miles[b]	0.2	5.8	34.3	40.2	69
% of total[c]	0	14	85		(68%)[e]

[a] Production of white wheat, red wheat, malting barley, or feed barley.
[b] Sum of separate road distances may not equal total distance because of rounding error.
[c] May not total to 100% because of rounding error.
[d] Percentage of grain producers shipping non-direct who responded to the given category.
[e] Percentage of grain producers shipping direct who responded to the given category.

Table 3. Total Trucks and Trucks per Respondent for Eastern Idaho Grain[a] Producers Shipping Direct and Non-Direct, 1982.

	Non-Direct Shippers		Direct Shippers		
	Total Number of Trucks	Trucks per Owner	Total Number of Trucks	Trucks per Owner	Chi-square Statistic
Truck type[b]					
2 axle	338	2.07	195	1.93	
3 axle	145	0.89	112	1.11	
Semi[c]	26	0.16	9	0.09	
Totals	509	3.12	316	3.13	6.04[c]
Number of respondents	163		101		

[a]Producers of white wheat or red wheat or malting barley or feed barley.

[b]Idaho law specifies the maximum gross loads for farm trucks hauling unprocessed agricultural commodities: 2 axle, 26,000 lbs.; 3 axle, 50,000 lbs.; semi, 50,000 to 80,000 lbs. (Idaho Department of Transportation).

[c]Significant chi-square at a = 0.05 and df = 2 strongly suggests dependence between truck type and shipping method.

Table 4 Idaho Farm Truck Registrations: 1979 and 1983

Gross Vehicle Weight Class Pounds	1980	1983	Change	Percent Change
18,000-26,000 (2 axle)	12,751	11,790	-961	-7.5
40,000-50,000 (3 axle)	2,342	3,157	+815	+34.8

Source: Doug Benzon Department of Motor Vehicle Registrations, Idaho Department of Transportation Boise, Idaho.

Table 5. Cost Comparison: Four Alternatives for Eastern Idaho Producers Transporting Grain from Farm to Market

	Case I (2 Axle)		Case II (3 Axle)		Case III (3 axle + trailer)		Case IV 5 axle semi)	
	ND*	D**	ND*	D**	ND*	D**	ND*	D**
Field to Market								
Miles shipped	28	35	28	35	28	35	28	35
Total cost								
cents/bushel	24.3	30.4	10.7	13.3	8.5	10.6	6.3	7.8
dollars/ton	8.09	10.13	3.57	4.43	2.83	3.53	2.10	2.60
Variable cost								
cents/bushel	11.7	14.6	5.8	7.3	4.4	5.4	3.7	4.7
dollars/ton	3.90	4.87	1.93	2.43	1.47	1.80	1.23	1.57
On Farm Storage to Market								
Miles shipped	27	40	27	40	27	40	27	40
Total cost								
cents/bushel	23.4	34.7	10.3	15.2	8.2	12.1	6.0	8.9
dollars/ton	7.80	11.57	3.43	5.07	2.73	4.03	2.00	2.97
Variable cost								
cents/bushel	11.3	16.7	5.6	8.3	4.2	6.2	3.6	5.3
dollars/ton	3.76	5.57	1.87	2.77	1.40	2.07	1.20	1.77

* ND is the non direct shipper selling at the country elevator.

** D is the producer shipping grain direct to user or subterminal elevator

Note appendices tables 1, 2, 3, and 4 for detailed assumptions.

Appendix Table 1. Case 1. Grain Shipping Costs Two Axle Eastern Idaho Farm Truck (10 Tons or 333 Bushels of Wheat Per Load)

	Non Direct Shipper	Direct Shipper
Field to Market		
Distance shipped (miles)	28	35
Total Transport Cost		
(¢/bu)	24.3	30.4
($/ton)	8.09	10.13
Variable Transport Cost		
(¢/bu)	11.7	14.6
($/ton)	3.90	4.87
On farm storage to market		
Distance shipped (miles)	27	40
Total Transport Cost		
(¢/bu)	23.4	34.7
($/ton)	7.80	11.57
Variable transport cost		
(¢/bu)	11.3	16.7
($/ton)	3.76	5.57
Assumptions		
Truck capacity (bu)	333	
Truck service life (yrs)	20	
Interest rate	12%	
Purchase price	$22,000	
Salvage value (20% purchase price)	$4,400	
Annual taxes and fees	$311	
Annual insurance costs	$225	
Number of tires	6	
Average tire life	50,000	
Cost per tire	$140	
Annual maintenance cost (4% purchase price)	$880	
Drivers hourly salary	$5.00	
Average speed (includes loading and unloading)	20 mph	
Fuel consumption	6 mpg	
Fuel cost per gallon	$1.25	
Bushels grain hauled per	13,000	15,000
Miles driven per year	4,000	

Appendix Table 2. Case II. Grain Shipping Costs Three Axle Eastern Idaho Farm Truck (17 Tons or 567 Bushels of Wheat Per Load

	Non Direct Shipper	Direct Shipper
Field to Market		
Distance shipped	28	35
Total Transport Cost		
(¢/bu)	10.7	13.3
($/ton)	3.57	4.43
Variable Transport Cost		
(¢/bu)	5.8	7.3
($/ton)	1.93	2.43
On farm storage to market		
Distance shipped	27	40
Total Transport Cost		
(¢/bu)	10.3	15.2
($/ton)	3.43	5.07
Variable transport cost		
(¢/bu)	5.6	8.3
($/ton)	1.87	2.77
Assumptions		
Truck capacity (bu)	567	
Truck service life (yrs)	12	
Interest rate	12%	
Purchase price	$28,000	
Salvage value (20% purchase price)	$5,600	
Annual taxes and fees	$311	
Annual insurance costs	$225	
Number of tires	10	
Average tire life	70,000	
Cost per tire (recaps)	$105	
Annual maintenance cost (4% purchases price)	$1120	
Drivers hourly salary	$5.00	
Average speed (includes loading and unloading)	25 mph	
Fuel consumption	5 mpg	
Fuel cost per gallon	$1.25	
Bushels grain hauled per	38,000	44,000
Miles driven per year	9,000	

Appendix Table 3. Case III. Grain Shipping Costs Three Axle Eastern Idaho Farm Truck Plus Pup Trailer (27 Tons or 900 Bushels of Wheat Per Load)

	Non Direct Shipper	Direct Shipper
Field to Market		
Distance shipped	28	35
Total Transport Cost		
(¢/bu)	8.5	10.6
($/ton)	2.83	3.53
Variable Transport Cost		
(¢/bu)	4.4	5.4
($/ton)	1.47	1.80
On farm storage to market		
Distance shipped	27	40
Total Transport Cost		
(¢/bu)	8.2	12.1
($/ton)	2.73	4.03
Variable transport cost		
(¢/bu)	4.2	6.2
($/ton)	1.40	2.07

Assumptions

Truck capacity (bu)	900
Truck service life (yrs)	10
Interest rate	12%
Purchase price	$48,000
Salvage value (20% purchase price)	$9,600
Annual taxes and fees	$326
Annual insurance costs	$325
Number of tires	18
Average tire life	70,000
Cost per tire (recaps)	$105
Annual maintenance cost (4% purchases price)	$1920
Drivers hourly salary	$5.00
Average speed (includes loading and unloading)	25 mph
Fuel consumption	4.0 mpg
Fuel cost per gallon	$1.25
Bushels grain hauled per	38,000 / 44,000
Miles driven per year	12,000

Appendix Table 4. Case IV. Grain Shipping Costs Five Axle Semi Eastern Idaho Farm Truck (27 Tons or 900 Bushels of Wheat Per Load)

	Non Direct Shipper	Direct Shipper
Field to Market		
Distance shipped	28	35
Total Transport Cost		
(¢/bu)	6.3	7.8
($/ton)	2.10	2.60
Variable Transport Cost		
(¢/bu)	3.7	4.7
($/ton)	1.23	1.57
On farm storage to market		
Distance shipped	27	40
Total Transport Cost		
(¢/bu)	6.0	8.9
($/ton)	2.00	2.97
Variable transport cost		
(¢/bu)	3.6	5.3
(¢/cwt)	1.20	1.77
Assumptions		
Truck capacity (bu)	900	
Truck service life (yrs)	10	
Interest rate	12%	
Purchase price	$70,000	
Salvage value (20% purchase price)	$14,000	
Annual taxes and fees	$940	
Annual insurance costs	$625	
Number of tires	18	
Average tire life	70,000	
Cost per tire (recaps)	$105	
Annual maintenance cost (4% purchases price)	$2,800	
Drivers hourly salary	$5.00	
Average speed (includes loading and unloading)	30 mph	
Fuel consumption	4 mpg	
Fuel cost per gallon	$1.25	
Bushels grain hauled per	38,000	44,000
Miles driven per year	30,000	

The Implications on Pacific Northwest Wheat Movements of Waterway User Fees: An Evaluation of Direct and Opportunity Cost Recovery

Phil Wandschneider and Ken Casavant*

Introduction

Pacific Northwest wheat constitutes a sizeable proportion of national wheat output and wheat exports. The contribution to exports is disproportionate (70-90 percent is exported). The competitive status of Pacific Northwest wheat is therefore significant not only for the regional economy, but for national trade balances and international market conditions.

The competitive position of Pacific Northwest wheat is heavily affected by the transportation costs associated with the rail and truck-barge system which serves it. Three policy issues have recently emerged which will, or already have, affected the transportation system and hence the competitive position of wheat. The first policy, deregulation of the rails, has already been realized in the form of the Staggers Act. The resulting

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switch from single car to multiple car rates has significantly lowered rail costs in some areas and brought changes in rail versus truck-barge traffic share (Casavant and Mehringer).

The second policy issue is waterway user fees. The national political climate clearly indicates that such user charges will be a fact of life in the 80s. However, questions remain as to the type of user fees to be imposed and the level of cost recovery to be attained. A related question concerns the relative cost shares to be paid by agriculture versus commerce. Both the competitive position of Pacific Northwest wheat and the market share of the truck-barge versus the rail transport mode are therefore in question.

The third policy issue is local to the Pacific Northwest, but again bears on the question of truck-barge versus rail modal share and the competitive position of wheat. The barge traffic on the Columbia River represents only one of the river's important uses. Alternative water uses include hydropower (3/4 of the region's electricity), irrigation (about 6 million acres) and fish production (salmon and steelhead trout). In this paper we are concerned with hydropower. As the price of electricity has risen the importance of the Columbia River's cheap hydropower has intensified. Conditions are now such that water used in lockage represents considerable lost hydropower which must be replaced from expensive generation sources (chiefly coal

and nuclear plants). This raises the question of whether fees should be charged to navigation to compensate for the lost hydropower.[1] The issue of lost water, therefore, ties immediately into the issue of the recovery of other, more direct, costs of operating and maintaining the waterway.

In this study we propose to examine the second two issues, those involving potential user fees. We will first examine the type and level of user fees needed to recover direct operations and maintenance costs only. Specifically we identify the impact of user fees on truck-barge rates, then we employ a transportation model to determine the impact of these charged rates on wheat distribution patterns and shipper's transportation bill. We will next examine the magnitude of indirect (opportunity) costs due to energy production foregone, and discuss the potential impacts rates incorporating these costs would have on wheat distribution patterns and shipper's transportation bill.

Waterway User Charges and Subsidies

Before discussing the impacts of potential waterway user fees, it would be useful to briefly review the economic rationale for fees or subsidies for waterway users. Waterways (and other transportation modes) have

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[1] An alternate approach would be administrative curtailment of lockages, especially for recreation.

traditionally been subsidized based on their decreasing cost characteristics (and also on the external or indirect effects in promoting development). Standard consumer surplus analysis shows that a subsidy can often lead to a net welfare gain in such cases (see Figure 1, where the consumer surplus gained, P_1ACP_2, is greater than the subsidy cost P_2Sbc). In the waterway case the subsidy has generally been the free provision of the waterway; the transportation costs therefore include only the private costs of the barge operators.

This standard argument can be extended to include the cost of electricity foregone as a factor which would shift the original supply curve from S to S''. The case can still be made for a subsidy, i.e., a shift from S'' to S'. According to this analysis a given subsidy may be greater or less than the consumer surplus it creates. One must calculate the exact quantities to determine the economic case for or against a subsidy.

Another approach to the increasing returns case can give some a priori guidance, however. The analysis focuses on the derived demand for the waterway itself (versus the transportation service) and the cost structure of the waterway (Figure 2). The assumption is of a large fixed cost (construction of dams and lockage facilities creating slackwater) and a small but constant marginal cost (operating costs of lockage facilities, dredging, etc.). On the basis of this analysis the

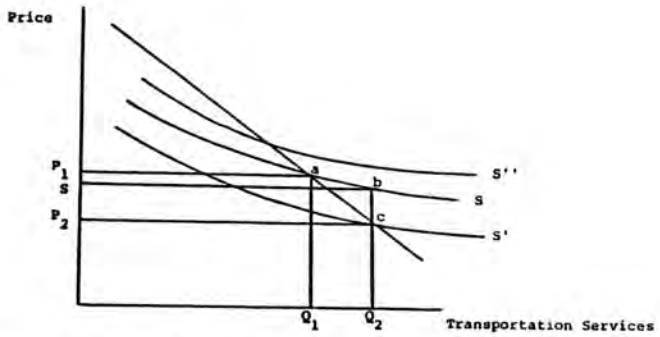


Figure 1: Consumer surplus analysis of decreasing cost industry.

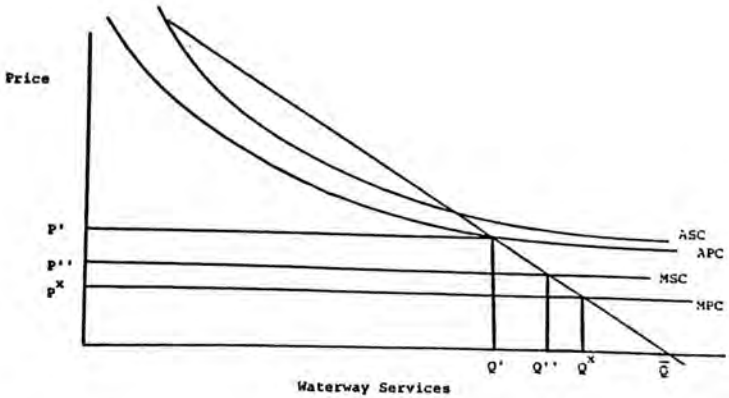


Figure 2: Efficiency analysis of decreasing cost industry.

(Pareto) efficient quantity of waterway services is Q^* at p^*. But production at such quantity and price only covers marginal costs.

If the price is set to recover the full cost of the waterway, only Q' at p' will be produced. The criterion of efficient production suggests that a subsidy take the form of no charge for fixed costs and full recovery of marginal (operating) costs.

While this argument appears to clearly indicate the economically efficient policy, there are two complications that must be introduced. First is the fact that costs so far have only included private costs, cost internal to the operation of the waterway system. The social cost of lost hydropower has not been included. Including the cost of foregone hydropower moves the marginal cost curve upward to MSC and suggests the production of Q'' at p'', with full recovery of the private and social operating costs.

The second complication of this analysis is that waterways are not ordinary goods, not even ordinary decreasing cost goods. Rather they have some characteristics of non-rival or public goods. One tug-barge flotilla's use of the waterway does not reduce the amount of waterway available to another--up to the point of congestion. According to this logic, once built, a waterway should have zero user fees, with derived demand at $\bar{Q}$. User fees in this case should be charged for only two purposes: (1) the actual cost of lockage, which is

mostly the social cost of hydropower foregone, and (2) fees charged to ration use in the event of congestion. Note that this argument suggests that private costs be ignored (except those specific to a given lockage) but social costs be included.

We offer the above analysis to indicate the complicated factors involved in arguing the relative merits of different levels of waterway fees. However, it is not our intention to endorse any particular level. Instead, the purpose of this article is to analyze the impacts which would follow from adoption of various levels of user fees.

Impact of Direct Cost User Fees

The policy variables of user fees structure and level of cost recovery were investigated based on the direct costs of operation and maintenance of the Columbia-Snake Waterway. The study analyzed four user fee types: a fuel tax imposed on a uniform basis throughout the nation, a fuel tax imposed on a river segment specific basis, lockage fees, and ton-mile fees. Alternative levels of recovery of operation and maintenance fees analyzed were 100, 75, 50 and 25 percent.

Research Method and Data

A standard transportation model was used to minimize the cost of shipping wheat in the PNW for export. In the model, wheat was shipped from 66 supply regions in the

PNW (Washington, Oregon, Montana, and Idaho) to the Portland area ports, the demand region, by the least cost transportation mode. Portland was used as the single demand region because, since 1981, 95% of wheat exported out of the PNW went through these ports. The alternative modes incorporated into the model included rail, truck-barge and truck.

The mathematical model included variables representing wheat production from each supply and the transportation rates from each supply area to Portland. The model minimized:

$$WTC = \sum_{i=1}^{66} \sum_{k=1}^{4} S_i \, T_{ik}$$

where WTC = wheat transportation cost
i = origin area
k = transportation mode
S_i = tons of wheat transported for origin area i
T_{ik} = transportation rate from origin area i to Portland by mode k

$$\text{subject to: } D = \sum_{i=1}^{66} S_i$$

where D = demand at Portland

Supply Areas

The supply areas and origin points within each supply represent the major wheat production areas in each state. The origin points within supply areas are

centrally located shipping points with terminal facilities or country elevators with rail and highway access (for more detail see Casavant and Mehringer).

Wheat Production

The quantity of wheat transported from each origin point to Portland is the total wheat production from the corresponding supply area in 1980. This assumes that all wheat transported from the supply region is exported, based on the fact that PNW wheat exports from these regions have been approximately equal to wheat production in recent years (Casavant and Mehringer).

Demand Regions

Pacific Northwest wheat is exported from Columbia River ports. The ports are located at Portland, Oregon, and Kalama, Longview and Vancouver, Washington but, since rates are the same to all areas, only one destination was used.

Transportation Rates

Transportation rates include various handling charges and wheat inspection fees that are added to the modal charges. The wheat inspection fee varies by mode. The barge rate changes as user fees are imposed. All rates remain constant regardless of volume because the supply of transportation is assumed to be perfectly elastic in a given supply period.

Truck-Barge Rates

The total water transportation rate is the sum of the truck rate for shipping wheat from the origin point to the river terminal, a $3.33 per ton "put-through" charge at the river terminal, the actual barge rate to Portland and a 1.5 cent per ton wheat inspection fee.

Rail Rates

A 17 cent per ton grain inspection fee is added to published rail rates to yield total rail costs.

Truck Rates

The truck rate is the tariff charge to move wheat from an origin point to Portland. A Portland terminal put-through charge of $2 per ton and a 50 cent per ton wheat inspection fee was included in the truck rate.

User Fee Development

User fees were added to the truck-barge rate at rates to recover desired levels of Federal operation and maintenance expenditures. All increases in costs due to user fees were assumed to be passed on to shippers in the form of increased rates. The total operation and maintenance costs allocated to navigation were $6.7 million in 1984, of which approximately $4.8 million was used for grain traffic (Casavant and Mehringer).

Fuel Fees

Estimation of the correct amount of fuel tax to generate desired cost recovery levels depends on the amount of fuel consumed. Results of previous research on energy intensities vary widely depending on the variables and assumptions used to estimate them. An energy intensity estimate based on conditions similar to the Columbia-Snake Waterway was 270 BTU's per ton-mile and this was the estimate used in this study.

Uniform Fuel Tax

Uniform fuel taxes were developed in the following manner:

$$\text{Uniform fuel tax per gallon of fuel used} = \frac{\text{Annual total Federal navigation O \& M expenditures}}{\text{Annual total gallons of fuel consumed by navigation}}$$

where:

$$\text{Annual total gallons of fuel consumed of navigation} = \frac{\text{Annual collection of the waterways Trust Fund}}{\text{Annual fuel tax per gallon according to the tax table in PL95-502}}$$

Segment Specific Fuel Tax

Under a segment fuel tax the commercial traffic on a particular river segment would bear the operations and maintenance costs allocated to navigation for that river segment. The specific tax was calculated in the following manner:

$$\text{Segment fuel tax per gallon} = \frac{\text{Grain share of annual Columbia-Snake Waterway federal navigation O \& M expenditures}}{\text{gallons of fuel consumed}}$$

where:

$$\text{gallons of fuel consumed} = \text{gallons of fuel to move 1 ton to Portland from each pool} \times \text{annual total tons from each pool}$$

where:

$$\text{gallons of fuel to move 1 ton to Portland from each pool} = \frac{\text{River miles to Portland from each pool}}{500 \text{ miles}}$$

Lockage Fee

The Columbia-Snake Waterway has eight locks where a fee would be collected. A typical grain flotilla configuration on the Columbia-Snake Waterway consists of 242 foot barges (3,000 ton capacity each), two 282 foot barges (3,500 ton capacity each) and a 110 foot tow boat. The calculations to allocate lockage costs per ton were as follows:

$$\text{Lockage fee from each pool} = \text{Average Lockage cost per ton} \times \text{Annual total tons from each pool} \times \text{Number of locks passed through to Portland}$$

where:

$$\text{Average lockage cost per ton} = \frac{\text{Average lockage cost per lock}}{\text{average size flotilla}}$$

where:

$$\text{Average lockage cost per lock} = \frac{\text{Annual grain O \& M per lock}}{\text{Sum of the annual tons through each lock}}$$

where:

$$\text{Annual grain O \& M per lock} = \frac{\text{Annual grain O \& M for each lock and dam}}{\text{Number of lockages through a dam}}$$

where:

$$\text{Number of lockages through a dam} = \frac{\text{Annual tons through each lock}}{\text{average tons in each lockage}}$$

Ton-mile Tax

A ton-mile tax imposes a tax on a ton of grain for each mile moved on the river. The calculations used the following procedure:

$$\text{Ton-mile fee from each pool} = \text{Dollars per ton-mile} \times \text{River miles to Portland from each pool}$$

where:

$$\text{Dollars per ton-mile} = \frac{\text{Annual Gain O \& M}}{\text{Total River ton-miles}}$$

where:

$$\text{Total river ton-miles} = \frac{\text{Sum of the ton-miles}}{\text{from each pool}}$$

where:

$$\text{Ton-mile from each pool} = \text{annual tons of grain at each pool} \times \text{River miles to Portland from each pool}$$

Specification of Model Alternatives

Each model in this study reflects the application of the different user fee types and different cost recovery levels. The base model reflects the PNW wheat transportation system before application of user fees.

User fees were added to the base model to form alternative models. The dollar per ton impact of the alternative user fees are indicated in Table 1 for 100 percent cost recovery. Different levels of cost recovery would be of the indicated percentage of the specified amounts.

Results

Modal Share

Market shares prior to imposition of user fees were rail--68.1%, truck-barge--16.3% and truck--15.5%. Imposition of waterway user fees caused only 1 percent (6 percent of truck-barge share) of the total movement to shift from truck-barge to rail in all but one model (Table 2). The uniform fuel tax at the 25 percent cost recovery level caused no shifts at all.

Transportation Bill

The transportation bill (the cost of transportation to PNW wheat shippers) is the sum of the quantity of wheat transported by a transportation mode multiplied by the rate of that mode. Prior to the imposition of user

Table 1. Level of User Fee Costs per Ton, by Pool, Columbia and Snake Waterway.

	River Pool	Alternative User Fees			
		Uniform Fuel	Segment Fuel	Lockage	Ton-mile
		---------Dollars per Ton----------			
Fuel Tax Per Ton From Each Pool to Portland	Bonneville The Dalles	0.117	0.238	0.217	0.308
	John Day McNary	0.231	0.565	0.507	0.605
	Ice Harbor	0.285	0.702	0.730	0.745
	Lower Monumental	0.315	0.773	0.876	0.821
	Little Goose	0.354	0.876	1.022	0.924
	Lower Granite	0.388	0.954	1.168	1.138

Table 2. Pacific Northwest Transportation Market Shares.

Fee Type	Cost Recovery Level	Percent of Market Share		
		Rail	Truck-Barge	Truck
	%	%	%	%
Base Model	0	68.1	16.3	15.5
Uniform Fuel	100	69.1	15.3	15.5
	75	69.1	15.3	15.5
	50	69.1	15.3	15.5
	25	68.1	15.3	15.5
Segment Fuel	100	69.1	15.3	15.5
	75	69.1	15.3	15.5
	50	69.1	15.3	15.5
	25	69.1	15.3	15.5
Lockage	100	69.1	15.3	15.5
	75	69.1	15.3	15.5
	50	69.1	15.3	15.5
	25	69.1	15.3	15.5
Ton-Mile	100	69.1	15.3	15.5
	75	69.1	15.3	15.5
	50	69.1	15.3	15.5
	25	69.1	15.3	15.5

fees, PNW shippers paid $216 million (Table 3). The uniform fuel tax increased shippers annual transportation bill $524 thousand, $395 thousand, $268 thousand, and $137 thousand at the 100, 75, 50 and 25 percent levels of cost recovery, respectively.

Of the segment specific fees the ton-mile fee resulted in the largest increase in costs, followed by the fuel tax and the lockage fee. The latter two fees had equal percentage increases in the transportation charge to the shipper, ranging from $320 thousand at the 25 percent cost recovery level to $1.2 million at the 100 percent cost recovery.

Overall User Fee Ranking

The different user fees had various levels of impacts on the PNW. A region would understandably desire the user fee which would minimize its additional transportation cost. In Table 4, user fees were ranked in order of desirability based on minimized transportation costs.

Regionally, the 25 percent cost recovery level, uniform fuel tax, was the most desirable user fee. The 25 percent cost recovery level of the three segment specific type fees were all more desirable than the uniform fuel tax at the 75 or 100 percent recovery level. The PNW as a whole was better off with a uniform fuel tax at 100 percent than lockage, segment fuel or ton-mile at

Table 3. Pacific Northwest Transportation Costs.

Fee Type	Total Cost (Dollars)	Change From Base Model (Dollars)	Change From Base Model (Percentage)
Base Model Two			
0	216,844,832	0	0
Uniform Fuel			
100	217,369,232	524,400	0.24
75	217,240,672	395,840	0.18
50	217,112,976	268,144	0.12
25	216,982,096	137,264	0.06
Segment Fuel			
100	218,104,176	1,259,344	0.58
75	217,799,120	954,288	0.44
50	217,484,224	639,392	0.29
25	217,170,080	325,248	0.15
Lockage			
100	218,102,352	1,257,520	0.58
75	217,796,032	951,200	0.44
50	217,477,968	633,136	0.29
25	217,166,352	321,520	0.15
Ton-Mile			
100	218,200,304	1,355,472	0.63
75	217,864,352	1,019,520	0.47
50	217,528,400	683,568	0.32
25	217,191,104	346,272	0.16

Table 4. Ranking of Least Cost User Fees by Fee Type and Cost Recovery Level for the PNW.

Rank	PNW	
Most Desirable	Uniform Fuel	25
	Uniform Fuel	50
	Lockage	25
	Segment Fuel	25
	Ton-Mile	25
	Uniform Fuel	75
	Uniform Fuel	100
	Lockage	50
	Segment Fuel	50
	Ton-Mile	50
	Lockage	75
	Segment Fuel	75
	Ton-Mile	75
	Lockage	100
Least Desirable	Segment Fuel	100
	Ton-Mile	100

50%. Of the three segment specific user fees, lockage fees were consistently most desirable, followed by segment fuel taxes and finally by ton-mile fees.

Direct Cost: Summary and Evaluation

The impact on shippers and modes from the imposition of user fees based on direct costs only was not large. The imposition of user fees caused only slight decreases in truck-barge market shares and slight increases in transportation charges. None of the user fees caused more than a 3 percent decrease of total truck-barge traffic.

The uniform tax is generally preferred over the segment taxes and always preferred when both types of taxes are imposed at equal cost recovery levels. This is because the Columbia-Snake Waterway is a relatively high cost segment. There is a trade-off between the combinations of user fee types and cost recovery levels. Some 75, 50, and 25 percent cost recovery level segment-specific user fees caused less impact than 100 and 75 percent cost recovery uniform fuel taxes. From a political viewpoint, shippers should be aware of the trade off between cost recovery levels and fee type.

The largest impact from user fees on shippers was in those areas where there were no modal market share shifts away from truck-barge. Shippers in these areas absorbed all the user fees under the assumptions of this study. The increase in transportation charges associated with

user fee imposition is modified by shippers having the ability to switch to lower cost alternative transportation modes. Thus, shippers' costs go up but not in the full magnitude of the user fee increase.

This initial attempt to evaluate the impact of user fees based on the direct costs of operating and maintenance is straightforward but naive. The transportation model of the PNW in this study allocated traffic in a least cost manner, based on existing rates and assuming capacity and service to be similar among modes. A more complete model should contain more determining variables such as temporal constraints on modal and equipment capacity. This type of transportation model also excluded unobservable variables such as quality and time of service of alternative modes. Rates were used for this study rather than transportation costs. The rates were for one point in time and only reflect the structure of the transportation system at that time. Factors such as the volume of wheat moving at any given time or backhaul availability that influence the competitive structure of rates make this essentially a short-run study. The model could be taken a step further in that effects of user fees are an iterative (general equilibrium) process. As traffic leaves the river as a result of user fees, the federal expenditures on the waterway remain about the same. The smaller amount of traffic left on the waterway must pay higher user fees, causing even more traffic diversions from the waterway.

Impact of Lost Energy Cost Recovery

Costs of Energy Foregone

In the operation of locks a certain volume of water is diverted from the generating turbines. The amount of energy foregone in a given lockage depends principally on two factors, the volume of water required for the lockage and the electricity which would have been produced had that volume of water passed through the turbines. The amount of electricity per unit of water is basically a function of the head at the dam. Table 5 shows lock volume and head data for the eight locks on the Columbia River waterway.

Multiplication of water volume times the appropriate energy conversion factor based on the head yields the energy cost in each lockage (Millham and Culver, 1979). Table 6 shows the losses for each facility.

The economic value of the energy is then easily found by multiplying the energy lost cost of the energy (Table 6). Multiplying this cost by the number of lockages and summing over the eight facilities then gives the total losses (Table 6).

A critical feature of this calculation is obviously the price attached to energy. The price used here is the cost of replacing the energy from some other source. Major current alternative sources are coal and nuclear plants with costs ranging from 30-60 mills per kilowatt (Berney, et al.). We show figures for 30, 40 and 50

Table 5. Lock Volume and Head Data.

Hydroplant	Head (ft)	Volume of Lock (cf)
Bonneville	62	2,356,000
The Dalles	88	5,108,400
John Day	105	6,095,250
McNary	75	4,353,750
Ice Harbor	100	5,805,000
L. Monumental	100	5,805,000
L. Goose	98	5,688,900
L. Granite	100	5,805,000

Table 6. Annual Energy Loss and Replacement Cost.

		Replacement Cost of Loss per Lockage			Annual Lockages Commercial Pleasure*				Commercial Lockage Replacement (thousands of $)					
									at 30 mills		at 40 mills		at 50 mills	
	Energy per Lockage kwh	at 30 mills/kwh	at 40 mills/kwh	at 50 mills/kwh	'81	'82	'81	'82	'81	'82	'81	'82	'81	'82
Bonneville	2,913	87	117	146	6289	4633	211	133	547	403	735	542	918	676
The Dalles	8,966	269	359	448	2215	1719	148	219	596	462	795	617	992	770
John Day	12,765	383	511	638	2067	1642	152	210	792	629	1058	839	1319	1048
McNary	6,513	195	261	326	2087	1688	260	370	407	329	545	441	680	550
Ice Harbor	11,578	347	463	579	2383	1885	540	900	827	654	1103	872	1380	1091
Lower Monumental	11,578	347	463	579	1253	1023	199	280	435	355	580	474	725	592
Little Goose	11,120	334	445	556	1224	1008	196	299	409	337	545	449	681	560
Lower Granite	11,578	347	463	579	1009	898	437	492	350	312	467	416	584	520
Total									4363	3481	5826	4650	7279	5807

Source: Based on Millham and Culver, modified and updated by authors.

*Lockages for pleasure craft are given for comparison purposes. Costs are not calculated.

mills. Notice the energy is not valued at the cost of producing hydropower (1-4 mills), because hydropower cannot be used to replace the lost energy. The out-of-pocket costs of operating the lockage system to the energy consumer is the price he must pay to get the energy elsewhere.

One additional point is that the energy lost in lockage is only really lost if the water would in fact be used for energy production and not spilled if it were not used for the locks. In general, this is a safe assumption. Currently, however, the Northwest has a short term power surplus. In 1982 and 1983 some water was spilled. The assumption that all lockages represent lost hydropower is still valid, however, for several reasons. First, since hydropower is so cheap, it is the last source to be shut down. In this case an energy surplus means that one shuts down thermal plants, not hydro. This would reduce the value of the lost energy to the amount saved by shutting down the thermal plant, say 20-30 mills. Secondly, the surplus is short term, perhaps 5 years. Finally, water flows have been above average for the last two years. Given uncertainty, one must assume that medium, or even low flows will occur, in which case every drop of water will be used.

Impact of Energy Cost Recovery

Depending on assumptions about the number of lockages and the replacement cost of energy, the value of energy lost ranges from 3.5 to 7.3 million dollars.

A conservative but realistic value would be the 5.8 million dollars generated by using 1981 lockages and the 40 mill energy rate. The 1982 traffic volume was down due to unfavorable economic conditions, and the 40 mill rate is the low end of the estimates for building thermal plants in 1980 dollars (Berney, et al.).

Thus the social costs of operating the locks are roughly equal to the direct operation and maintenance costs (5.8 million versus 6.7 million dollars).

The issue of lost hydropower is a regional issue and so can be disconnected from the national debate over user fees. Consider two scenarios. In one case national user fees to cover operations and maintenance are not imposed, but regionally fees are established to recover lost energy. In the second case, both sets of fees are imposed.

In case one, energy replacement user fees essentially replace national user fees dollar for dollar and the analysis and implications given in the preceding section on direct costs holds. In the second case, assuming 100 percent recovery of operations and maintenance, user fees are doubled. Whereas the first case had marginal impact on traffic patterns and

shipper's transportation bills, the second case could have substantial impacts. The impacts, if modal demands were of constant elasticity, could be similar to the difference between the 50% and 100% cost recovery levels, e.g., almost a doubling in the transportation bill (as expected) but with little or no change in the modal share.

One additional point should be made. From the perspective of energy loss, the lockage fee is the desired fee because it can be tailored to the losses at each facility. The result would be to discourage use of the locks, principally by making the impact of using many or all eight locks, much more costly than the use of only a few. This is interesting because it agrees with desirability of lockage fees as a means of recovering direct operating and maintenance, as identified in the earlier analysis.

Summary

The imposition of user fees on the waterways of the United States is a political and economic reality. The level and structure of these user fees are still under political and economic consideration. Included in the policy discussions of level of user fee are the economic questions of cost recovery of direct costs and consideration of opportunity costs of lock operation.

In the PNW direct costs allocated to navigation were $6.7 million in 1980. Opportunity costs were conservatively estimated at $5.8 million. Thus, inclusion of opportunity costs in cost recovery could almost double the level of user fees.

The impacts of direct cost user fees appear small on modal split but were identifiable on the transportation bill faced by shippers. It appears that, if elasticities of modal demand do not vary, the inclusion of opportunity costs would also have little impact on modal share but would double the increase in transportation bills.

Incorporating the opportunity costs into the transportation model is an appropriate and reasonable next step in this research effort. Such a full model would allow specific attention to be paid to regional versus national perspectives in a impact distribution framework.

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MOTOR VEHICLE COLLECTIVE RATEMAKING AND THE COMBINES INVESTIGATION ACT: TWO DECADES OF CONFLICT

E. Leah Clark

INTRODUCTION [1]

The collective ratemaking activities of tariff bureaux would appear, at first glance, to be illegal under Section 32 of the Combines Investigation Act. However, a number of factors, including long-standing jurisprudence which suggests that provincially regulated conduct is exempt from the Act, and the limited exemption from the Act provided to other modes for similar behaviour, have made this conclusion far less certain. Since the mid-1960s, the trucking industry, shippers, federal and provincial governments and courts, have been embroiled in an effort to clarify the legal status of collective ratemaking. To date, these efforts have been largely unsuccessful: the resulting uncertainty has placed the collective ratemaking system, as well as the industry which relies upon it, in considerable jeopardy.

This paper outlines the legal status of collective ratemaking in Canada, examines the factors that contribute to the uncertainty surrounding it (including American pressures), and discusses efforts to clarify the situation.

The collective ratemaking "debate" is multifaceted, and as such is largely beyond the scope of this paper. This paper focusses on the institutional framework of the tariff bureau issue. Years of academic inquiry and governmental investigation into collective ratemaking (most

frequently in an effort to determine and quantify its "goodness" or "badness") have been inconclusive. For our purposes, there are three major questions which must be addressed. Although this paper is directed towards the first, the other two are important in respect to it.

In Canada, the collective ratemaking issue is essentially twofold. In addition to the economic question of whether the benefits of collective ratemaking justify immunity from Combines legislation, an institutional and jurisdictional question of who should bear the authority for monitoring or regulating tariff bureaux must be addressed.

Concern with collective ratemaking has as its base, concern over the level of competition in the trucking industry. The question then becomes that of how best to achieve a more competitive environment. Is removal of tariff bureau immunity a viable way to increase competition in the industry? Examination of collective ratemaking and regulation suggests this may not be the case. Entry regulation affords bureaux latitude for price setting. Therefore, attempts to increase the level of competition in the trucking industry through prohibition of collective ratemaking may not the most effective policy focus.

This leads to the third major question, is there a future for tariff bureaux in a radically altered regulatory environment, such as exists in the U.S.? With free market entry, above normal profits (as a result of collective pricing or any other reason) would attract new en-

trants, expanding supply to the point where prices would be determined competitively by the market. Artificially high prices could not be sustained. With open entry, collective ratemaking will largely phase itself out. The American experience with deregulation to date, demonstrates that the collective ratemaking issue tends to resolve itself in the face of relaxed entry.

FACTORS UNDERLYING THE RESURGENCE OF THE COLLECTIVE RATEMAKING DEBATE

The legal and jurisdictional problems inherent in the absence of legal definition and assigned governmental responsibility provide the major impetus towards re-evaluation of collective ratemaking. Although the problem has existed for many years, several factors underlie its recent resurgence in Canada:

- charges laid under the Combines Investigation Act against two trucking tariff bureaux and some of their members;
- the ongoing process of amendment of the Combines Investigation Act;
- provincial re-evaluation of trucking regulation (including entry regulation);
- reaffirmation of provincial support for collective ratemaking;
- American re-evaluation of the collective ratemaking system arising from the changing structure of the trucking industry ,precipitated by the new regulatory environment.

A recently completed Senate Committee examination of collective ratemaking in the United States has recommended

abolition of the immunity of the American trucking tariff bureaux have enjoyed for almost four decades.

The changing situation of collective ratemaking in the United States is of particular importance to Canada, as it demonstrates that changes in Canadian ratemaking practices will occur, regardless of Canadian iniatives. Recent experience has shown that it is difficult for Canadians to participate in transborder trade when substantially differing regulatory regimes exist. Firstly, and most immediately, a number of Canadian carrier members of the Niagara Frontier Tariff Bureau (NFTB), have been indicted by a Grand Jury for antitrust infractions. Canadian truckers participate in most major United States general freight bureaux, and threat of other prosecutions must be considered. If antitrust immunity is further eroded or removed in the United States, extraterritorial reach of American law could seriously disrupt the transborder trucking market. Ratemaking of Canadian portions of transborder shipments could result in prosecution, as is currently the case with transborder rail movements.

Secondly, changes in the status of American tariff bureaux will directly affect Canadian truckers operating in the United States. Prohibition of joint-line ratemaking, that is, collective ratemaking for movements involving more than one carrier, may affect interlining agreements, with a probable reduction in interlined freight. The implications for Canadian carriers will probably depend on the balance of movements originating in the two countries, as it is usually accepted that originating car-

riers control the movement. The transborder trucking market has been traditionally dominated by Canadian carriers, and transborder traffic is a major revenue source for Canadian carriers (particularly those based in Southern Ontario).

COLLECTIVE RATEMAKING IN CANADA

Collective ratemaking is the process by which participating carriers obtain, exchange and discuss information, jointly establish rates, charges, and rules concerning the transport of goods. Motor carrier collective ratemaking occurs within the institutional framework of tariff bureaux, which provide a forum for ratesetting, publishing and distribution of tariffs. Collective ratemaking has evolved as a major factor in pricing of trucking services in the less-than-truckload (LTL) market.

There are 6 Canadian general freight bureaux -- Atlantic Provinces Motor Carrier Tariff Bureau (APMCTB), Quebec Tariff Bureau (QTB), Canadian Transportation Tariff Bureau (CTTB), Western Tariff Bureau (WTB), Western Transportation Association (WTA), and Pacific Tariff Services (PTS).[2] The organization and operations of these bureaux vary greatly, and are summarized in Table 1.[3] It is important to note that some bureaux (PTS, APMCTB) do not play an active role in ratemaking.

Tariff bureaux emerged to assist carriers with the requirements and demands of regulation, and have evolved in response to changes in the regulatory environment. Differences in functions and operations among bureaux can

TABLE 1 - Canadian Tariff Bureaux

GENERAL CHARACTERISTICS	Publishes Tariffs	Files (or Applies for) Tariffs with Government Authorities	Acts as an Agent for Motor Carriers	Type of Ownership	Approximate no. of members (1976)	Jurisdiction
Atlantic Prov. Motor Carrier Tariff Bureau Ltd., St. John	Yes	Yes	Yes	Member owned	14	Extra-prov.: Atlantic Provinces Extra-prov.: Ont. & Atlantic provinces
Quebec Tariff Bureau Inc., Montreal	Yes	Yes	Yes	Member owned Profit oriented	230	Intra-Quebec Extra-prov.: Atlantic Provinces & Que. Quebec - 12 states
Canadian Transport Tariff Bureau Association, Toronto	Yes	Yes	Yes	Member owned	261	Extra-prov.: Western & Ontario Extra-prov.: Western & Quebec Extra-prov.: Ont. & Que. Intra-Ontario
Western Tariff Bureau, Calgary	Yes	Yes	No (with qualifications)	Private	94	Extra-prov.: 4 Western provinces Intra-Alberta Int'l: Prairies & NW U.S.
Western Transportation Assoc., Calgary	No WTB	No WTB	No	Member owned	13	Extra-prov.: 4 Western provinces
Pacific Tariff Service Ltd., Burnaby	Yes	Yes	Yes (with qualifications)	Private	398	Intra-B.C. Extra-prov.: B.C. & West, Ontario

RATEMAKING PROCESS	Emergency	Analytical Fuction	Info to Shippers	Control	Formal Rate Committee	Formal Bylaws	Allow Shippers Participation
Atlantic Prov. Motor Carrier Tariff Bureau Ltd., Saint John		No, only for member fee calculations	Nfld: Gazetted Informally advises Shippers, CITL, APIC of changes	None exercised	No	Yes	
Quebec Tariff Bureau Inc., Montreal	Only rail competition	Yes	CRI discussed with CITL. Newspapers Gazetted	Limited, reports violators to Board	2 Level - CRC - SRC	Yes	
Cnd. Transport Tariff Bureau Association, Toronto	Yes	Yes	Price notification to number of shippers & Govt bodies Newspapers	Reports violators to regulatory board	3 Committees - Intra-Ont. - Ont/Que. - East/West	Yes	Yes
Western Tariff Bureau, Calgary	Yes	Little	Newspaper Occasional meeting with Shippers' Groups	None exercised	2 Level: Principal committee handles items not receiving majority vote in lower level	Yes	Can discuss rate changes
Western Transportation Assoc., Calgary	Special procedures			No	2 Level: Principal committee handles items not receiving majority vote in lower level	Yes	Can discuss changes
Pacific Tariff Service Ltd., Burnaby		No	Newspaper ads		No	No	

largely be attributed to differences in trucking regulation in the jurisdictions in which they operate

CANADIAN COMBINES LAW AND THE STATUS OF COLLECTIVE RATEMAKING

Section 32 of the Combines Investigation Act establishes it as an offense to conspire, combine, agree or arrange together to prevent or unduly lessen competition in a market. Collective ratemaking activities of tariff bureaux would appear to be in violation of this provision. Two cases have recently reached the courts: one has been resolved, resulting in the dissolution of the Canadian Household Goods Carriers Tariff Bureau Association; the other remains in litigation. Nevertheless, the legal position of collective ratemaking under the Combines Investigation Act remains clouded with uncertainty arising from two major sources -- a widely held assumption that collective ratemaking is exempt from the Act, and uncertainty surrounding the scope and applicability of combines law.

The widely held belief that tariff bureaux have a degree of protection from Combines Investigation Act prosecution appears to be based on questionable assumptions. The immunity from antitrust prosecution enjoyed since the 1940s by motor carriers in the United States which allows them to jointly set rates on interstate movements through tariff bureaux which are approved, monitored, and regulated by the Interstate Commerce Commission, has led many to assume that Canadian law was similar in practice. Similarly, the apparent exemptions from Combines Investi-

gation Act scrutiny provided for collective ratemaking in Canada among other modes (Section 279 of the Railway Act, the Shipping Conferences Exemption Act) led to the assumption that motor carriers may be exempt or were unlikely to be charged. With the exception of Section 33 of the National Transportation Act, which ensures the right of independent filing by tariff bureau members, bureaux have received no legal or governmental recognition. To some this benign neglect signalled sanction of the institution and its practices.

Turning to the law itself, three areas of uncertain Combines Investigation Act authority have clouded the legal status of tariff bureaux -- services, Crown corporations and regulated industries. Although service industries were not fully included under the Combines Investigation Act until 1975-76, transportation appears to have previously been subject to the conspiracy provisions of the Act, as Section 32 referred to lessening of competition in production, manufacture, purchase, barter, sale, storage, rental, transportation or supply of an article. Some uncertainty remained until the 1975-76 ammendments were implemented, however, as will be illustrated later in the discussion of the Western Transportation Association case.

The applicability of the Combines Investigation Act to Crown corporations has also been a matter of considerable discussion. Under a ruling with respect to the Interpretations Act, and upheld in the Uranium case, agents of the Crown are not "persons" under the Combines Investigation

Act. Although CN, for example, is a Crown corporation, it is not of a type that would accord it status as an agent of the Crown, so it would not demand special treatment under the Combines Investigation Act. The proposed ammendments to the Combines Investigation Act would clearly make the Act binding on both federal and provincial Crown corporations in respect to commercial acitivities conducted in competition with other firms. Activities associated with their regulatory activities would be exempted.

Controversy concerning regulation and competition policy has been the primary contributor to the haze surrounding the legal status of collective ratemaking. The position of regulated industries under the Combines Investigation Act is dictated by jurisprudence rather than legislation; three major precedents are relevant to discussion of tariff bureaux, the Farm Products Marketing Reference (1957), the Canadian Breweries Case (1960), and the Jabour Case (1902).

In the Farm Products Marketing Reference (1957) and the Canadian Breweries Case (1960) it was held that in situations where legislatures have empowered boards to set or fix prices, it must be assumed that power is exercised in the public interest. In the Jabour Case, the Supreme Court found the Combines Investigation Act does not apply to regulatory activities (including self-regulatory agencies) permitted under provincial statutes. This case established that provinces have the right to choose modes of regulation, establish statutes, and determine admini-

strative techniques for execution of the policies of statutes validly enacted within its sovereign sphere. A provincial statute does not have to expressly authorize an activity to protect it from the Combines Investigation Act.

Prior to the Jabour decision, the untested legal debate focussed on the effectiveness and extent of regulation necessary to justify exemption. Consumer and Corporate Affairs interpretation of the Breweries Case suggested rate approval was necessary to exempt provincially regulated activity. When applied to tariff bureaux, this suggests the industry is protected in some provinces, but vulnerable in others. The Jabour decision suggests that, under current law, provinces could authorize tariff bureaux through legislation, and protect them from the Combines Investigation Act without directly regulating ratemaking activity.

Efforts to amend the Combines Investigation Act over the past 15 years have attempted to codify the jurisprudence concerning regulatory agencies and regulated industries. Bill C-256, an effort to create a new competition policy originating in the late 1960s, included a clause exempting regulated activities of regulated industries from Combines Investigation Act scrutiny. That bill died on the order paper, although many of its provisions resurfaced in revised form in two parts which became known as the Stage One and Two amendments. Stage One (passed in 1975) contained the less contentious clauses of C-256 and did not address the regulated industries issue. Stage Two

originally presented in Bill C-42, exempted regulated conduct and required regulatory agencies to exercise their powers in the manner least restrictive of competition. Three conditions had to be met for regulated conduct to be exempt:

1) conduct would have to be expressly authorized by federal or provincial agencies not appointed by those regulated;
2) the agency would have to be expressly empowered to regulate conduct in the manner in which it was regulated and have expressly directed attention to regulation of the conduct.
3) application of the Competition Act would have to seriously interfere with attainment of the objectives of the regulatory act.

Bill C-42 was withdrawn, and re-emerged as Bill C-13. The regulated conduct section was changed slightly to include farmer controlled marketing boards (if they were subject to a supervisory agency meeting the requirements listed above). The Stage Two amendments were unsuccessful, and the attempts to introduce a new competition policy continues. Current proposals for Combines Investigation Act amendments (Bill C-29) do not address regulated conduct, leaving the framework established by the jurisprudence.

TARIFF BUREAU CASES UNDER THE COMBINES INVESTIGATION ACT

As part of its efforts to more clearly define the parameters of regulated conduct under the Act, test cases were pursued by Consumer and Corporate Affairs, two of these

cases attempted to establish the status of tariff bureaux activities under the Combines Investigation Act.

Following 12 years of investigation by Consumer and Corporate Affairs, information was laid by the Attorney General of Canada in 1979 against 20 member companies of the Western Transportation Association and 11 individuals. It was alleged that between 1960 to 1979 members of the Western Transportation Association (and its predecessors) violated Section 32(1)(C) of the Combines Investigation Act, in that they combined, agreed or arranged together to prevent or lessen unduly competition in the interprovincial transport of general merchandise, in shipments up to and including 10,000 lbs (LTL shipments), between points in Alberta and points in Manitoba, Saskatchewan and British Columbia.

An attempt to prohibit further proceedings in the Provincial Court of Alberta on constitutional grounds (the proceedings were not being carried out by the Attorney General of Alberta) was rejected. Although the provinces have exclusive jurisdiction over administration of justice, the court found Section 32(1)(C) of the Combines Investigation Act to be valid legislation under Federal authority to regulate trade and commerce. After appeal by both sides, the Supreme Court of Canada decided in favour of the Attorney General in October 1983. Preliminary hearings are expected to commence in Alberta during 1984.

In late 1983, the Canadian Household Goods Carrier Tariff Bureau Association and 5 member van-lines were found guilty of conspiracy to unduly lessen competition in

interprovincial transportation of used goods between 1963 and 1980. Continuing investigation since 1966 demonstrated that from 1963 to 1968, four van-lines (Allied, United, North American, Aero Mayflower) used the Moving and Storage Conference of the Canadian Warehousing Association to establish common rates, standardize service packages, and to monitor and discipline agents. Due to the uncertainty surrounding the applicability of the Combines Investigation Act to service industries, action was delayed. In 1967, the Exchequer Court found used household goods to be "articles" under the Combines Investigation Act, and further appeal was dismissed.

In 1968, the van-lines withdrew from the Canadian Warehousing Association, forming a ratemaking body -- the Canadian Household Goods Carriers Tariff Bureau Association (CHGCTBA) and a lobby group -- the Canadian Association Movers. Following this reorganization, there was an attempt to negotiate Consent Order in order to avoid prosecution. However, in the face of evidence of continued contestable behaviour, investigation was resumed.

In 1973, the Restrictive Trade Practices Commission found the van-lines to have continued ratemaking and standardization activities. Efforts to convince Atlas to join the bureau were uncovered at the hearing. Atlas joined the bureau, raising its rates approximately 10% to meet those of other bureau members.

In February of 1980, an information was laid by the Attorney General of Canada charging the CHGCTBA with one count under 32(1)(C) of the Combines Investigation Act.

Evidence presented at a preliminary hearing before the Ontario Provincial Court demonstrated a tightly concentrated market with a great degree of homogeneity and the absence of price competition. In January 1982, the accused were ordered to stand trial.

The accused pleaded guilty to conspiracy. Rates and tariffs filed by the van-lines through the CHGTBA were virtually identical, containing the same spelling and grammatical errors. Statistics Canada data on market shares illustrate extensive control of the market, with the collective share for the 5 lines ranging from almost 88% to a peak of 95.52% in 1978.

An Order of Prohibition against the 5 van-lines prohibited continuation or repetition of the offense as well as other anti-competitive practices. The tariff bureau was ordered to cease operations within 3 weeks. The van-lines and members are specifically prohibited from using bureaux, agents or services to submit or file rates, if that service is used by another van line or carrier. Similarly, they are unable to present, direct, coordinate or participate in submissions to any governmental or regulatory body concerning tariff filing, alleged tariff violations, or operating authority application. A fine of $250,000 was divided to reflect the market share of each van-line.

The Director of Investigation and Research, Consumer and Corporate Affairs, suggests the CHGTJA case:

> ...is a particularly important precedent in view of the widespread use of tariff bureaux in Canada. The example will probably be followed with great interest by the trucking industry, policy makers and regulators.[4]

Both cases clearly indicate that the courts do not appear to question Combines Investigation Act applicability to tariff bureaux and that the operations of a least some tariff bureaux are viewed to be in violation of the law. It also should be noted that, if currently proposed ammendments are implemented, successful prosecutions under Section 32 should be easier to achieve.

EFFORTS TO EXEMPT COLLECTIVE RATEMAKING FROM THE COMBINES INVESTIGATION ACT

In addition to attempts to clarify the situation of bureaux under the Act, there have been continuing efforts to formally exempt bureaux from the Act's provisions. Three major players have evolved in this struggle -- the industry, provinces, and shippers.

The Canadian Trucking Association (CTA) has tirelessly lobbied for anti-trust exemption for tariff bureaux since serious consideration of a new competition act and investigation of the WTA and CNGCTBA began in the late 1960s. The CTA believes the operations of tariff bureaux are dependent on the collective ratemaking function, and that bureaux are vital to the efficent functioning of the transportation system.

The provinces have traditionally supported collective ratemaking, viewing tariff bureaux as bodies which facilitate smooth operations of interprovincial trucking service and, of great importance to many provinces, significantly reduce the administrative burden of regulation.

Shippers do not present a common front in respect to collective ratemaking. The Canadian Manufacturer's Asso-

ciation vigorously opposes Combines Investigation Act exemption for tariff bureaux, while the Canadian Industrial Traffic League claims unanimous member support for the exemption of collective ratemaking from competition legislation, as long as the right of independent action is preserved, and several other pro-competitive conditions are met.

In the past two decades, proponents of tariff bureaux have proposed changes to the Combines Investigation Act; specific exemptions to the Combines Investigation Act; amendments to the Motor Vehicle Transport Act; as mechanisms to exempt collective ratemaking from the combines legislation.

Bill C-33 to amend the National Transportation Act contained provisions that would have directly exempted motor carrier tariff bureaux and airlines from Section 32 of the Combines Investigation Act. Clause 3.3 allowed the Governor in Council, on recommendation of the Ministers of Transport and Consumer and Corporate Affairs, to exempt activities considered necessary to the achievement of the objectives of transport policy if the conduct were imposed or required by regulation. The Bill was not successful.

Most recently, the CTA has approached the provinces for support in its efforts through the Canadian Conference of Motor Transport Administrators (CCMTA), which represents federal and provincial motor vehicle regulatory agencies. In 1980, the CCMTA directed its Working Group on Policy Issues to respond to a CTA request that the CCMTA support exemption from Combines legislation for collective rate-

making by trucking tariff bureaux through amendment to the Motor Vehicle Transport Act. The group concluded that the Act was not the proper legislative vehicle for an exemption. Further study concluded that bureaux had many desirable and commendable activities, but found the provinces divided on the question of whether collective ratemaking is necessary for continued tariff bureau operations. The CCMTA examined a number of options and recommended bureaux be required to adapt their operations so as to be in accord with Combines legislation.

The Council submitted a proposal to Consumer and Corporate Affairs, under which a group formed of members of Highway Transport Boards of all jurisdictions would hear evidence from representatives of the general freight trucking industry, shippers and consumers, and determine a freight-all-kinds rate schedule for all mileage bands and weight ranges. The group would also rule on certain regulations and conditions of carriage. The rates would be published by the CCMTA or by the tariff bureaux. CCMTA suggested that collusion between van-lines should not be allowed. Consumer and Corporate Affairs found the proposal unacceptable, unless directly sanctioned by legislation. A revised proposal put forward by Ontario, emphasizing "sunshine" in the ratemaking process, was similarly rejected.

In the fall of 1982, the Council of Ministers asked the Minister of Transport to request conditional exemption under the Combines Investigation Act for collective ratemaking from the Minister of Consumer and Corporate

role by the federal government would involve extensive federal-provincial coordination and agreement, or changes to the delegation of powers under the Motor Vehicle Transport Act. Under existing jurisprudence collective ratemaking could be accommodated within the Combines Investigation Act if bureaux were established as self-regulatory bodies through provincial legislation, or collective ratemaking was required by provincial authorities.

In a broader view, however, it appears that while concern with competition in the trucking industry is justified, it is probably inappropriate to focus attention on the operations of tariff bureaux. The potential for market abuse is not inherent in the structure of tariff bureaux; it is inherent in governmental regulation of the trucking industry. In a more competitive environment, bureaux are unlikely to maintain a long run presence in the industry as a rate setting body. To maintain rates, a tariff bureau would need to be able to control supply, and the barriers to entry necessary for such control were established and exercised by governmental regulatory bodies. Without entry regulation, it is unlikely the less-than-truckload industry would approach perfect competition. However, the industry would be more competitive, and bureau ability to set and sustain artificially high prices would be limited. Thus neutered, tariff bureaux would cease to be an anti-competitive force or a major policy problem.

The domestic tariff bureau issue cannot be examined in territorial isolation. Perhaps the question is not

whether the federal government should establish a policy stance on tariff bureaux, but rather can Canada establish transportation policy independent of American policy. Recent experience illustrates the problems with maintenance of a Canadian independent regulatory system differing substantially from that of the United States. Changes in collective ratemaking in the United States could well be reflected in increased efforts on the part of American carriers to establish or expand Canadian operations. This makes it increasingly important for Canadians to examine entry regulations in a critical light, cognisant of potential pressures from the United States.

In conclusion, the tariff bureau "question" would probably answer itself, if entry into the trucking industry were deregulated. Early evidence in the United States points to this conclusion. However, Canada will have to make trade-offs between the inefficiencies fostered by regulation and the probable encroachment of American carriers in both the Canadian and international markets.

REFERENCES

1 For a fuller treatment of the issues presented in this paper, refer to The Role of Motor Carrier Collective Ratemaking in Canada and the United States: The Impact of Deregulation, E. Leah Clark, Strategic Policy Directorate, Transport Canada, 1984.

2 In 1976, approximately 100 small carriers split from the QTB to establish the Quebec Carrier Conference (QCC). Focussing on the needs of small carriers (particularly in regards to maximizing benefits from government subsidy programs), the QCC was involved in collective ratemaking for several years, before returning the ratemaking responsibilities to the QTB. A specialized bureau, the Canadian Household Goods Carriers Tariff Bureau Association was abolished in 1983 as a result of a price fixing case, discussed more fully later in the text. Although the structure of the "moving" industry, its market, and its regulatory environment are distinct from those of general freight common carriers, the bureau functioned in a similar manner. In addition, four American-based bureaux publish transborder rates.

3 This table is derived from Tariff Bureaus in Canada, R.K. House and Associates, Transport Canada, 1976, with additional information.

4 Consumer and Corporate Affairs, News Release NR-83-20, 17 December 1983.

OPERATIONS MANAGEMENT IN THE MOTOR-CARRIER INDUSTRY

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ABSTRACT

The purpose of this paper is to provide a better understanding of the Motor-carrier's environment, its operating characteristics and management systems, and finally to offer suggestions on how to deal with cost/service tradeoffs.

INTRODUCTION

Freight transportation plays a vital role in this nation's economy. Raw materials, semi-finished and finished goods must often travel long distances in order to reach industrial sites and national or international markets. The freight transportation industry, as a whole, is nevertheless suffering from the recent economic slowdown and this situation is particularly serious in the public trucking industry which is losing ground to private and other forms of trucking, (e.g. illegal trucking).

However, in spite of the economic situation, some will blame the motor carrier's management for their poor performance while others will put the blame on government regulation. Others, yet, claim that the major problem in freight transportation is that very few people have a complete understanding of transportation data.

It is therefore intended, in this paper, to provide a better understanding of the particular environment in which motor-carriers

must operate. Then, more specific issues related to the motor-carrier's operations management will be discussed while focusing on the necessity to deal with cost/service tradeoffs with a global approach.

THE MOTOR-CARRIER'S PARTICULAR ENVIRONMENT

Figure 1 provides a simplified illustration of the Motor-Carrier's particular environment and its impacts on the design and performance of a carrier's transportation system. When designing a transportation system, a carrier must take into account its customers (e.g. shippers and/or receivers) transportation needs. These needs vary according to freight characteristics (volume, weight and special equipment required), service required (pick-up and delivery, transit time) and origin/destination of traffic.

The design of a transportation system is also influenced by some form of government regulation (e.g. through the concession of permits) and by competitors who are already offering transportation services in a given market (these influences will be discussed in more details later on). Capacity planning is also a strategic decision linked to market definition and service policy. For example, a carrier wishing to supply L.T.L. (less-than-truckload) transportation services will normally have to organize a network of consolidation terminals where traffic picked up in small shipments (L.T.L.) will be consolidated into larger shipments (T.L. or truckload) for more economical long distance movement. Therefore, the location, number and size of the terminals are major components of the transportation system design process.

THE MOTOR-CARRIER'S PARTICULAR ENVIRONMENT

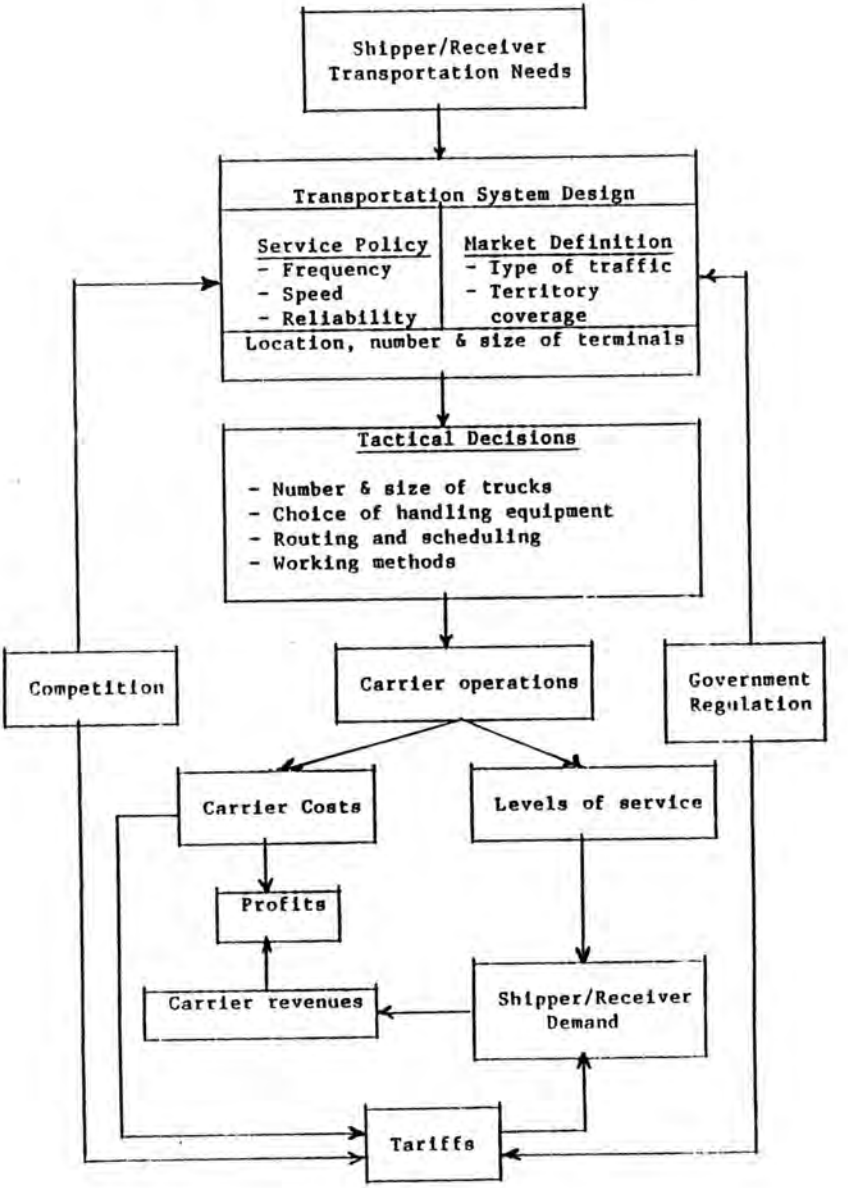


FIGURE 1:

Decisions taken at the transportation system design level will, in turn, influence tactical decisions such as the number and size of trucks, the choice of handling equipment, working methods and routing and scheduling. For example, handling methods and scheduling of terminal employees and drivers will be directly influenced by the level of service required. Also, the type of traffic handled will determine the type of equipment and procedures used. Consequently, freight carriers tend to specialize into one of three categories of shipments: truckload (T.L.), less-than-truckload (L.T.L.) and small packages (less than 50 pounds). Table 1 illustrates the differences between these categories by comparing the average revenue per ton for a sample of carriers of T.L. and L.T.L. and the company "United Parcel Service" (U.P.S.) which specializes into small packages. (Norritz, 1977)

REVENUE PER TON FOR A GROUP OF 477 CARRIERS IN THE U.S. AND THE COMPANY UNITED PARCEL SERVICE.

Carrier Type	Revenue per ton			
	1973	1974	1975	1976
T.L.	24.03	27.15	28.46	29.56
L.T.L.	80.69	81.13	89.58	98.63
U.P.S.	290.62	300.89	310.73	351.41
Total	35.98	46.79	51.99	54.38

TABLE 1

The transportation system design and the tactical decisions derived from it determine, together, a set of constraints applied to the day-to-day trucking operations. The outputs of the transporta-

tion system can be simplified as 1) levels of service provided to the shipper/receiver and 2) costs resulting from strategic and tactical decisions (relatively fixed costs) and from short term decisions (relatively variable costs)... Levels of service provided by a carrier are a major determinant in the freight transportation Supply and Demand Equilibrium process. Indeed, shippers and/or receivers will be influenced by the kind service they obtained from a carrier in the past when they decide on which carrier to select in order to satisfy their transportation needs. On the other hand, carriers will adjust their supply of transportation services according to the volume of traffic they have obtained from a given market segment. This iterative process is important as it is continuously taking place and thus requires both carriers and shippers to periodically adjust their decision making.

Tariffs are the prices paid by the shipper/receiver for the transportation services provided by the carriers. They are determined by taking into account the carriers costs to provide the service and must generally be approved by government agencies in provinces or states where the motor-carrier industry is regulated. A more detailed discussion of the impact of government regulation and competition on tariffs and transportation system design will follow in the next two sections. Then, some important cost characteristics particular to the motor-carrier industry will be briefly presented.

Government regulation, market definition and tariffs

In Canada, each provincial government has jurisdiction over all freight and passenger transportation inside its province. However, all inter-provincial transportation is regulated by a federal govern-

ment agency, the Canadian Transport Commission (C.T.C.). This shared jurisdiction means that a carrier wishing to extend its services outside its province must obtain a permit from each provincial government agency where he intends to operate.

As indicated in figure 1, government regulating agencies directly influence motor-carriers by issuing transportation permits and approving tariffs[1]. There are many categories of permits issued: general freight or specialized transport, local or long distance, regular or irregular route, etc. A carrier wishing to offer or extend services over a new route must prove to the regulating agency that a real transportation need exists and that this need is not satisfied adequately by any other carrier. Such regulation is justified by the following reasoning: if too many carriers share the freight transportation market between two points, they will not obtain a sufficient amount of traffic to reach profitability and service will suffer; only a few strong carriers would survive and gain control over the market which is contrary to public interest. It is also important to note that when a carrier obtains a permit, not only has he the right to provide a service but also the obligation to do so.

Regulating agencies must also approve the tariffs submitted to them before publication. Tariffs are based on transportation costs and vary according to the distance travelled and such shipment characteristics as weight, density, value and risk. Generally, tariffs must be "fair and reasonnable", taking into account the interest of

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1 Motor-carrier regulation varies considerably from one province to another; from minimal regulation in Alberta to a relatively strong control in Quebec and Ontario, for example.

carriers, shippers and the general public. It is the regulating agencies's responsibility to reach a compromise between those interests. The tariff issue is so complex that carriers have long decided to form associations, called tariff bureaus, in order to establish tariffs in common and to submit them together to the agencies concerned.

In recent years, strong opposition to trucking regulation has emerged in the United States. This movement has resulted in the "Motor Carrier Act" of 1980 which has practically deregulated the U.S. trucking industry. This trend will, no doubt, influence the canadian regulation and some provinces (e.g. Quebec and Ontario) have already taken some steps in this direction; however the deregulation movement in this country is expected to be much slower and progressive than in the U.S.

Competition, levels of service and tariffs

Notwithstanding government regulation, the motor-carrier industry is submitted to intense competition from either intermodal or intramodal sources. In a given market, intramodal competition is that which comes from carriers using the same transportation mode, while intermodal competition is coming from carriers using a different mode of transportation, e.g. rail vs truck.

Even though intramodal competition is restricted by Government regulation (through permits), carriers are sometimes facing unfair competition on the part of those who operate without a permit in a given market. Furthermore, carriers are quite often reducing tariffs in order to gain a competitive advantage. This practice could lead to destructive competition contrary to the objectives of govern-

ment regulation. These problems are particularly serious in Quebec where many industry spokesmen have requested more stringent controls by the Quebec Transport Commission, (Alary, 1981 and Perron, 1979).

Intermodal competition can take many forms: rail, containers, T.O.F.C. (trailer-on-flat-car), in addition to maritime and air transportation. Trucking will generally be more advantageous when a rapid, frequent and reliable service is required, distances are rather short, a door-to-door service is required, and the value of merchandise is high. On the other hand, rail will normally be prefered to truck when a large volume of traffic is shipped over long distances, loss and dammage risks are low, a door-to-door service is not necessary and speed and frequency of service are less important.

Since rail is more economical over long distances and trucking provides superior service, then combining the two modes by transporting a trailer on a flat car over long distances (T.O.F.C.) offers a good solution, at times.

There are also other forms of competition in road transportation. For example, private trucking, that is shippers who use their own equipment to satisfy their freight transportation needs, represents about half the total freight transportation market in Canada. Indeed, private trucking, a non regulated activity, may often represent a more profitable transportation alternative to shippers. Finally, many motor-carriers believe that short-term leasing of transport equipment (a softly regulated activity) may, at times, become another form of unfair competition since truck renting can be used to disguise illegal transport.

After this brief discussion on the different forms of legal and illegal competition in the road transportation, one could be tempted

to conclude that motor-carriers should compete on the tariffs, at the expense of service. This would be a mistake because all shippers surveyed, either inside or outside of Canada, stress the importance of service as a selection criteria for a transport mode and a carrier. Indeed, table 2 (Research Bureau, 1976), table 3 (Stock and Lalonde, 1978) and table 4 (McGinnis, 1980) clearly indicate that a motor-carrier who offers a speedy and reliable service will have a net advantage over his competitors.

Even though surveys indicate the prepondance of service criteria over tariffs in the transportation choice priorities of shippers, tariffs remain extremely important for shippers in periods of economic recession. Furthermore, not all shipments must be delivered with the same degree of urgency.

RELATIVE IMPORTANCE OF DIFFERENT FACTORS IN THE CHOICE OF A CARRIER IN CANADA

Factors	Rank on a national basis			
	1976	1973	1970	1968
- On time delivery	1	2	3	2
- Transit time	2	1	1	1
- Tariffs	3	3	2	3
- Loss and damage	4	8	9	9
- Door-to-door service	5	4	6	6
- Tracing	6	5	4	4
- Service frequency	7	6	5	5
- Equipment availability	8	7	8	7
- Claims settlement	9	9	7	8
- Information services	10	11	10	10

TABLE 2

SELECTION CRITERIA USED IN THE EVALUATION OF MOTOR-CARRIERS IN THE U.S.A.

Rank	Selection Criteria	Importance (average/100)
1	On time delivery	92.4
2	Tariffs	79.8
3	Transit time	79.1
4	Extent of distribution network	73.9
5	Service frequency	72.1
6	Loss and damage	69.2
7	Equipment availability	65.6
8	Door-to-door service	61.9
9	Tracing	61.8
10	Claims settlement	60.8

TABLE 3

IMPORTANCE OF TRANSPORTATION CHOICE FACTORS FOR A SAMPLE OF 351 SHIPPERS IN THE U.S.A.

Rank	Factors	Average	Standard deviation
1.	Speed and reliability	1.67	0.461
2.	Tariffs	1.81	0.600
3.	Loss and damage	2.01	0.745
4.	External market influences	2.26	0.865
5.	Inventories	2.28	0.688
6.	Market competitiveness	2.28	0.703
7.	Company policy & Customer influences	3.65	0.765

(1 = strongly agree with importance to transportation choice, 2 = agree, 3 = no opinion, 4 = disagree, 5 = strongly disagree).

TABLE 4

Cost characteristics

Before we conclude this first section dealing with the motor-carrier's particular environment, we must underline some cost characteristics that are important in understanding the industry's performance. First, there is still a debate on the issue of economies of scale in this industry. Some will even talk about diseconomies of scale. Indeed, it has been observed that terminal expenses will increase more rapidly then revenues when traffic volume increases; thus leading to deterioration of the financial situation of small carriers attempting to grow to a medium-size company. This process would however stabilize when the carrier reaches a large volume of traffic. Many hypotheses have been suggested to explain this phenomenon. For example, Wyckoff (1974) believes it is a consequence of the difficulty experienced by a small informal organization to adapt to a more formal style of organization when business volume increases; thereby requiring a decentralization of authority.

Another important characteristic of the motor-carrier industry is that manpower costs generally account for more than half of the operating costs. It is therefore necessary to exercise complete control over these costs, in particular, and all costs in general, since cost control is a crucial operations management task, as will be seen in the next section, in such a particular environment where profits are generally very slim (typically around 4%).

MOTOR-CARRIER OPERATIONS

For a better understanding of motor-carrier operations, figure 2 represents the typical flow of L.T.L. shipments (Wychoff, 1974). The cycle starts with a pick-up demand which is seldom known in ad-

TYPICAL FLOW OF L.T.L. SHIPMENT

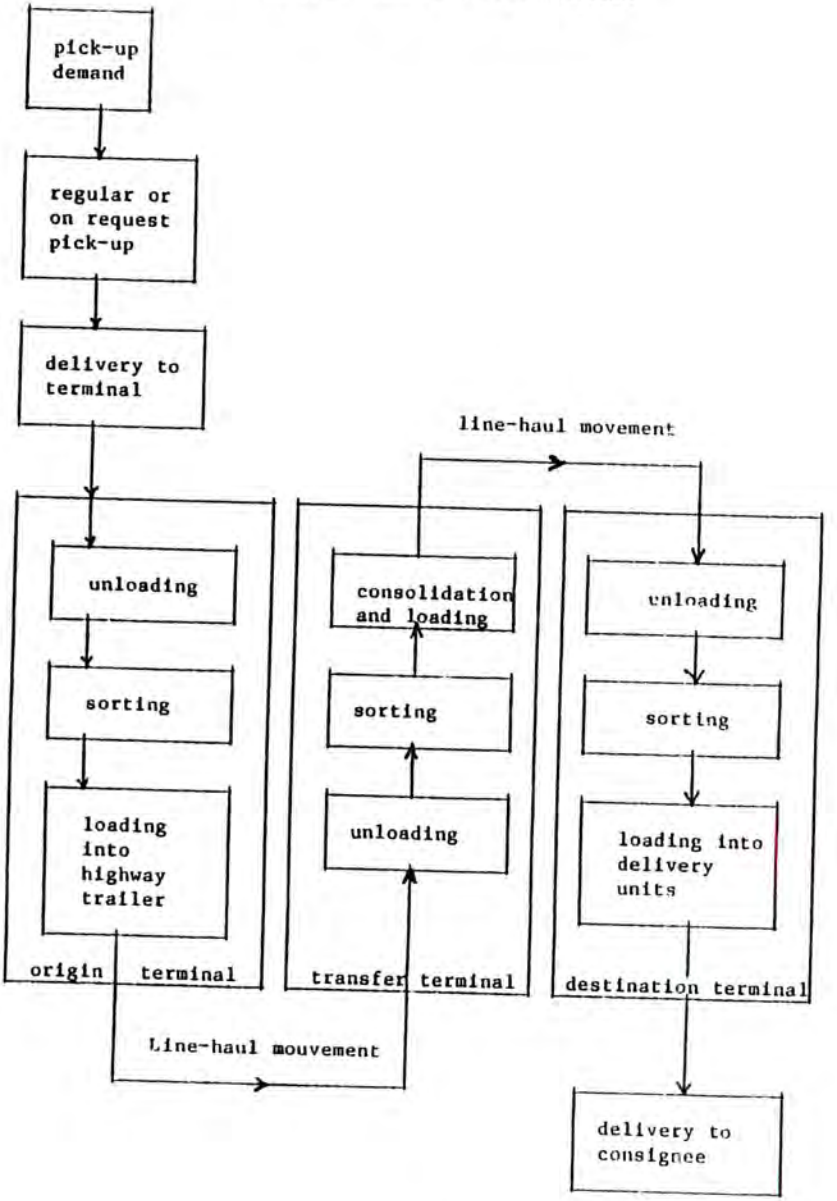


FIGURE 2

vance and may vary significantly from one day to an other. Demand for transportation services also varies according to seasonal variations and type of traffic. For example, early spring and fall are peak periods in the garment industry. Aggregate planning is therefore one of the many operations management problems in the Motor-Carrier industry.

If a full load (T.L.) is picked up, then it is normally delivered directly to the consignee (receiver) without any other form of handling. This explains why truck load tariffs are significantly less than L.T.L. tariffs per unit of weight (refer to table 1).

Some L.T.L. shippers who ship regularly may get a regular pick-up service whereby pick-up trucks stop by these customers every day or on a fixed schedule. Motor-carriers believe that such a regular service incites shippers to increase the volume of traffic shipped through their company. However, this pratice may be costly if too many unproductive stops are made at these shippers' door. As for the other L.T.L. shippers, they must call the carrier's dispatcher to get a pick-up.

Shipments picked-up are then delivered to the origin terminal where they are unloaded and verified against the information appearing on the documentation (bill of lading) prepared by the shipper: weight, dimensions, number of pieces per shipment, type of traffic etc. Tariffs are determined and a waybill is prepared. The waybill is the documentation that accompanies the traffic and is used to verify it in subsequent handling operations.

Once unloaded and verified, the traffic is moved to a staging area where it is sorted according to its destination. It is then moved to its loading area and awaits loading into highway trailers

departing for the traffic destination or an intermediate terminal. Traffic adressed to other points in the origin city is directed to loading zones for local delivery (normally the next morning).

It is not always possible to economically dispatch a trailer for each destination where traffic is adressed. Traffic is then consolidated into trailers for an intermediate terminal where it will be loaded with other traffic at this intermediate or transfer terminal for movement to its final destination. In the worst case, traffic will be once again unloaded, sorted and reloaded at the transfer terminal. However, it is sometimes possible to keep this traffic in the nose of the trailer and add some more traffic to it; in which case the handling costs are considerably reduced.

At the destination terminal, traffic will once again be unloaded, verified, sorted, coded and moved to a loading area for local delivery to its consignee. There exist, of course, some variants to the procedure described above. For example, many large companies use computerized billing and tracing systems for documentation control. The destination terminal managers then know ahead of time (through telecommunication) the content of incoming (inbound) trailers, thus allowing for better planning of work schedules and local deliveries.

MANAGING THE TRANSPORTATION SYSTEM

In the first part of this paper, we have seen how the transportation system design and all decisions derived from the operations management of that system influenced both levels of service provided to customers and operating costs (refer to figure 1). In fact, whatever the size of the motor-carrier's system considered, performance

control remains a vital element of its management system. Indeed, any relaxation in the control of either costs or levels of service could bring about substantial losses while a tight control should provide an excellent return on investment since capital expenditures are normally quite modest in this industry; manpower costs accounting for more than half the total operating costs. This is why so much emphasis is placed on manpower planning and control in motor-carrier operations management. In the following sections, we will see how information systems and decision support systems can assist motor-carriers in improving their operations planning and control activities. We will then discuss means of dealing with the very important issue of cost/service tradeoffs.

Information systems and performance reports

The typical transportation system planning and control cycle is illustrated in figure 3. It represents a simplification of the transportation system (refer to figure 1) from which information is fed-back to management through an information system and performance reports in order to assist management in its decision-making.

Information systems. Information systems should assist motor-carriers in managing their transportation system profitably. However, the issue of transport profitability is a complex one, when considering the number and variety of shipments transported by the average motor-carrier. For example, is it more profitable for a carrier to transport a shipment weighting 200 pounds, including 7 pieces, from Montreal to Toronto or a shipment comprising only one piece weighting 200 pounds from Montreal to Vancouver? The answer to this question rests with the carrier's knowledge of, on the one

MANAGING THE TRANSPORTATION SYSTEM

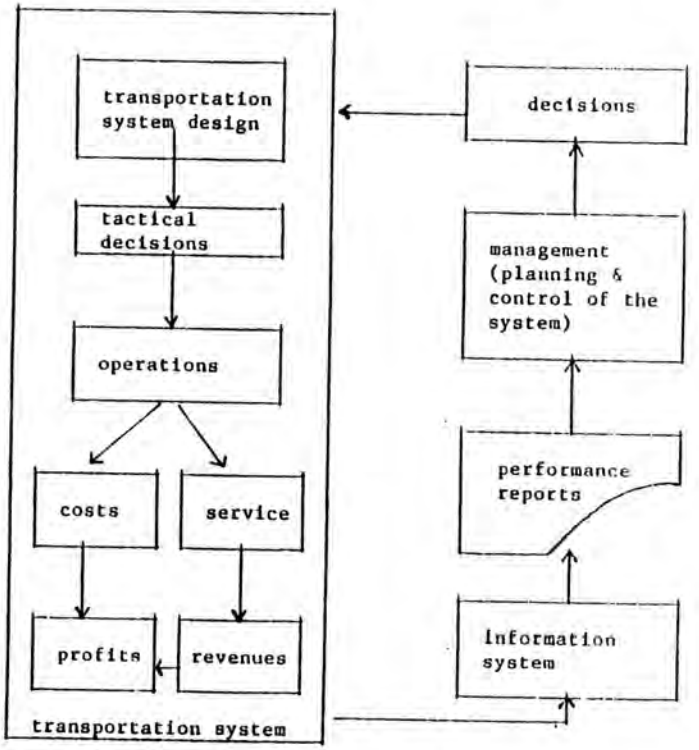


FIGURE 3

hand, costs related to each one of these shipments which vary according to the number of pieces handled, their weight, the distance between origin and destination, the distance between terminals and pick-up and delivery points, the number and types of transfer terminals involved and so on, and, on the other hand, the revenues which are known. Ultimately, each shipment carried has its own cost history. It is therefore almost impossible to measure the exact contribution of each shipment to the carrier's profits or losses.

It is possible, however, to establish standard costs for most operations involved in the movement of freight (refer to figure 2) and thus capture the essence of costs related to the movement of a typical shipment between any two points in the carrier's network; a typical shipment having a given weight and number of pieces. Next, fixed costs must be allocated to these typical shipments and then, all costs are substracted from the appropriate revenues. This type of analysis can be performed for each type of shipment and results can be used to produce profitability reports by shipment weight category, by terminal, by lane (origin-destination of traffic) or for the whole system (Schiff, 1972).

This type of analysis requires the use of computers and substantial investments which limit this kind of approach to motor-carriers who can afford it. In the past ten years, most major american and canadian motor-carriers have adopted this type of information system. Some (e.g. Ryder Truck Lines Inc.) have even used this kind of system in conjunction with an incentive program for managers, based on their performance as measured by the system.

Nevertheless, not all motor-carriers have achieved such a degree of sophistication in their information system. Hence, many carriers must still be content with classical budgetary controls, manually prepared productivity reports and surveys provided by outside organizations. But, as its volume of operation increases, a motor-carrier has to adapt to a more formal type of organization. And one way to measure a motor-carrier's organizational formality is to evaluate the quality of the information system used in order to compensate for the progressive distance his top managers (or owners) take from the day-to-day operations. Furthermore, this progression

to a more formal type of organization with the help of more sophisticated information systems is considered as an essential condition for growth in the motorcarrier industry (Wyckoff, 1974).

Performance measures. If all motor-carriers cannot afford sophisticated information systems, most of them will, however, use some performance indicators in order to measure the efficiency of their transportation system in terms of: revenues and expenses, service and productivity.

Revenues and expenses are normally monitored by budgetary controls. As of service levels, various indicators can be used to control them. Here are some examples: the percentage of missed pick-ups, the percentage of on-time deliveries for each major lane, the number of shipments not delivered "x" hours after their arrival at a terminal, and so on.

Measuring productivity is very important in transportation. In a study prepared for the National Council of Physical Distribution Management, A.T. Kearney Inc. (1978) estimates savings realized by productivity improvement programs at 10 to 20% of total distribution costs. Moreover, Wyckoff and Maister (1977) claim that if productivity has improved recently in intercity transportation, it is not the case for terminal productivity which has deteriorated, especially in the larger terminals. Thus it would seem that there is room for productivity improvement in the motor-carrier industry. Many performance indicators can be used in every segment of motor-carrier operations (i.e. intercity transportation, pick-up and delivery fleet, terminal operations, office work). They are discussed in detail in the NCPDM study (A.T. Kearney, 1978) which also suggests

means to improve productivity in a distribution system (see also Wyckoff, 1974; Roy and Ravacley, 1982; and Flannery, 1980).

Management support systems for transportation

Decision support systems are quickly expanding in many areas of management, including physical distribution. In this particular area, the name of the game is "Management Support Systems". (Geoffrion, 1982). Among other references on this topic, we find the work of Gavish (1979), Geoffrion and Powers (1980, 1981) and Little (1978).

According to Geoffrion (1982), a management support system is made up of the following elements:

a) A data file written in computer-readable form.

b) A model describing the real system studied and the relations which may influence its performance.

c) A solver or computer program for solving the model with various commands, e.g. simulation or optimization.

d) An interface facility for communication between the above elements and the manager.

All these elements must be integrated and organized in such a way to assist the manager in its decision-making. This may seem quite theoretical but many successful applications have been reported in the literature (Geoffrion, 1981). It may also be necessary to distinguish between Management Support Systems (M.S.S.) and Management Information Systems (M.I.S.). The latter are normally composed of data files and produce reports in order to satisfy the managers' information needs. But they don't normally include models that assist managers in evaluating various decision alternatives in

order to find a solution that satisfies (or optimizes) his objectives. Management support systems are thus much more sophisticated (and usefull) than management information systems but at the same time their complexity makes them more difficult to design.

Let us now return to the management of a transportation system (figure 3). It is based on an information system producing performance reports that assist managers in making decisions that will improve the system performance. It is an interactive process whereby managers are reacting to the information by making decisions whose effects will not be known for some time. This situation could be improved with the help of a management support system (figure 4). The main characteristic of this new system is that managers can now consult the M.S.S. in order to evaluate different solution alternatives to problems identified in the performance reports (simulation function) or yet find the best solution to a particular problem (optimization function). To achieve these results, all decision-making support activities such as industrial engineering, operations research and information systems must be integrated into an organized system in order to provide answers to management's questions rapidly. Applications of this concept in the motor-carrier industry are developping rapidly (see, for example, Barker et al., 1981).

Managing the cost/service tradeoff

Motor-carrier operations management is an area opened to suboptimization. Indeed, operations managers in that industry have traditionnally pursued cost minimization while sales managers were trying to maximize revenues. Pursuing those two laudable objectives has however dragged some carriers into financial disaster, in the

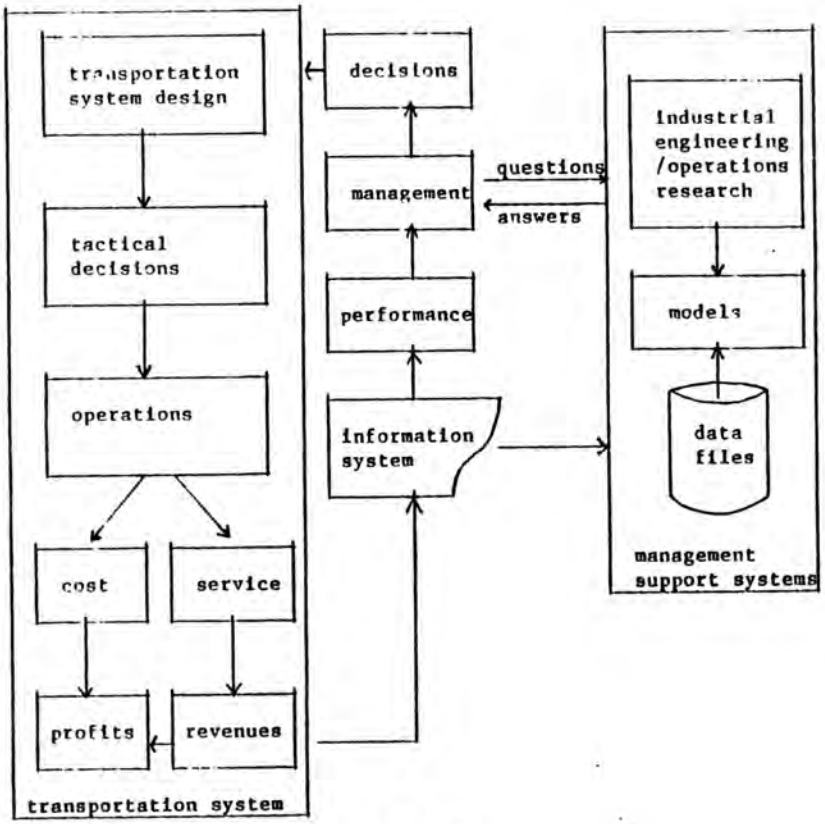


FIGURE 4

past. In fact, cost minimization is quite often detrimental to service which, as seen earlier, is a determinant factor in the shipper's transportation choice and carrier's revenues. Cost reduction must then be subjected to the attainment of service levels specified in the company policy. On the other hand, in their efforts to increase revenues, sales representatives may be tempted to sollicit that kind of traffic which, after analysis, will be found unprofitable.

This kind of situation is common where managers are evaluated only on a cost or revenue basis instead of being held responsible for profitability (Picard, 1980). Indeed, when operations managers are evaluated on the basis of their operation costs only, they tend to increase productivity at the expense of service. Similarly, when sales managers evaluation is based solely on sales volume, not much consideration will be given to the additional costs generated from servicing new customers or increasing service levels to special customers. It is thus clear that both sales and operations managers should also be evaluated on the basis of profitability in order to ensure that they are well aware of the interdependancy of their respective functions. But, unless the motor-carrier can afford the sophisticated information systems refferred to earlier, managing a transportation system by profit centres will not be an easy task.

This discussion leads us to a fundamental issue in motor-carrier operations: the cost/service tradeoff. As noted earlier (see figure 1), the outputs of a transportation system can be simplified as costs and level of service. Then profit maximization can be obtained by cost reduction and service improvements; which are normally considered to be conflicting objectives. A tradeoff must therefore be made between cost and service in order to reach a satisfactory profitability level.

Several methods can be used in managing the cost/service tradeoff in the Motor-carrier industry. But most of these have not been implemented to untill recently because, among other reasons, the data required to study large-scale network operations were not available untill sophisticated information systems were developped in the 1970's. The first modelling efforts were directed at designing

freight network operations evaluation models (Terziev et al., 1978). Such models intended to improve motor-carrier operations planning by assisting managers in evaluating different operations strategies (e.g. freight routing, vehicle dispatching, capacity planning, etc.) by measuring their effects on both operating costs and service levels. These evaluation models can also be used in interactive mode and some successful applications have been reported recently. (Barker et al., 1981).

These evaluation models do not, however, provide managers with optimal, or near-optimal, solutions to critical motor-carrier operations management problems. Only optimization models would provide motor-carriers with optimal solutions and enable them to fully take advantage of cost/service sensitivity analysis. Unfortunately, while several such models have been formulated in the past, the efforts required to solve these large-scale nonlinear models have been too excessive for practical use, so far. Research is going on, however, in order to solve this challenging problem in the near future.

Whatever the methodology used in managing the cost/service tradeoff, it is often necessary and advantageous to apply selective operating strategies to different customer groups. For example, it is only common sense to categorize customers (shippers/receivers) according to an ABC analysis (well known in inventory control). It can then be profitable to plan and control service levels improvements and cost reductions according to customer categories (Roy and Ravacley, 1982).

CONCLUSION

Government regulation, competition and market influences determine largely what a motor-carrier can do. In order to be successful (and profitable), a motor-carrier will therefore have to be very efficient in doing what he can do best, that is providing its customers with the service needed. And, in the Motor-carrier industry, efficiency can be measured by the way carriers manage the cost/service tradeoff. Considering the interdependancy of carrier operations (pick-up and delivery, terminal handling and intercity transportation) and their impact on operating costs and service levels, it is clear that motor-carrier activities must be planned, coordinated and controlled with globally oriented objectives that can only be achieved if managers possess the necessary information and decision support systems available today and in the making for tomorrow. Indeed, according to a recent NCPDM study on transportation strategies for the '80s, the major technological innovations in the Motor-carrier industry, for the 1980-1990 decade, will take place in the fields of communication and information technology (Schneider et al., 1982). Improved communication, information and management support systems should enable motor-carriers to enhance their competitive position, by facilitating operations and investment planning and by providing information support and service to shippers.

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OWNER-OPERATORS IN CANADIAN TRUCKING: THEIR ROLE AND STATUS AND IMPLICATIONS OF THEIR USE

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ABSTRACT

This paper presents the results of a preliminary investigation into the role of owner-operators in Canada's trucking industry. All provinces have accommodated the use of owner-operators in one way or another. However, this accommodation has been more by default than by design. There are exceptions to this observation (e.g., Quebec), but in the main, the regulatory-registration system has not developed a well-defined status for these operators. Among other things, this poorly defined status for owner-operators results in a series of regulatory problems and/or issues. These are briefly discussed. Finally, the paper concludes with an examination of some limited data sources to develop a sense of the numbers of such operators (for-hire carrier sector only) and an examination of some other issues pertaining to the use of owner-operators.

1. INTRODUCTION

Most commentators suggest that the use of owner-operators has been on the increase in Canada. This use of owner-operators raises a number of problems, concerns, and questions. These issues often constitute some of the central concerns of the current "regulatory review" process that is being undertaken in most provinces.

The purpose of this paper is to develop a preliminary examination of some of these issues: given the paucity of available material (particularly data), it is difficult to make more than a preliminary effort at this stage. The specific objectives of this paper are as follows: i) to provide a description of the status of owner-operators in each of the ten provinces, and, for comparative purposes, a brief review of their status in the United States; ii) to discuss some of the regulatory (and other) implications that result from this status; and, iii) to develop and discuss the limited amount of information that is available on the nature and extent of the use of owner-operators, and the cost/rate/competitive consequences that result from their use.

2. THE STATUS OF OWNER-OPERATORS

Over the last few years, several of the provincial reviews of trucking regulations have produced statements to the effect that "owner-operators have no legal status" or that the methods used to engage owner-operators are "legally tenuous" [1]. It is not easy to explain the basis for these statements. Nevertheless, if the issues surrounding the use of owner-operators are to be understood, it is necessary to make the attempt.

Prior to doing so, however, one of the more confusing aspects involving owner-operators - the definition of such entities - has to be explained. Simply put, there is no definition for the term "owner-operator" that will satisfy the common usage of this, or similar terms in various parts of the country, in various situations, or, the regulatory structures found in each of the ten provinces. Space does not permit a full explanation for this (although some of

the reasons will become more apparent subsequently). For here, it can simply be noted that, in terms of common usage, the term "owner-operator" is sometimes used to mean the same as "leased-operator", "independent-trucker", "broker", "broker-operator", or "contractor". (Of perhaps equal importance, these terms are sometimes used to mean slightly different things.) In terms of regulatory structures in various provinces, it can be noted that entities which have the legal status of a "licensed for-hire carrier", a "lessor", an "exempt-hauler", an "illegal-lease-situation", or (sometimes) a "person who owns a truck" can sometimes encompass what are commonly regarded as "owner-operators" in some provinces but not in others.

There is no need here to develop a precise definition of an "owner-operator" (in any case, it may be impossible if the regulatory structures of all provinces have to be accommodated.) Nevertheless, it will help the exposition if a non-rigorous definition is used: for here, a person who owns a truck (or trucks) and who operates that truck (usually, but not always, driving it himself) under someone else's authority will be considered an owner-operator. ("Authority" is being used very broadly to mean either: the conventional notion of "operating authority" as it applies to for-hire carriers; or, the "authority" to truck goods on a private carriage basis.) It is emphasized that the term is actually used more broadly than this. [2]

With this working definition, then, the next step is to explore the actual mechanics of how an owner-operator arranges to operate his truck under someone else's authority. This is not easy, considering the diverse regulatory structures and the numerous "grey areas" encountered in provincial regulations. In order to make the subject intelligible, it is necessary to invent three terms to describe the

various mechanisms. The three mechanisms are: i) the "re-registration" mechanism - whereby an owner-operator transfers the vehicle registration to someone else's name; ii) the "vehicle-lease" mechanism - whereby the owner-operator formally leases his vehicle (this may also involve the transfer of vehicle registration, and, in some provinces, this second mechanism is the same as the first); and, iii) the "authority" mechanism - whereby the owner-operator obtains a form of his own authority, and then works under the authority of another carrier (for-hire or private).

The construction of these three mechanisms aids in the understanding of how owner-operators work in various provinces; the actual practices are more complex. In any case, Table 1 shows where these mechanisms work -- or, "are believed to work" -- in each province. To expand on this, the following is a brief summary of the situation in each province. (While this description touches on some of the "grey areas", it ignores the clearly illegal situations.)

- Newfoundland: An amendment to the legislation in (about) 1974 [3] prohibits the use of vehicle leases as a mechanism for engaging owner-operators. Specifically, where vehicles are leased, the lessor is not allowed to pay or exercise any control over the driver. (In the case of an owner-operator, the lessor is generally the same person as the driver.) For this reason, the re-registration mechanism is the only process that can be used to engage an owner-operator.
- Prince Edward Island: There does not appear to be anything in the legislation which prevents an owner-operator from leasing a vehicle to a carrier (either for-hire or private) and driving it

Table 1

Mechanisms Used to Engage Owner-Operators

	Nfld	PEI	NS	NB	Que	Ont	Man	Sask	Alta	BC
A. For-Hire										
1 Re-registration	Y	Y	Y	Y	N	Y	Y	Y(b)	Y	Y
2 Vehicle-Lease	N	Y	?	Y	N	Y	N		N	Y
3 Authority	N(a)	N(a)	N(a)	N(a)	Y	N(a)	N(a)	N(a)	N	N(a)
B. Private										
4 Re-registration	Y	Y	Y	Y	N	Y	Y(b)	Y(b)	N	Y(?)
5 Vehicle-Lease	N	Y	N	Y	N	Y			N	N
6 Authority	N	N	N	N	Y	N	N	N	Y(c)	Y(d)

Notes:

Y = allowed; N = not allowed

a) In the provinces indicated, there are certain commodities which are exempt from for-hire licensing requirements. In these cases, anyone can buy a truck and haul freight on a for-hire basis under what may be regarded as his own "authority", or haul these same exempt commodities under some form of arrangement with another person ("carrier", "freight broker", "shipper"). Some of these operators regard themselves as "owner-operators (or "independent truckers", etc.).

b) As far as is known, there is no distinction between the re-registration mechanism and the vehicle-lease mechanism (i.e., "vehicle-lease-with-a-driver").

c) Strictly, it is not possible for a person who owns a truck to "lease on" to a shipper's fleet in Alberta. However, given that intra-provincial for-hire licences are relatively easy to obtain, there may be many "one-truck, contract-for-hire-carriers" in Alberta that would be regarded as "owner-operators-engaged-by-a-shipper" in most other provinces.

d) In B.C., there are what may be regarded as owner-operators engaged by shippers and hauling under their own authority. Technically, however, these are small, contract for-hire carriers (with a "limited freight-vehicle" authority).

himself (or having another driver operate it). It is understood that the regulatory authorities would regard the owner-operator in such a situation as an "employee" - that is, in order that various other conditions of the Act were not violated.

-Nova Scotia: The current legislation does not provide for real regulation of owner-operators -- except that an owner-operator would appear to be prohibited from working in a "private carrier" capacity if his payments (under the terms, say, of a vehicle-lease arrangement) were considered compensation for for-hire transportation. From the one known regulatory hearing on this issue [4], it would appear that there has to be some separation between the vehicle owner (or lessor) and the vehicle driver. (Nova Scotia is reviewing its regulatory system; no details are available on whether or not the status of owner-operators will be affected.)

-New Brunswick: The situation in New Brunswick is clearer than in some other provinces. In terms of for-hire licensing requirements, a vehicle owner is defined to include the person in whose name a vehicle is registered, including a lessee where a lease agreement has been approved by the Board. [5] Second, the Board's criteria for approving lease agreements does not seem to include, in the case of owner-operators, any of the prohibitions found in other provinces concerning the lessor (the owner-operator) from exercising control over the driver. It is believed that the vehicle lease mechanism (in conjunction with the re-registration mechanism) is the standard practice.

-Quebec: Quebec has developed a more all-encompassing regulatory system than any other province. Concerning owner-operators, Quebec is the only province to establish a true regulatory

regime for such individuals. That is, owner-operators are specifically defined under the relevant legislation, and a special class of permits has been created for them - the "Haul Away Permit". [6] These permits authorize an owner-operator to haul the trailers of a named and licensed for-hire carrier.

There are several other points to note about the Quebec system: i) there is no "public interest" test applied in the granting of these permits; ii) although owner-operators have their own "authorities", these are not independent (i.e., they are constrained by the authority of the licensed for-hire carrier); iii) there is no restriction limiting an owner-operator to "one vehicle/one driver"; iv) the application process for a permit involves the filing of the lease agreement with the regulatory agency (on a form approved by the Commission); and, v) unlike the situation in other provinces (some exceptions) the regulatory process in Quebec allows owner-operators to retain vehicle registrations in their own names.

With respect to owner-operators engaged by shippers (i.e., what might be regarded in other provinces as "private carriage"), there is some confusion about past practices. Formally, Quebec maintains that owner-operators were not allowed to work for shippers; in practice, Quebec officials might have adopted a "blind eye" to some situations. In any case, recent changes will permit owner-operators to be engaged by shippers. (This is restricted to owner-operators who own only one vehicle.)

-Ontario: In Ontario, there are two mechanisms whereby owner-operators can be engaged by either a for-hire carrier or a shipper. The first process, and the most common, is the re-

registration mechanism. This usually entails the following [7]: i) the owner-operator transfers the name of the vehicle registration; ii) the vehicle is subject of a "Safety Standard Certificate"; iii) most owner-operators enter into some form of written agreement - often referred to as a "contract of service"; and iv) there is no regulatory control exercised over these "contracts of service".

The second mechanism used in Ontario is a vehicle-lease process. These arrangements are subject to regulatory control [8], and, this control prohibits the lessor paying or exercising any control over the driver. For this reason, Ontario authorities question whether or not an owner-operator arrangement that involves a vehicle-lease (which, in the case of for-hire carriers, has to be approved by the Board) is legal.[9]

-Manitoba: In Manitoba, the re-registration mechansim is used in the case of for-hire carriers engaging owner-operators. These are sometimes referred to as vehicle-leases, but, for a variety of reasons, they should be considered simply as transfers of registrations associated with some type of contract between carriers and owner-operators. [10] (In particular, one cannot legally register a truck as a for-hire truck [or "PSV"] independent of a for-hire authority: the practical implication of this is that it has to be the carrier [the "PSV" carrier] that registers the owner-operator's vehicle.)

With respect to private carriage in Manitoba (where the "CT" truck is the most common form of registration outside of urban areas), the situation is different. Here, an owner-operator may be engaged by a shipper if the truck is registered in the name of the owner-operator "leased to the company" and a formal lease

agreement is filed.

-Saskatchewan: Saskatchewan's regulatory system is different from other provinces. Without going into detail (which is not necessary for this discussion), the important points are: i) all registration classes encompass some notion of "authority" (i.e., in terms of "permitted uses"); and ii) the name in which a vehicle is registered must be identical to the name in which the authority is held. ("Authority" is being used here in its broad context.) The implications of this are that, in either for-hire or private carriage situations, owner-operators can only be engaged through the re-registration mechanism. [11]

-Alberta: In terms of for-hire carriage, the only permitted mechanism for a carrier to engage an owner-operator is the re-registration process. However, given that intra-provincial authorities are relatively easy to obtain (the situation is generally referred to as "unregulated"), anyone can buy a truck and obtain an authority, and then enter into some contractual relation with another for-hire carrier. These situations may or may not be regarded as carrier/owner-operator arrangements.

With respect to private carriage, Alberta authorities insist that there is no legal way for an owner-operator to "lease on" to a shipper's fleet. However, it is relatively easy - in terms of intra-provincial operations - for someone who wishes to be an "owner-operator" to obtain his own for-hire authority. These operators are probably more appropriately considered "one-truck, contract for-hire carriers" than "owner-operators".

-British Columbia: There are two procedures whereby a for-hire carrier in British Columbia can engage the services of an owner-

operator: the re-registration mechanism - which entails no real regulatory control (although, given British Columbia's unique system of for-hire licensing, on a "vehicle-by-vehicle" basis, such a procedure would at least come to the attention of the authorities) [12]; and, the vehicle-lease mechanism. In the second case, there is no formal regulation; however, an "administrative" procedure has been developed whereby a written copy of the lease agreement must be filed. [13] Various criteria are used to judge whether the lease agreement is "acceptable" (e.g., it must state the term of the lease, the rental to be paid, and so on). Unlike some other provinces, there do not appear to be problems created where the lessor is the driver (i.e., the owner-operator).

The situation with respect to owner-operators being engaged by shippers is more confusing. It is understood that there may be some instances of the re-registration mechanism being used. (Officials in B.C. who were contacted about this were reluctant to admit that this was acceptable: they emphasized that the driver would have to ensure that he became a "regular" employee of the shipper.) However, it is also possible to use the authority mechanism to become (what amounts to) an owner-operator in B.C. That is, the vehicle owner may apply for a "limited freight-vehicle" for-hire licence and, in effect, become a "one-truck, contract for-hire carrier".

To summarize, the re-registration mechanism is the most common procedure (i.e., by the number of provinces) whereby owner-operators engage themselves to a carrier (for-hire or private). The vehicle-lease mechanism is sometimes indistinguishable from the re-

registration mechanism (e.g., Sask.) but more often - where it is allowed - is an alternative which usually entails a degree of regulatory control (e.g., N.B., Ont., Man., and B.C.). The re-registration mechanism is generally preferred as: i) it can be "simpler" in some provinces where it avoids the requirement to file a lease agreement; and, ii) the vehicle-lease mechanism is not available in other provinces - generally because there is a prohibition on lessors paying or exercising control over drivers. (The prohibition has been implemented to prevent "phony" or "unlicensed" for-hire carriage situations.)

The authority mechanism is only shown (on Table 1) to be available in a few cases (most notably, Quebec). In fact, this is not quite correct as indicated in note "a" to the Table. In most provinces, anyone can buy a truck and haul "exempt commodities" on a for-hire basis. In some situations, particularly where someone other than the truck owner provides some of the "load-procuring" services, these exempt commodity haulers are regarded as owner-operators (or "independent truckers"). Additionally (and not shown on line 6 of the Table), in all provinces there is nothing stopping owner-operators from applying for for-hire (contract) authorities which would enable them to work for a shipper on an exclusive basis.

Owner-operators are treated quite differently in the U. S. than they are in Canada. Space does not permit a full treatment of this subject here (it is well covered elsewhere [14]). What follows is a brief account of the major differences between Canada and the U. S.:

-the most significant difference is that, in the U. S., there has been a deliberate encouragement of the use of owner-operators;

-owner-operators in the U. S. are generally permitted to retain

vehicle registrations in their own name;

-there are rules in the U. S. which make it easier for owner-operators to "trip-lease" (i.e., rather than - as is generally the case in Canada - enter into a longer-term arrangement). [15]

-the rules in the U. S. are much clearer with respect to owner-operators leasing their vehicles to shippers and becoming bona fide full time employees of the shipper;

-the MCA of 1980 contained a number of measures designed to assist owner-operators (e.g., authorities could be obtained on the basis of a "fitness test" for certain commodities; etc.)

-ICC rules have been introduced which regulate the content of leases between owner-operators and carriers - the intent of these rules ("truth in leasing") was to protect owner-operators.

These are some of the major differences between Canada and the U. S. While the purpose of including these comparisons here is simply to show that the regulatory system in the U. S. has attempted to deal with this element of the transportation system (which is generally not the case in Canada), it would be misleading to end this discussion here. In particular, it should be noted that there are still "problems" in the U. S. [16].

3. REGULATORY IMPLICATIONS

The absence of a clearly defined status for owner-operators in Canada leads to a wide number of regulatory issues -- both for the regulatory system designed to control for-hire trucking and a number of other areas of regulation (labour, vehicles, tax, etc.).

For-Hire Trucking Regulation: General: Possibly the most

fundamental regulatory issue is that the legislation which was originally introduced to regulate for-hire trucking did not anticipate the use of "intermediaries". To elaborate, it helps to view the original intent of the legislation in terms of two "pure" types of trucking activities. On the one hand, a "for-hire" carrier owned vehicles, hired drivers, moved goods owned by someone else, received compensation for transportation services, accepted a certain degree of liability for the goods while in his possession, etc.. On the other hand, a "private trucker" owned vehicles, hired drivers, and moved his own goods. The original legislation did not view any middle ground between these two "pure" cases: in particular, an owner-operator who owned his own vehicle, and entered into some form of contractual arrangement with a for-hire carrier or a shipper.

The problem for the regulators became, in part, classifying these "other actors". (Could a person owning his own vehicle, moving someone else's goods, receive some type of payment which would not be construed as "compensation for transportation service"?)

Inter-Provincial Differences: From the previous discussion, it is clear that the provinces have adopted different ways of accommodating the use of owner-operators. Inevitably, this has lead to problems when owner-operators cross provincial boundries. Details of where these difficulties occur, or how important these difficulties are, are hard to obtain. Nevertheless, the following examples (undocumented) demonstrate the types of problems which occur: i) in New Brunswick, where there is a requirement to file lease agreements, it has proved very difficult to enforce this with respect to out-of-province owner-operators; ii) in Quebec, it is understood that for a number of years owner-operators engaged by shippers in Ontario

could not "legally" operate into the province, but (at least in some cases) were allowed in under the "blind eye" of the authorities; and iii) in Alberta, there has been at least one instance of owner-operators being deemed employees and acting in a "private carriage" capacity on the Alberta-side of the border, whereas on the British Columbia side they were required to obtain for-hire authorities.

"Contracts of Service" versus "Vehicle-Leases": In those provinces where there is a clear distinction between the re-registration mechanism and the vehicle-lease mechanism, the contractual agreement between an owner-operator and a carrier is usually referred to as a "contract of service" (or some term other than a "vehicle-lease"). In some provinces (most notably Ontario) questions have been raised as to whether or not these "contracts of service" are lease arrangements as defined under the applicable statutes [17].

Workmen's Compensation: The subject of workmen's compensation is too complex to be included here. It is sufficient to merely note that the issue of whether or not owner-operators are to be considered "employees", "independent", or "truly independent" (or something else) has been a source of continued trouble in some provinces.

Carrier/Owner-Operator Contracts: Five (six, in the past) provinces require the filing of the contracts between owner-operators and carriers in at least some situations. However, this does not represent any "real" regulation of the form of the contractual relationship. (The reason for requiring these filings is to prevent unlicensed for-hire carriage from occurring, and not to control the bargaining process between owner-operators and carriers.) On several occasions over the past decade [18], regulators have considered the

desirability of becoming more involved in this process.

Trip Leasing: There are few (if any) situations in Canada where owner-operators may trip lease. Some of the regulatory issues are: i) would the allowance of trip leasing lead to a more competitive, a more responsive, or a more efficient transportation system? ii) can a system of trip leasing be developed which does not jeopardize other licensing requirements of the regulatory acts or which does not make enforcement of such acts more difficult? iii) would the allowance of trip leasing improve the financial position of owner-operators?

Control of Licensed Carriers/Obligations of Carriers: It can be argued that a part of the original intent of the regulatory legislation has been circumvented through the growing use of owner-operators. In particular, the original system envisaged the granting of licences to someone to provide a trucking service. This system depended on certain obligations on the part of the licence-holder and on the ability of the regulator to impose sanctions on the licence-holder for a variety of infractions.

There are some situations in Canada where the licencee has almost become a freight broker. While there may be nothing undesirable about this, it can sometimes give the regulatory system a problem. For example, it may be difficult to apply some sanctions on carriers that own no vehicles. Probably of somewhat greater concern is the fact that the power of the regulatory boards to grant authorities is partly eroded. That is, boards grant authorities to carriers; these carriers, in turn, may end up in the position - in a de facto sense - of granting (or not granting) the real authorities to individuals (owner-operators) who actually provide the service. [19]

Other Issues: There are a variety of other issues which have not been investigated. These include: i) the position of owner-operators who have transferred their vehicle registrations to a carrier's name where that carrier becomes insolvent - possibly putting the owner-operator in a difficult position with respect to the continued use of his vehicle; ii) labour (hours of work, etc.) regulations where it may be difficult to monitor or exercise any control over owner-operators; iii) vehicle weight and dimension regulations where they may be an inherent conflict between carriers (who may have an incentive for heavy loads and who may, in fact, control load-size) and owner-operators (who may find themselves responsible for fines); iv) in most provinces, regulations require the licensed carrier to be responsible for some type of insurance — when the carriers employ owner-operators (and do not own their own vehicles), complications can arise; and, v) highway safety — the current system may encourage unsafe driving practices.

4. COST CHARACTERISTICS AND THE USAGE OF OWNER-OPERATORS

This section of the paper examines certain cost characteristics of owner-operators, and presents the results of efforts to develop statistical indicators of the extent of owner-operator activity in Canadian for-hire trucking. It is concerned only with owner-operators who own tractors (not trucks) and use them primarily in linehaul (i.e. ex-urban) trucking.

OWNER-OPERATOR COSTS

Table 2 presents results of a telephone survey of trucking officials pertaining to rates paid to owner-operators through the period 1975 to 1984. These officials were asked to provide typical mileage rates applicable in their respective organizations, where the owner-operator supplied the tractor but not the trailer(s). The rates cover a variety of detailed contractual provisions (e.g. sometimes the carrier buys the plate, while other times the

owner-operator does so), a variety of carrier types (e.g. truckload bulk commodity carriers, LTL inter-city general freight carriers, etc.), and a variety of operating circumstances (as characterized by region of operation). Several of the respondents had to transform a 'percentage-of-revenue' rate into the 'equivalent mileage rate' in order to respond to the survey.

There is no basis for assigning any statistical validity as to how well this sample represents its population. All that can be said is that it is the authors' opinion that the carriers sampled include both those which would generally be viewed as paying high rates (e.g. national, unionized, inter-city general freight carriers) and low rates (i.e. prairie region, 'exempt-type' commodity haulers). Although there are undoubtedly instances of both lower and higher rates which have been paid across the country during the period examined, it is felt that this sample provides a lower and upper boundary on what would have been the actual weighted-average owner-operator mileage rate across the country for each of the years shown.

For comparative purposes, Table 3 presents a summary of tractor mileage costs as developed in the TRIMAC truck cost model [20] for the period 1972 to 1982. These mileage costs are based on the following considerations:

- they represent 'Tractor Total Costs' only, meaning 'Tractor Variable Costs' (i.e. driver, fuel, repairs, cleaning, transport, tires) plus 'Tractor Fixed Costs' (i.e. depreciation, licences).

  Interest charges, insurance costs, administrative costs associated with the tractor and 'profit' are excluded.

  (For detailed definitions of the above terms, and explanation of the model, see [20].)

- they apply for utilization rates of 160,000 kms/yr (or 100,000 miles/yr).

  Owner-operators would generally have to realize a utilization level of this order to cover costs and earn a decent wage. Many owner-operators are obliged to function at higher utilization levels to remain viable.

- they apply to tractor costs associated with standard 5-axle, power unit semi-trailer, combinations.

TABLE 2*

Mileage Rates (¢/mile) Paid to Owner-Operators[a]

Source[b]	'75	'76	'77	'78	'79	'80	'81	'82	'83	'84
A							77			
B			43	44		60	68	74	74	
C							75			80
D	41	42	43	47	54	60	71	73	73	73
E	50				59					
F	40	40	44	58	60	63	68	73		77
G									76/86/78[cd]	
H							81			88
I								80	80	80
J										80
K							81[d]			88[d]
L[e]	37	39	43	47	53	61	71			
M[e]	41	43	47	52	58	66	78			

* see FOOTNOTE [21] for details on sources and rates

TABLE 3

TRIMAC Tractor Plus Driver Mileage Costs (¢/mile)
(5-axle unit: 100,000 miles/year utilization)

	B.C.	Alta.	Sask.	Man.	Ont.	Que.	Marit.	Nfld.
DRY FREIGHT								
1972	41.3	31.3	31.4	31.1	37.1	37.1	33.8	34.6
1974	52.8	40.6	39.6	41.2	49.9	48.5	43.1	43.5
1976	67.9	57.1	56.8	56.5	64.4	64.3	56.5	57.0
1978	78.2	73.9	69.0	68.1	77.8	74.7	66.4	60.3
1980	97.0	88.4	88.7	89.8	95.8	92.5	80.3	75.8
1982	132.8	118.6	112.8	118.1	115.5	116.4	102.4	101.5
BULK								
1972	40.6	30.7	30.9	30.6	36.4	36.4	33.8	34.6
1974	51.7	38.9	38.3	39.9	48.6	48.0	42.6	42.4
1976	62.0	49.2	47.3	49.4	59.1	58.3	52.6	53.4
1978	70.4	59.7	56.4	55.8	71.5	68.1	61.9	56.9
1980	88.8	73.2	71.5	75.2	86.4	85.1	71.8	70.6
1982	115.1	98.2	91.1	98.0	105.2	110.7	94.3	96.6

Source: [20]

Five axle combinations dominated ex-urban trucking operations through the seventies and into the early eighties. The rapid growth in doubles (7-8 axle units) has only occurrec .n the last 3 or 4 years. (See [22] for an analysis of the change in fleet mix experienced in and to/from the prairie region as a result of relaxed weight and dimension regulations introduced through the seventies.)

- they distinguish between general freight and bulk carrier operations, with the former being generally 5-20% higher than the latter (depending on year and region of operation).

Figure 1 presents a comparative illustration of the range of rates paid to owner-operators (as detailed in Table 2) and the range of tractor costs developed by TRIMAC (as detailed in Table 3). The following observations are of interest:

- through the period 1976 to 1982, the highest mileage rate paid to owner-operators was more or less equal to the lowest tractor cost calculated by TRIMAC.

- rates paid to owner-operators appear to have been escalating at more or less the same rate as have costs.

  Through the period 1976 to 1982, rates paid to owner-operators appear to have been in the range of 75-80% of tractor costs developed by TRIMAC.

- since the early eighties, the escalation of rates paid to owner-operators has declined rapidly.

  This decline probably simply reflects an attendant stagnation in trucking rates themselves during this period. With many owner-operators being paid on a percentage-of-revenue basis, as the revenue per trip remains more or less constant, the owner-operator earning per trip also stays more or less constant.

It is useful to consider the means by which an owner-operator could and apparently does function at a rate which is about 75-80% of the costs of a tractor and driver as developed in the TRIMAC model. To do so, and for illustrative purposes only, consider the following detailed cost elements of the TRIMAC model [20] for a tractor and driver involved in general freight trucking using a 5-axle unit, in Manitoba in 1982. with a utilization level of 160,000 km/year:

FIGURE 1

OWNER OPERATOR MILEAGE RATES
VS. TRACTOR PLUS DRIVER MILEAGE COSTS (¢/MILE)

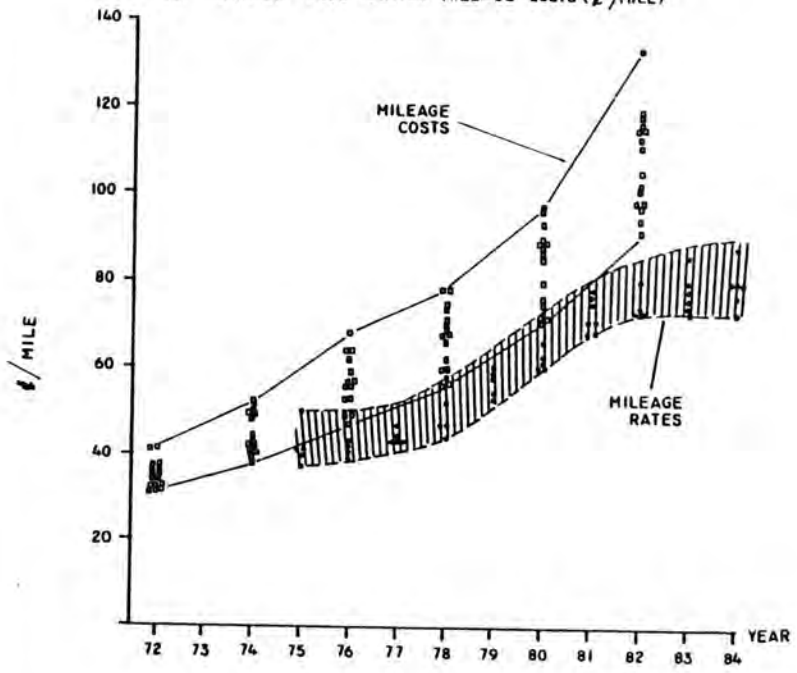
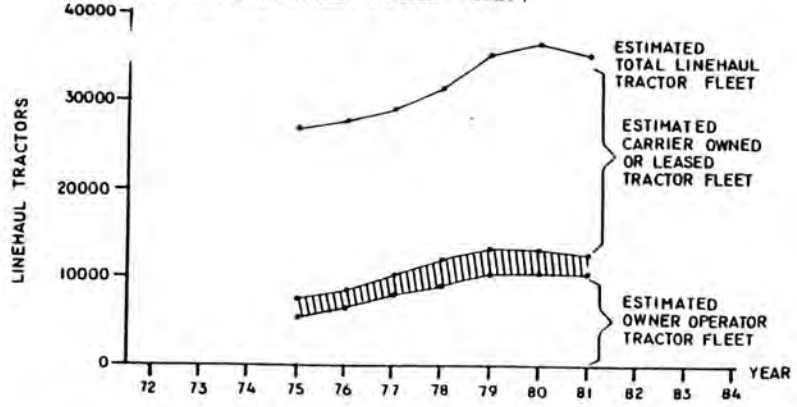


FIGURE 2

COMPARISON OF OWNER OPERATOR FLEET
WITH TOTAL LINEHAUL TRACTOR FLEET.



labor	31.1¢/km
fuel	19.4¢/km
repairs	9.4¢/km
cleaning	0.9¢/km
transport	1.6¢/km
tires	1.9¢/km
depreciation	7.9¢/km
licences	1.2¢/km
TOTAL TRACTOR COST	73.4¢/km

Of these items, it is suggested that an owner-operator could do little to reduce the cost of fuel, tires or licences indicated, and probably could do little to reduce the capital cost indicated (particularly in that it already excludes interest on debt). Thus, about 30¢ of the above kilometer cost is really beyond the influence of the owner-operator (albeit, in the short term, the consumption of capital represented by the depreciation charge may not be fully appreciated). Given that the owner-operator would typically be paid only 75-80% of the total cost shown, total earned revenue/kilometer would be (say) 57¢, thus leaving (57¢ minus 30¢), or 27¢, to cover the cost of labor, repairs, cleaning and transport. Assuming that the owner-operator could, by ingenuity and sweat, half the TRIMAC costs of the latter three items (i.e. experience a repair, cleaning and transport expense of 6¢/km rather than (about) 12¢/km), 21¢/km remains for wages (vs. the 31¢/km labor cost indicated by TRIMAC). Thus, in this case, by receiving a kilometer rate of 75-80% of the TRIMAC kilometer cost, it would appear that the owner-operator is obliged to work for a wage which is about two-thirds of the wage cost indicated by TRIMAC.

It is suggested that the acceptance of this substantially reduced wage rate, possibly often coupled with an inadequate appreciation for the consumption of capital and the opportunity cost on invested capital, is the means by which the owner-operator is able to function at the rate levels indicated in Figure 1.

EXTENT OF OWNER OPERATOR USAGE

Statistics Canada publication 53-222 ('Motor Carriers: Freight and Household Goods Movers') [23] provides basic data useful for assessing the extent of owner-operator activity in for-hire trucking in Canada. This section references only the general freight trucking component of this survey; data pertaining to household goods carrier activity is ignored.

Detailed qualifications respecting this data base, and the definitions of terminology, are explained in the source material. The following points, however, are of particular importance to the data presented and analyzed below:

- the statistics presented pertain to the sum of Class I, II and III carrier activity (i.e. carriers earning a gross operating revenue of more than $100,000/year in the year prior to the actual survey year) across Canada.
- it is assumed here that data reported under the term 'payments to lessor (or broker) operators' represents payments made to 'owner-operators' as defined for this paper.

  (To this effect, Statistics Canada defines broker or lessor operators as those who 'by means of owned or leased vehicles, haul trailers or other equipment for another carrier').

Table 4 presents a summary of payments made by Class I, II and III carriers to owner-operators, total expenses reported by these carriers, and the resultant ratio of owner-operator expense to total expense, through the period 1975 to 1981, for all Canada. Of particular interest in this table is the following observation:

- payments to owner-operators as a percentage of total carrier expenses has steadily increased from 11% in 1975 to 16% in 1981, indicating an apparently growing dependence on owner-operators in for-hire trucking in Canada.

To translate this relative indicator into an absolute indicator of the importance of owner-operators in for-hire trucking in Canada, the following methodology was used:

TABLE 4

Payments to Owner-Operators vs. Total Carrier Expenses
1975-1981

Year	Payments to Owner Operator (in millions $)	Total Carrier Expenses (in millions $)	Ratio Payments: Total
1975	280.7	2459.2	0.11
1976	339.4	2746.9	0.12
1977	418.7	3133.5	0.13
1978	530.6	3854.9	0.14
1979	688.7	4470.0	0.15
1980	801.6	5060.1	0.16
1981	872.4	5498.0	0.16

Source: [23]

TABLE 5

Estimates of the Owner Operator Fleet
1975-1981

	1975	1976	1977	1978	1979	1980	1981
Payments to O/O[a] (millions $)	280.7	339.4	418.7	530.6	688.7	801.6	872.4
'LOW' Rate[b]	37	39	41	44	51	60	68
'HIGH' Miles[c]	759	870	1021	1206	1350	1336	1283
'HIGH' Estimate[d]	7.6	8.7	10.2	12.1	13.5	13.4	12.8
'HIGH' Rate[b]	50	50	52	58	65	74	81
'LOW' Miles[c]	561	679	805	915	1060	1083	1077
'LOW' Estimate[d]	5.6	6.8	8.1	9.2	10.6	10.8	10.8
MEAN of LOW & HIGH Estimates[b]	6.6	7.7	9.1	10.6	12.1	12.1	11.8
Estimated Linehaul Tractors Owned or Leased by Carriers ('000)[e]	20.3	20.1	19.9	21.9	23.4	24.8	23.5
Estimated Total Tractor Fleet ('000)	26.9	27.8	29.0	32.5	35.4	36.9	35.3
O/O as % Total	25	28	31	33	34	33	33

FOOTNOTES:

a See Table 4
b See Figure 1: rates paid to owner-operators (¢/mile)
c annual distance travelled by lessors (million miles)
d estimated number of owner-operators ('000) assuming 100,000 mile/-unit/year
e See [24]

(i) the 'highs' and 'lows' of the mileage rate range paid to owner-operators (as presented in Figure 1) were divided into total payments made to owner operators (as presented in Table 4) for each year through the period 1975 to 1981, to obtain an estimated range of total owner-operator miles operated in each year.

(ii) the resulting estimated range of total owner-operator mileage for each year was then divided by 100,000 miles/unit (as noted earlier, an assumed typically-required utilization level for owner operators), to provide an estimate of the range of the number of owner-operator units in Canada's for-hire fleet through the period 1975 to 1981.

Detailed calculations based on this methodology are presented in Table 5. The following observation is of particular interest:

- the number of owner-operators in for-hire trucking in Canada has apparently increased from (in the order of) 6,600 in 1975 to (in the order of) 11,800 in 1981, or about 10%/year.

Assuming that the vast majority of these owner-operator units were (primarily) engaged in linehaul trucking, and were 'tractors', it is useful to compare this estimate of the range of the number of owner-operators to the number of linehaul tractors reported to be owned or leased (without driver) by carriers responding to the Statistics Canada Survey. Estimates of this latter number (for 1975-1981 inclusive) are also presented in Table 5.

This comparison of the owner operator fleet relative to the carrier owned (or leased) fleet is shown in Figure 2. The following observations are of interest:

- the total linehaul tractor fleet (i.e. carrier owned (or leased) plus owner-operator units) has increased from (in the order of) 26,900 in 1975 to (in the order of) 35,300 in 1981, an increase of about 5%/year.
- the owner-operator component of this total fleet has increased from (in the order of) 25% in 1975 to (in the order of) 33% in 1981.

5. OBSERVATIONS AND COMMENTARY

The following observations are of particular relevance:

- owner-operators comprise a significant component of the total linehaul

tractor fleet employed by for-hire truckers in Canada.

It has been estimated that as of 1981, owner-operators accounted for one-third of a total fleet of about 35,300 linehaul tractors. No estimate of owner-operator usage in private trucking has been possible.

- as of 1981, owner-operators in the for-hire sector were apparently working at an effective wage rate of in the order of two-thirds of that paid to equivalent salaried employee drivers.

  It is also possible (and it is suggested, likely) that there is a substantial amount of capital 'loss' associated with the owner-operator sector of the trucking industry. This presumably translates into lower rates than would otherwise be the case, at least in the short term.

- with the exception of Quebec, no Canadian jurisdiction has really recognized the place of owner-operators in their regulatory system governing truck transport.

  This failure to do so, to a great extent, accounts for many of the regulatory problems in Canadian trucking. Problems of particular interest include: status of leased vehicles; definition of for-hire carriage and definition of private carriage, and; a resultant difficulty in distinguishing between permitted and un-permitted ('illegal') for-hire carriage.

As a final comment, it is of interest to observe that the great 'regulation' debate in Canada tends to concentrate on the question of the controls on carrier authorities and carrier rates, and related carrier obligations. With the large amount of owner-operator activity, and its apparent growth, within for-hire (and probably private) trucking, one wonders if the focus of this debate is well-directed. Is it possible that the issues and concerns which initially gave rise to the regulation of motor carriers are now re-appearing with respect to owner-operators?

ACKNOWLEDGMENTS

Funding support for part of the work reported in the paper was provided by the Centre for Transportation Studies, University of Manitoba. The assistance of Mike Janssen and Richard Mak, graduate students at the University of Manitoba, is also acknowledged.

Footnotes

1. The Task Force Review of Motor Carrier Regulations in Manitoba, Manitoba Motor Carrier Industry: Background Information, "Economic Regulation of the Motor Carrier Industry in Manitoba: Motor Freight Carrier Industry Structure and Performance", June, 1983, p.27; Ontario Ministry of Transportation and Communications, "Discussion Paper: Owner-Operators of Trucks and Truck Transportation Brokers in Ontario", May 1980.

2. In particular, persons owning a truck and hauling "exempt commodities" are also referred to as "owner-operators" (or "independent truckers") in some situations.

3. Section 4A of the Motor Carrier Act.

4. Decision of the Board of Commissioners of Public Utilities, April 8, 1981, concerning the application of Marcel Montgrain.

5. Section 1 of the Motor Carrier Act.

6. Section 1(d) of the Act defines "carrier" as (among other things) a person who uses a truck-tractor to pull a trailer.

7. Ont. Ministry of Transportation and Communications, op. cit., pp.7 - 10. Also, Ontario Trucking Association, "Owner-Operator Survey: Summary Report", Aug. 1980, p.7. (Sixty of the 64 companies included in the survey reported that owner-operators registered their vehicles in the carrier's name.)

8. Sect. 16(4) of the PCVA states that no one can operate a licensed trucking operation unless he is the registered owner of the vehicle or unless "he has entered into an agreement for a lease of the vehicle in accordance with this Act and the regulations". Sect. 4 specifies what constitutes a valid lease. In addition, the Board has adopted administrative procedures which further define the form and/or contentsof leases.

9. Ont. Ministry of Transportation and Communications, op. cit., p.9

10. The Manitoba Task Force discusses owner-operators working for for-hire carriers under the general heading of "Leasing" (The Task Force Review of Motor Carrier Regulations in Manitoba, Manitoba Motor Carrier Industry: Problems, Issues, Options, pp. 17-27.) However, the authors write: "The agreements between trucking companies and so-called owner-operators are technically not lease agreements but simply 'agreements' or 'contracts'. By the terms of the agreement the company does not lease or buy the vehicle and does not assume any financial obligations pertaining to the ownership of the vehicle." (p.20)

11. In the past, this re-registration mechanism required that a lease agreement be filed with the regulatory authorities.

12. D. H. Maister and W. Behrenbruck, "The Owner Operator Study: Phase One: A Review of Current Laws", Nov. 1978, describe these procedures.

13. Maister and Behrenbruck, op. cit., pp. 4-5.

14. There is a large number of articles available. For example, the Ont. Ministry of Transportation and Communications, op. cit.,; or, the (U.S.) Office of Transportation Analysis, "Owner-Operators and the Motor Carrier Act of 1980", mimeograph paper, Feb., 1982; or, T.M. Corsi and J.M. Tuck, "The ICC and Owner-Operators: Leasing Rule Modifications", mimeograph paper, April, 1982.

15. To elaborate, owner-operators are permitted to trip lease for licensed for-hire carriers; as licensed for-hire carriers can trip lease for other carriers, owner-operators who are on long-term leases for one carrier can temporarily work for another carrier; and, owner-operators who haul exempt commodities can trip lease with licensed carriers under certain conditions.

16. T.M. Corsi and J.M. Tuck, op. cit., ("... Leasing Rule Modifications"); or, by the same authors, "Owner-Operator Turnover Between 1977-1980", mimeographed paper, June, 1982 (there was a turnover rate of roughly 50%); or, a report by the Secretary of Transportation Neil Goldschmidt, Problems of Truck Owner Operators, U.S. Department of Transportation, Washington, Oct., 1979; or, a report by the Owner-Operators Independent Drivers Association of America, The Economic Status of Owner-Operator Truckers: A Preliminary Investigation, Nov., 1983.

17. Ont. Ministry of Transportation and Communications, op. cit., p. 10.

18. See, for example, the recommendations made by the Select Committee of the (Ontario) Legislature on Highway Transportation of Goods. (A Public Policy Direction for the Highway Transportation of Goods, 1977, p. VI-94.)

19. This, in part, is the concern of the Task Force Review in Manitoba (op. cit., ... Problems, Issues, Options, p. 21) discussed in the broader context of vehicle leasing.

20. "Operating Costs of Trucks in Canada", prepared by TRIMAC Consulting Services Ltd., published by Transport Canada: 1972, 1974, 1976, 1978, 1980, 1982.

21. a Several of these rates were estimated by the respondents from a conversion of a 'percentage-of-revenue' rate to an equivalent mileage rate.

b Notes on Sources
- A Manitoba-based carrier, operating nationally
- B Saskatchewan-based carrier, operating in western region
- C Saskatchewan-based carrier, operating intra-Saskatchewan
- D Saskatchewan-based carrier, operating in prairie region
- E Saskatchewan-based carrier, operating in prairies and to/from U.S.
- F Saskatchewan-based carrier, operating in prairies and to/from Ont./Que.
- G Alberta-based carrier, operating in western region
- H national carrier, rates applicable in Ontario
- I national carrier, rates applicable in prairie region
- J national carrier, rates applicable on Toronto-Winnipeg lane
- K national carrier, rates applicable in Ontario
- L national carrier, rates applicable in prairie region
- M carrier L, rates applicable in Ontario

c 76¢ (Sask.); 86¢ (Man.); 78¢ (Alberta)
d averages of quoted rates for 'loaded' and 'M/T' haul
e average of quoted rates for 1 and 2 drivers.

22. "Truck Industry Technological Response to the Western Canada Highway Strengthening Program", [A. Clayton, G. Sparks and R. Mak,] R.T.A.C. Annual Conference, Edmonton, September, 1983.

23. "Motor Carriers: Freight and Household Goods Movers", Statistics Canada, Catalogue 53-222, Annual: 1975 to 1981 inclusive.

24. The number of linehaul tractors owned or leased by Class I carriers are presented directly in [23]. Equivalent numbers for Class II and Class III carriers were estimated by multiplying 'total tractors' for these classes by the ratio of (linehaul: total) tractors for Class I carriers in each of the respective year.

AN ANALYSIS OF THE TRANSBORDER LTL TRUCKING INDUSTRY

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ABSTRACT

This paper examines the Less than Truckload, British Columbia - U.S.. Trucking Market and the entry policies that might be enacted in B.C.. It concludes that an open border policy would not result in a severe loss of market share from Canadian to U.S. domicile carriers. The primary diversions would be from U.S. domicile to U.S. domicile or from Canadian domicile to Canadian domicile carriers. The study highlights the need to understand competitive and behavioral relationships that govern the conduct and performance of new and existing carriers in the market.

INTRODUCTION

Transborder trucking between Canada and the United States is an important link between the two economies. Both countries agree that transborder trade should be expedited by means of the most efficient and economical transportation possible, but differences in the policies and economies of the two nations make it difficult to pursue this objective.[1] This is most evident in the divergence of regulatory philosophy and practice between the two countries. The U.S. enacted the Motor Carrier

Act of 1980 which significantly reduced the regulation of the industry. Specifically, it removed the proof of public necessity and convenience as a requisite for obtaining operating authority. Meanwhile entry regulation in Canada remains comparatively static as each province continues to utilize some form of public convenience test in evaluating operating rights applications. At the present no province has significantly changed their transborder entry policies but most provinces are investigating the issue formally or informally. Certain consequences of a more relaxed transborder entry policy by Canada are investigated in this paper.

This paper concentrates on the Less Than Truckload (LTL) British Columbia (BC) - U.S. transborder market and the regulatory changes that might be enacted in B.C. Regulation has always had a stronger impact on the LTL sector of trucking. The regulation of transborder trucking, like interprovincial trucking, was delegated to each province by the Motor Vehicle Transport Act of 1954, and this remains the case until the Federal government implements the provisions of the National Transportation Act (1967) that undo this delegation of Federal responsibility. As with most Canadian provinces, B.C.'s transborder trucking regulation is characterized by restrictive entry control and no rate control.[2] However, B.C.'s economy, geographic and economic relationship with the U.S., and current transborder industry structure could vary significantly from those of other provinces. Hence conclusions made about one province should not be

expanded to other provinces without consideration of these differences.

MAJOR TRANSBORDER TRUCKING ISSUES

The province of Ontario has gone the farthest in investigating the impact of relaxing Canadian restrictions on entry into the transborder trucking market. Their July 1983 report highlighted the lack of factual information required to make rational policy decisions and identified the major concerns of shippers and carriers.[3] The broad issues that appear to be emphasized are:

(1) whether reduced economic (entry) regulation will result in an efficient industry that meets the needs of transborder trade both in the short and long run,
(2) whether selective entry by U.S. domiciled carriers will impair service to non-transborder markets (in particular small communities), and
(3) whether reduced regulation will result in severe dislocation of Canadian trucking.

The efficiency issue is not addressed in this paper. Trucking performance under regulation has been the subject of a great volume of research and the U.S. situation is offered as an example of how the regulated Canadian industry might perform with much less regulation, yet the evidence is apparently not conclusive. In the last three years all but two provinces have begun a formal review of trucking regulations in their jurisdictions and the variety of recommendations reflect the continuing uncertainty about the potential effects of deregulation. Ontario's review committee recommended that the province significantly reduce entry regulation, Quebec endorsed

marginal changes and the study group in New Brunswick and Nova Scotia essentially endorsed the current regulatory structure.[4]

All of the available evidence suggests that the impact of a relaxed transborder policy on small communities would be minimal except possibly in Saskatchewan and Manitoba where cross subsidization has been observed. The argument against freer transborder entry is that new entrants would increase competition in the major traffic lanes serving large communities. The increased competition would lower the ability of existing carriers (serving both large and small communities) to serve the smaller communities. This cross subsidization has only been observed in provinces that regulate rates and explicitly not observed in non-rate regulating provinces such as Ontario.[5] Furthermore, this argument could only be correct if the majority of carriers serving small communities also competed in transborder market lanes. This does not appear to be the case in most of the provinces, including B.C. Since B.C. also does not regulate rates, it is unlikely that changes in transborder entry regulation will have a negative impact on service to small communities in that province.

The most widely publicized issue is the potential loss of transborder market share from Canadian domiciled carriers to U.S. domiciled carriers. It is argued that differences in geography, the distribution of economic activity and the characteristics of the carriers between the two countries confer a competitive advantage to U.S.

domiciled operations. Canadian domiciled carriers would have to relocate their base of operations in the U.S. in order to effectively compete, resulting in a loss of jobs, assets, purchasing power, and taxes to the U.S.

Dislocation of industry is a legitimate concern of the policymaker who is sensitive to all of its public. The Ontario PCV committee, in calling for a significant reduction in regulation, also recommended a gradual implementation process that would minimize the transition from a government regulated to a market regulated environment.[6] It is important to know which components of the current transborder industry will gain and who will lose. This is the major issue that will be studied with respect to the BC-US LTL truck market.

METHODOLOGY

This investigation seeks to simulate the conduct and resulting structure of the transborder industry under a changed regulatory scenario. In order to accomplish this the current structure of the industry, probable conduct of the market participants, and characteristics of competitors must be understood. The behavior of U.S. and Canadian carriers since the Motor Carrier Act of 1980 and explicit statements by carriers provide insight about the market conduct changes that would occur if B.C. relaxed entry. The success of these strategies are dependent however on the competitive strengths of the various competitors, shipper/receiver (s/r) choice processes and factors such as customs procedures. Information was

consolidated from existing studies, industry literature and forty eight field interviews conducted with carriers, shippers and other participants involved in transborder shipping both in the U.S. and Canada.

BC-US TRUCK TRAFFIC FLOW

Accurate statistics of the flow of goods by truck are unavailable. However, the dollar flows displayed in Table 1 are indicative of several characteristics of the BC-US truck market. Overall, there is a significant imbalance of trade with the U.S. exporting 62 percent more to B.C. than B.C. exported to the U.S. by truck. About 70 percent of the exports and 57 percent of the imports are with the Pacific states. B.C. exports more fabricated products to these west coast states than they import, while the reverse situation characterizes the trade of end products. Fabricated products are more likely to be low valued shipped in TL lots. These two product categories account for 73 and 57 percent of export and import value (by truck) respectively. End products are most likely to be transported by LTL type carriers and be of high value.

These directional imbalances are confirmed by the LTL carrier respondents. The transborder carriers estimated that northbound general freight traffic volume is two to four times that of southbound general freight traffic although the traffic imbalance has lessened due to the declining value of the Canadian dollar. The carriers also confirmed that the majority of the

TABLE 1

1982 BC-US TRADE BY TRUCK

(000,000 $Cdn)

To/From (Product Type)	Exports from B.C.	Imports to B.C.
U.S. (all)	1,068	1,733
Washington Oregon Alaska (all)	552	616
California Hawaii (all)	187	375
Pacific Region (Fabricated Materials)	353	203
Pacific Region (End Products)	187	364

Source: Tabulated from Import and Export data provided by Statistics Canada.

Note: Statistics refer to goods entering and leaving Canada in B.C. A small but unknown percentage of the flow may originate from or be destined to other parts of Canada. Traffic to and from Alaska and Hawaii are also assumed to be negligible.

transborder traffic in and out of B.C. was from or to the West coast states and specifically Seattle, Portland, the Bay area and southern California. Finally, the carriers all indicated that the primary destination of freight in and out of B.C. is Vancouver, a reasonable conclusion given that the Vancouver regional district accounts for about half of all manufacturing establishments, value of factory production, and population of B.C. Several Canadian carriers did indicate that they transported

substantial volumes of freight from the U.S. west coast through B.C. and east to Ontario in competition with U.S. carriers who would transport the goods to Ontario through the Buffalo gateway. This pattern of traffic flow is consistent with that observed by Maister and Munro in an earlier survey.[7]

THE CUSTOMS ENVIRONMENT

Customs requirements are a major influence on the behavior of the participants in the transborder freight market. Two pieces of documentation are typically required in a transborder movement.[8] Goods imported to Canada from the U.S. require a U.S. Shipper's Export Declaration and a Canada Customs Invoice. Goods exported from Canada require a Canadian Export Entry and the U.S. Special Customs Invoice. Typically, it is clearance in the destination country that is the most complex and the cause of delays. The importer completes the customs invoices sent by the consignor by adding tariff, sales tax, commodity codes and other information, and then stands in line at customs to present the entry and pay applicable duties and taxes. After these are paid a customs officer (commercial inspector) examines the merchandise to make certain that they are the ones described on the invoices. The goods are now cleared for delivery to or pickup by the consignee. Frequently a customs broker is hired to perform these activities as the agent for the consignee.

There is a significant difference between U.S. and

Canadian clearance procedures on goods entering the respective countries by truck.. Goods entering Canada may be cleared at designated border crossings or at inland sufferance warehouses. The bulk of the LTL freight is cleared at the sufferance warehouse for many reasons. Incorrect or insufficient documentation on any one shipment could delay all other shipments on that trailer. Rehandling is avoided for some carriers. Freight that is cleared at the border could potentially be unloaded for inspection, reloaded, and then rehandled at a local terminal. However, several carriers have their local terminal located at the sufferance warehouse so that freight is unloaded for customs inspection and cross docking for delivery at the same time. The major sufferance facility for motor carriers in western B.C. is United Terminals which is owned by its largest tenant, Consolidated Freightways. Canadian customs is provided free office space at the terminal and all carriers that have terminal space there pay rent to United Terminals. Currently the tenants are the large U.S. carriers and one Canadian carrier. Since most Canadian carriers are not tenants of United Terminals and, they must use the public portion of the facility where freight can be unloaded for customs inspection (although inspection may not necessitate complete unloading all of the time). The freight may be reloaded for direct delivery by the carrier or by an interlining carrier, or for further handling at a local terminal. Carriers agree that being located at United Terminals results in substantially less

handling cost and fewer delays.

U.S. customs requirements are easier to deal with relative to Canadian Customs, according to shippers and carriers. The main difference between Canadian and American Customs clearance is the border procedure. Most LTL freight destined for the U.S. is cleared at the BC-US border. When moving freight southbound from Canada to the U.S., the LTL freight must be loaded in such a way that an aisle (about three feet wide) exists down the centre of the trailer. In this way, U.S. Customs officials can visually inspect shipments, if they so desire. The effect of such a loading pattern is that the usable capacity of the trailer is drastically reduced. In addition, some trucking firms allege that damage claims are higher due to the loading restriction. However, the imbalance of freight favoring northbound movement minimizes the problem caused by this loading and inspection requirement.

Customs requirements are cited by shippers and carriers alike as a source of confusion and delay. Because there are so many ways in which a delay may occur, an aura of complexity shrouds transborder movements, particularly for s/rs who deal infrequently with such freight movement and those who are geographically far from the physical process.

SHIPPER/RECEIVER CHARACTERISTICS

The behavior and choice processes of the s/rs involved with transborder movement ultimately determine

the success of various carrier strategies in the market. In particular, it is important to know who (the shipper or receiver) makes the carrier selection and what factors are important in that selection decision.

The direction of major BC-US traffic flows indicate that the predominant flow of LTL competitive goods is from the U.S. to B.C. Shipper and carrier interviews confirmed the findings of Maister and Munro (1977) who found that both the majority of the Canadian receivers (importing from the U.S.) and the majority of the Canadian shippers (exporting to the U.S.) chose or strongly influenced the selection of the carrier. All of the carriers stressed the predominance of inbound sales in Vancouver. The majority of the shippers (U.S. and Canada) indicate that northbound movements are typically sent on freight collect terms and that the receiver specified the carrier. This is in sharp contrast to the commonly perceived notion that carrier selection is controlled at the point of origin of the shipment. Several explanations were offered to explain receiver control of imports into B.C. U.S. exporters deal with the transborder market infrequently and are not familiar with customs and transportation procedures for international freight. Most American firms interviewed receive less than five percent of their revenues from Canadian sales and did not appear to be interested in controlling this minor market at the expense of its larger domestic market. Several U.S. shippers indicated that they normally complied with receiver routing

requests to maintain good customer relations. One U.S. shipper, for example, participates in an aggregate volume discount program but complies with routing requests that result in higher transportation charges. The shippers that did control freight movements emphasized the ability to obtain volume rate discounts. Freight collect and FOB origin sales terms contribute to the current structure. U.S. exporters note that goods that do not pass customs or are rejected leave the supplier in a vulnerable position if they own the goods at that point.

All of the Canadian receivers that were interviewed seem to want to control freight movement. In addition to wanting to minimize costs on freight collect movements, they also indicated a desire to know what carrier is delivering the shipment to be able to trace the movement and to coordinate the physical movement performed by the carrier with the transactions of its chosen broker. The latter form of control is very important in order to minimize the potential delays involved in customs clearance.

The Maister/Munro survey also indicated that Canadian shippers controlled freight movement to the U.S. The s/r respondents were in most cases dealing in northbound movements. Returned or damaged merchandise shipped to the U.S. was always the responsibility of the shipper in Canada. Two Canadian respondents did ship and control large quantities to the U.S., however these were TL movements. As noted above, the carrier respondents confirmed that most exports from B.C. were controlled at

point of origin.

Regardless of who controls the freight movement and ultimately makes the carrier selection, shippers and receivers overwhelmingly rank time related service factors as the most important consideration in transborder carrier selection. These include transit time, reliability, and on time Pickup and Delivery (P&D). Other highly ranked factors were rates and Loss and Damage (L&D) experience. Most of the respondents indicate however that most of these factors are evaluated simultaneously and many indicated that they would accept slower or less reliable service in return for lower rates (without indicating the precise tradeoff). Several respondents indicated that they had switched carriers based on rates and on L&D claims. It appears that carriers in direct competition are providing equal service with respect to transit time and differentiating themselves with regard to rates and other service aspects.

Single line service was not presented as a carrier choice factor in the field interviews since it is not a mutually exclusive category from more basic factors such as transit time, tracing and L&D. Instead respondents were asked to indicate their preference for single line versus joint line service. The preference was for the former for numerous reasons including:

1. interline freight has higher L&D ratios,
2. interline freight claims, particularly on hidden damage, are more difficult to resolve,

3. interline freight is harder to trace, expedite and control,
4. interline freight service is less reliable and takes longer,
5. discounts are not always available on interline service.

One selection factor that was mentioned only once in the top five factors by any respondent was market coverage. This factor was similarly ranked sixth by shippers and receivers in the Maister/Munro study. This is reasonable because the benefits of one stop shipping occur when the market of the respondent (in bound or outbound) are widely dispersed. Most Canadian importers dealt with a few suppliers concentrated in one or two states on the West Coast. There were indications that some U.S. exporters preferred broad coverage carriers because this gave them greater opportunities to obtain multiple tender or volume discounts. But as noted earlier, the tendency is to comply with receiver routing requests or to send the product freight collect on exports to Canada.

Structure of Transborder Competition

A transportation market is defined by its geographic origin and destination as well as the type of service (LTL in this case) provided. Major geographic markets are classified in Figure 1 which identifies the types of competitors and their relative importance in each market. This assessment was developed from the

consolidated responses of carriers since market share data was unavailable.

Motor carriers participating in the transborder market can be classified by the type of operating authority it holds and its domicile. The structure and conduct of each type is explored below.

1. SLUSUS - U.S. domiciled carriers with broad authority across the U.S. and international authority into B.C. There are currently three: CFWY (CFWL) - Consolidated Freightways Corp. (Canadian Freightways, Ltd.), MLNT (DELT) - McLean Trucking Co. (Delta Lines, Inc.) and RYPI - Ryder/ P.I.E. Nationwide Inc. All of these companies have extensive market coverage in the U.S. and were in the transborder market before 1980 either in the present form or as another carrier. The major change has been the withdrawal of T.I.M.E. D.C. whose operating authority was absorbed by CFWY. All of the carriers have dedicated terminal space at United Terminals to facilitate the coordination of customs and rehandling activities. All of the carriers, except CFWY, generally have authority to Vancouver and not into the B.C. interior. CFWY interlines with CFWL, its Canadian affiliate which serves key points in the B.C. interior and Alberta. Shipper and carrier competitors view that integrated operation as effectively single line service and unanimously agree that CFWY is the dominant competitor in the BC-US transborder market.

The operating strength of all of these carriers are

Figure 1

STRUCTURE OF COMPETITION IN THE BC-US LTL MARKET

Georgraphic Market	Competing Carriers
Pacific Northwest-Vancouver	1. SLCDCN and SLUSUS at keypoints (Seattle, Spokane, Portland) in U.S. 1. JLUSNW with SLCDCN from outlying areas using key points as interchange point in US. 2. JLUSNW with SLUSUS as above.
California-Vancouver	1. SLUSUS 2. JLUSCA with SLCDCN interchanging in the Bay area, Portland and Seattle. 3. JLUSCA with SLUSUS interchanging in California 4. RFF especially from Southern California. 5. SLCDCN (TNTD from Bay area)
U.S. other than West Coast - Vancouver	1. SLUSUS 2. JLUSUS with SLCDCN interchanging in U.S. 3. RFF (consolidates from U.S. East, South and Central states) 4. JLUSXX with SLCDCN or SLUSUS interchanging in US (especially from mountain states).
Pacific Northwest-BC Interior	1. SLCDCN and CFWY to key points in BC. 2. JLCDBC with SLUSUS to key points in BC interchanging in Vancouver. 1. JLCDBC with SLCDCN or SLUSUS to outlying areas interchanging in Vancouver.
California to BC Interior	1. CFWY to key points 2. SLUSUS with JLCDBC to key points interchanging in Vancouver. 2. JLUSCA with SLCDCA to BC key points interchanging at U.S. key points. 1. SLUSUS with JLCDBC to non-key points interchanging in Vancouver. 2. JLUSCA with SLCDCN with JLCDBC to non-key points interchanging in US and Vancouver.

US others than West Coast - BC Interior	1. CFWY to key points 2. JLUSUS with SLCDCA to key point interchanging in US. 2. SLUSUS with JLCDCN or JLCDBC to key points interchanging in BC. 1. SLUSUS with JLCDBC to non-key points interlining in BC. 2. SLCDCA with JLCABC to non-key points interlining in BC.
Pacific Northwest-Canadian points East of BC	1. CFWY and SLCDCN to Alberta 1. SLCDCN to Eastern Canada * SLUSUS could joint line with JLCDCN but typically routes across U.S. and crosses border at Eastern entry point.
California - Canadian points East of BC	1. CFWY to Alberta 2. JLUSCA with SLCDCN to Alberta and eastern Canada see * - above

Notes: Abbreviations defined in text. Numbers indicate relative importance in market.

their long haul single line service. As a group they are the dominant competitors between B.C. and U.S. points outside of the Pacific Northwest.

2. SLCDCN - Canadian domiciled carriers with broad authority across Canada and international authority into the U.S. There are currently four: CDAP - Canadian Pacific Express and Transport, KIFL - Kingsway Freightlines, Ltd. MOWL - Motorways Ltd., and TNTD - TNT Canada Inc. (Alltrans). Most of the Canadian carriers are recent entrants into the U.S. TNTD (Alltrans) began single line service into Washington before 1980 but the entry of the other three carriers into the Pacific Northwest have all occurred since 1980. All of these carriers had to successfully obtain both B.C. and U.S. international operating authority and have voluntarily

limited their direct service to key points such as Seattle and Portland. Only TNTD has direct service to the Bay Area and this is also marketed as a means to transport freight to Eastern Canada via Vancouver. All of these carriers interline with local and regional U.S. carriers (see JLUSXX below) in order to serve outlying areas and particularly California. Of the four, only MOWL and CDAP directly serve the B.C. interior to any extent. TNTD and KIFL have only one terminal each in B.C. outside of Vancouver.

These carriers are most competitive in the short haul market between Pacific Northwest points on the U.S. side, and Vancouver, key points in the B.C. interior, and eastern Canada on the Canadian side. Their other role is as a partner with regional U.S. carriers in competition with SLUSUS. As Canadian carriers have expanded into the U.S., many U.S. carriers had the opportunity for the first time to compete in the transborder market by interlining with Canadian carriers which were not direct rivals in the domestic market.

3. JLUSUS - U.S. domiciled carriers with broad authority across the U.S. who are joint line partners with SLCDCN. Carriers frequently identified in this group are: ABFS - ABF Freight Service Inc., RDWY - Roadway Express, Inc., and YFSY - Yellow Freight Systems, Inc. A typical situation is the interline arrangement between YFSY and TNTL at Seattle. These carriers are similar to the SLUSUS being large and well financed and having broad market coverage. They all have established

operations in Seattle as part of aggressive expansion plans since deregulation and at least one is likely to expand into Vancouver if given the opportunity.

4. JLCDCN - Canadian domociled carriers with broad authority across Canada who are joint line partners with single line carriers (e.g., have no transborder authority). Frequently mentioned carriers were: DTSL - Direct Transportation System Ltd./Millar and Brown Ltd., ICTL - Intercity Truck Lines Ltd., and DKPT - Dickson, P. Trucking Ltd. To the degree that any freight moves from the U.S. to other parts of Canada through B.C., these carriers could be a competitor along with the SLUSUS against the SLCDCN. However California traffic would have to travel from 35 to 50 percent further distance if it were routed through Vancouver. Thus this traffic is usually routed by the SLUSUS across the U.S. and cross the border at the Detroit or Buffalo gateways. In contrast, circuity is not an important factor in the Pacific Northwest-Eastern Canada or West Coast to Alberta traffic lane. Finally some of these JLCDCN carriers have extensive coverage into B.C.'s interior (e.g., DTSL) and are a competitive factor in those areas.

5. JLUSXX - U.S. domociled carrier with authority primarily in one U.S. region (XX) and who interline with single line carriers especially the SLCDCN. Some well known competitors are: AICF - Acme Inter-City Freight Lines, EAFF - Edmonds-Alderwood Auto Freight Co., RETL - Reddaway's Truck Line Inc., SECG - Silver Eagle Co., WCAF - Wallace-Colville Motor Freight Inc. in the Northwest;

DSTK - DiSalvo Trucking Co., VIKN - Viking Freight System, Inc., SSTM - System 99 in California; IMLF - IML Freight, Inc., BNTN - BN Transport Inc., GFLS - Garrett Freightlines Inc. from the mountain states. There did not appear to be much interlining from regional carriers in the southern, central or eastern US.

The traffic base of most of these carriers is short or medium haul domestic movement in the U.S. They tend to be assembly and distribution carriers whose local market coverage could be used to consolidate or distribute from key points where the SLCDCN have a terminal. As with the larger JLUSUS, these carriers became part of the transborder industry because Canadian carriers expanded their line haul service to key points in their region. Consequently, actual joint line competition in the transborder market has increased significantly. There are 37 carriers domiciled in Washington and Oregon alone who are listed as interline carriers in PITB Tariff No. 352.

U.S. regional carriers are not impeded by regulation from expanding in the U.S. now. The market size, economic constraints, customs barriers, and other non-regulatory barriers associated with the Canadian traffic lanes probably would make expansion into Canada even less desirable or attainable. The pacific northwest carriers that are most familiar with customs are small and not likely to expand into Vancouver if given the opportunity.

6. JLCDBC - Canadian domociled carriers with authority solely in B.C. and possibly Alberta or the northern

territories and who interline with single line carriers in Vancouver. Carriers frequently mentioned are: Abbotsford Freight, Capital Freightways, Public Freightways Ltd. (Johnston Terminals), Langley Freight, Mission Freight Lines Ltd., Sidney Freight Ltd., Van Kam, and White Pass Transportation. These carriers are assembly and distribution carriers like their counterparts (JLUSXX) in the U.S. However their service points are stillconstrained by entry control so that many serve a very limited market. Capital Freightways and Sidney Freight, for example, provide scheduled service out of Vancouver to Vancouver Island. Public Freightways has the most extensive coverage of B.C. points from Vancouver.

7. RFF - Rail freight forwarders such as: Acme Fast Freight of Canada Ltd., B.C. Forwarding Company Ltd. (Chi-Can Freight Forwarding Ltd.), Coast Carloading of Canada Ltd., and Superior Fast Freight. These carriers are most competitive in long distance, in bound markets, for example, from Southern California or from Chicago.

Conduct of Transborder Competitors

The transborder market has not escaped the pressure to be price competitive. All of the major motor carrier competitors participate in Pacific Inland Tariff Bureau (PITB) or Rocky Mountain Tariff Bureau (RMB) rate tariffs and most have offered some form of discount off of these published rates for single line movements. Discounts available on transborder freight include straight

reductions, selected reductions on certain types of freight or customers, and discounts in return for multiple tenders and other cost reduction actions. Several shippers indicated that they had switched carriers as a result of price differences. Additional price competition arises from the rail freight forwarders who generally charge a lower rate in return for slower rail service.

When comparing relative rate levels between U.S. domestic and transborder lanes, almost all carriers agreed that US-BC transborder rates had not decreased as much as some domestic freight charges. However deep price reductions were not ubiquitous throughout the U.S. so it is unfair to say that the transborder market was any less price competitive. No Canadian (B.C.) rate regulations exist to contrain price competition and there is no evidence of carrier collusion to prevent price competition as was the case in Eastern Canada-U.S. markets.[9] CFWY reports in their annual report that there was an increase in price competition in Canada (faced by CFWL) similar to that in the U.S. (faced by CFWY) yet there was no change in the regulatory status in Canada.[10] The question that remains unanswered is whether price competition would have been more intense if a greater number of competitors were in the market.

All of the competitors appear to offer about the same level of transit time and reliability between Vancouver and major cities along the West Coast of the U.S. In most cases advertised joint line and single line

transit times were equal. Price/service competition include expedited service such as TNTD's Comet service and CFWY's day saver service (an air-ground service) which are at least one day faster than conventional road service to California. However, several s/rs indicated that they had switched carriers because of poor L&D performance. Both U.S. and Canadian competitors also have tried to differentiate themselves by offering various information services such as special tracing procedures or inbound manifests, but none of the s/r respondents appear to value these services very highly vis a vis the basic dimensions of service (transit time and reliability, L&D factors) and rates.

A major competitive advantage held by RYPI, MLTN, TNTD and in particular CFWY is the location of their terminal facility at the sufferance warehouse in Vancouver. Carriers located at United Terminals are able to keep paperwork inconvenience and delays at a minimum, at the same time moving the freight as efficiently as possible because brokers (or the shipper), customs, and carriers all have working access to the freight at a common point. Other carriers utilize the less convenient public dock for customs clearance where freight is potentially off loaded for inspection and reloaded for delivery to the local terminal. Proposals to establish another sufferance warehouse in the Vancouver district have been rejected.

Regulatory Options

The impact of deregulation on the various competitors in the transborder market cannot be assessed without knowing the applicability of relaxed entry to types of routes and types of traffic. In the discussion above, the high density U.S. to Vancouver market was distinguished from the low density U.S. to B.C. interior market. The deregulation alternative must indicate whether relaxed entry is to apply to one route type or to both. Furthermore, there is intraprovincial and interprovincial freight movement in addition to international freight movement to deal with. The deregulation alternative must indicate whether one, two, or all three types of traffic can be carried by a carrier and since the demand for all three types of movement often occur simultaneously in space and time, changes in the control of transborder freight cannot be considered in a vacuum apart from domestic movements.

Three deregulation alternatives seem plausible. First relax entry control on the U.S. to Vancouver (or Lower Mainland) market. Second, relax entry control on all transborder but not intraprovincial or interprovincial movement into B.C. A regulatory policy separating one movement from the other would lead to obvious inefficiencies since Vancouver is the major source and destination of intraprovincial traffic as well as the transhipment point for transborder freight destined or originating in the B.C. interior. Consequently a third option is to relax entry control on

both the transborder and intraprovincial movement in the province. Interprovincial policy is not considered because the effect would be contingent on the entry policy of the other provinces. The probable market shift encouraged by each of these options are outlined below along with the major supporting assumptions.

Open Border Policy to Vancouver

One or more of the large and well financed JLUSUS carriers would probably expand into Vancouver and move their interchange point with the SLCDCN carriers from the U.S. to Vancouver. These carriers can offer service comparable to that offered by the current SLUSUS carriers except they will not have the benefit of being located at United Terminals. It is assumed that Revenue Canada will not be amenable to the establishment of another sufferance facility unless there is a substantial increase in the volume of freight that requires customs clearance. Although there could be more carriers, this is not increased freight volume. Nevertheless, carriers not located at the sufferance facility can be competitive as suggested by the existence of CDAP, KIFL and MOWL. The JLUSUS have the market coverage that would generate sufficient volume to warrant expansion. SLCDCN will lose interline traffic and the existing SLUSUS will face substantial new competition.

JLUSXX could also expand into Vancouver but this is less likely. Some of these carriers are small and without the resources to expand into Canada. Others are

regional carriers by design, seeking to develop that niche rather than expanding the breadth of their operating area. These carriers certainly would not have the potential to generate the same freight volume to Vancouver as the JLUSUS can.

This open border policy would also permit the JLCDCN to expand into the U.S. This would probably only occur in the short haul market to the Pacific Northwest as the current SLCDCN have generally stopped at that point because of economic rather than regulatory barriers. Another strategy for these carriers would be to remain as interline carriers except that they now have a wider choice of interline partners as the JLUSUS carriers become SLUSUS carriers. Freight that was interlined in the U.S. to SLCDCN can now be interline directly to JLCDCN or JLCDBC in Vancouver. The JLCDBC carriers have the same expansion opportunities as the JLCDCN carriers except, like the JLUSXX, they have less ability or incentive to expand past Vancouver into the U.S. Both the JLCDCN and JLCDBC carriers will have expanded opportunity to compete on transborder freight between the Pacific Northwest and key points in the B.C. interior which CFWY and several of the SLCDCN carriers currently dominate.

In sumary the existing SLUSUS will face increased competition and the SLCDCN will lose interline traffic in the long haul markets with these carriers. The SLCDCN can remain competitive in the short haul (Pacific Northwest) but could face new competition from expanding

JLCDCN. Interline arrangements between JLUSXX and the SLCDCN, especially to California, will probably be maintained since that carrier type is unlikely to expand out of their regions or another regional carrier will always be available to take its place. The intensity of competition to interior B.C. points would increase not because there are additional carriers but because the existing carriers (JLCDCN or JLCDBC) can expand their single line coverage or have a greater choice of interline partners to choose from in Vancouver.

Open Border Policy to All B.C. (On International Freight Only)

JLUSUS expanding into Vancouver from the U.S. and existing SLUSUS would have the opportunity to provide single line service directly into the B.C. interior under this option. This service would compete directly with CFWY and also reduce the interline traffic available to the current JLCDCN and JLCDBC. However there are several economic factors that minimize any potential loss from the Canadian joint line carriers to expanding SLUSUS. First, the transborder traffic base is small and probably would not by itself justify expansion into the interior. Canadian joint line carriers which already have intraprovincial authority can consolidate the transborder freight with intraprovincial movements to and from Vancouver. In 1981, 80 percent (approximately $252 million) of B.C. intraprovincial freight revenue involved Vancouver.[11] Second, such service points would not fit

into the hub systems of the large SLUSUS carriers since these points would be two or more interchange points from a major hub or line haul consolidation point. This is not true for CFWY or the SLCDCN because these Canadian operations are basically linear systems, across B.C. to Alberta for CFWY or across B.C. to Eastern Canada for most SLCDCN.

Expansion into B.C. is more likely to arise from the SLCDCN or JLCDCN who are already crossing B.C. as interprovincial carriers. However, assembly and distribution operations to small communities seldom combine well with long haul keypoint service so a major displacement of the small JLCDBC carriers is unlikely.

Open Border Policy and Intraprovincial Deregulation

This regulatory option removes a major economic barrier to expansion into B.C. by the larger U.S. and Canadian carriers. The similarity of the B.C. interior with areas frequently not served by the large U.S. carriers in their domestic markets suggest that such expansion is not likely in the short run. However the potential does exist for substantial displacement of local carriers in the long run by the SLCDCN and JLCDCN carriers rather than by SLUSUS carriers.

Overall Impacts of Relaxed Entry Policies

Any relaxed entry policy is not likely to result in immediate improvements in service as lower prices. The potential entrants into BC, in particular the JLUSUS who

want to become SLUSUS, are similar in size and operational structure to the existing SLUSUS and have generally matched the service of the same SLUSUS in domestic markets. Discounting and increased rate competition has already occurred in the transborder market and that suggests that the new entrants would find it difficult to significantly decrease prices much further. However an increase in the number of single line competitors will increase the intensity of the competitive environment. Shippers will have more choices and the carriers will have greater incentive to sustain their efforts to be the best for less. Finally the economies of scale brought by additional large SLUSUS produce a level of competitive pressure on the existing SLUSUS that the SLCDCN could not exert.

The carriers who have the most to lose from the entry of the JLUSUS into Vancouver are the existing SLUSUS so the major shift in market share would be from one U.S. based carrier to another. The SLCDCN stands to lose freight interlined in the U.S. by these large JLUSUS. However the strength of these carriers are their direct service to the Pacific Northwest and joint line service with regionals to California and the Northwest. These services can be maintained and would remain competitive even against the expanding JLUSUS. Afterall there are three large SLUSUS in the market today and despite their size and market coverage they have not prevented the SLCDCN from gaining market share during the last four years. Actually these carriers have more to

fear from JLCDCN who may enter the U.S. from Canada. In this case market share loses would be to another Canadian based carrier.

There are several reasons why the SLCDCN have been able to compete with the SLUSUS successfully and can continue to do so. The major inherent service advantage held by the large carriers is their ability to provide a s/r with one carrier service to/from a broad market area. But this is only beneficial if the s/r in fact has customers or suppliers so dispersed. The broad coverage of CFWY or RYPI yields no particular benefit to the receiver whose suppliers are all in California and a few key cities. The s/r respondents did not rate market coverage very highly in carrier selection and most indicated that than tranborder movements were concentrated in either the Pacific Northwest to Vancouver or California to Vancouver traffic lane.

The balance of LTL freight movement is overwhelmingly northbound from U.S. origins to or through BC. It is generally asserted that the carrier who originates the traffic also controls the routing. Typically a SLUSUS carrier will want to transport goods as far as its own operations extend except when it is more economical to interline (convenience interlining). However all of the survey evidence indicates that the bulk of the freight destine to Vancouver is receiver controlled and routed. The reasons for tis phenomenon were explained earlier and to the degree that this remains the situation, Canadian carriers have an advantage not a disadvantage.

It is argued that Canadian carriers cannot operate as efficiently into the U.S. as U.S. carriers can operate into Canada. This argument is premised on two institutional realities. First the bulk of the freight flow in Canada is to or from an area close to the border while U.S. traffic points are more dispersed over larger distances from the border. Second, a foreign carrier is prevented from transporting US domestic freight while using a non-American driver. There is some validity to this argument in the east where a significant volume of domestic traffic to and from border cities such as Detroit or Buffalo could be picked up or dropped off by a Canadian line haul driver traveling to terminals further in the U.S. from Ontario terminals. This arguement is less valid for international operations extending past the first relay terminal. For example a new driver would be required to continue a movement that originates in Toronto and is destine to North Carolina via New York or Philadelphia unless a slip seat or sleeper operation is used. Layover costs for the Canadian drivers would dictate that a U.S. domiciled driver would drive the last leg of this journey. Consequently the immigration laws are not a barrier to traffic solicitation on the purely U.S. legs of Canadian carrier operations.

The closest U.S. freight generation point across the BC border is Seattle where several SLCDCN interchange with JLUSXX. There is very little domestic freight that could economically be picked up between the two cities. However SLCDCN who want to single line to major points

south of Seattle such as Portland and the Bay area would benefit from the ability to pick up domestic freight in Seattle destine to such points (and vice versa). This would require the SLCDCN to use Seattle as the relay point where U.S. domiciled drivers perform the line haul function southward. Operationally this is not unreasonable given that the Vancouver-Seattle roundtrip run requires approximately one driving day and would eliminate layover of Canadian drivers.

Finally there is no incentive for the larger SLUSUS carriers to cross subsidize their transborder business to the detriment of Canadian carriers. This is because the primary competitor of the each SLUSUS is another SLUSUS. The primary impact of such a competitive practice would be to divert freight among themselves rather than divert traffic from Canadian carriers. It is doubtful that any of the large SLUSUS carriers would resort to truly predatory pricing because they each recognize that their direct competitors have equally deep financial pockets to draw upon to respond to such pricing.

Conclusions and Implications

Each province should be concerned about the potential dislocation of Canadian industry resulting from a relaxation of Canadian entry control on transborder trucking. Although no quantitative estimates were made it is apparent that none of the regulatory options examined for BC would result in a severe loss of market

share from Canadian to U.S. domiciled carriers. The most probable new entrants, the JLUSUS, would compete directly with existing SLUSUS. The SLCDCN would lose interline traffic from the far ends of the U.S. tendered by these JLUSUS but would maintain a strong joint line arrangements with regional JLUSXX serving the Mountain states and the west coast where the bulk of the BC-US traffic flows. These are also numerous reasons why they can remain competitive against the industry giants. These include a freeze on expansion of the existing sufference facilities, the control of inbound and outbound carrier selection in BC, and restrictions on intraprovincial authority. It is reemphazied that the large SLUSUS have been unable to prevent errosion of their market to the SLCDCN since US deregulation. The major cause of disruption to existing Canadian carriers is new competition from other Canadian carriers who can expand from Canada. Finally the extent to which relaxed entry is applied to areas outside of Vancouver or to intraprovincial traffic will dictate the long run consequence for BC domiciled carriers. A Vancouver only policy would increase competition into the interior without increasing the number of existing carriers connecting Vancouver with the interior.

This conclusion differs sharply in principle from the dislocation estimates made before the Ontario Highway Transport Board (OHTB). It was argued that Ontario domiciled carriers cannot compete against the potential U.S. domiciled entrants into the Ontario-U.S. market and

that the Ontario based carriers would either give up the traffic or relocate in the U.S.[12] This study would suggest that such an extreme event is unlikely in B.C. It highlights the need for each province to examine closely their own particular situation in terms of existing competition, relative competitive strenghts and the probable behavior of all of the market participants including the users of transportation. The OHTB lamented the lack of data on international traffic and that was no less a problem in this analysis. This study shows however, the importance of understanding the competitive relationships that govern how data is processed in the quantification of potential policy changes.

Acknowledgment

The research upon which this paper is based was supported by Transport Canada under its Transport University Program. The author also thanks former students Daniel Askham and Dale Pinnekamp for their assistance in implementing and analyzing the field survey.

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THE CHANGING FACE OF ENVIRONMENTAL IMPACT ASSESSMENT IN CANADA

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ABSTRACT

Recent administrative and procedural changes in the Federal Environmental Assessment and Review Process are reviewed with emphasis on the implications for major transportation projects in Canada. Research initiatives designed to improve the scientific and technical basis of environmental assessment are also described. Particular attention is given to the extent to which these activities are moving environmental impact assessment into a more clearly defined project planning role. Finally, the changing responsibilities for project proponents and managers as a result of these developments are considered from environmental and social perspectives.

INTRODUCTION

Environmental impact assessment (EIA) in Canada has evolved into a fairly sophisticated socio-political phenomenon involving complex interactions between governments, industries and the general public. Although the basic principles underlying the federal EIA process have not changed since they were adopted in 1973, there have been modifications to procedures and shifts in

emphasis which may have important ramifications for future development, including transportation projects.

Transportation is a key sector in the Canadian economy and many of the projects subjected to environmental impact assessment in this country have major transportation components. Indeed, many of the emerging ideas and approaches to EIA can be traced back to transportation-related activities and the specific environmental management issues which they raise. Due to the pervasive nature of transportation networks, whether in the highly populated southern regions of the country or in the frontier areas in the arctic or offshore, it is likely that projects in this sector will continue to be "test-beds" for new concepts in environmental assessment and management.

This paper reviews the latest developments in EIA at the federal level with an emphasis on those aspects which would be of interest to proponents of large-scale transportation projects.

THE ENVIRONMENTAL ASSESSMENT AND REVIEW PROCESS

The Canadian government's policy on environmental impact assessment is articulated in the Environmental Assessment and Review Process (EARP) adopted by the federal Cabinet in 1973. Under this policy "the environmental effects of federal projects, programs and activities are assessed early in their planning, before any commitments or irrevocable decisions are made" (FEARO,

1979a). Federal projects are those initiated by federal departments and agencies and those involving federal funds or federal property. EARP is mandatory for all federal departments and applies on a voluntary basis to Proprietary Crown Corporations and certain regulatory agencies.

The cornerstone of EARP is the principle of self-assessment. In other words, participating departments and agencies must decide whether projects could result in significant environmental damage. If they conclude that their actions could have significant impacts then the proposed projects are referred to the Federal Environmental Assessment Review Office (FEARO) where they are submitted to a full public review. Such reviews are carried out by independent panels which submit the resulting reports and recommendations directly to the Minister of the Environment. If there is provincial involvement in a project, a joint federal-provincial panel is formed which reports to the ministers of environment at both levels of government.

The openness of the public review process is a major characteristic of EARP. Over the years the general public has been given greater opportunity to participate in the process such that public hearings are now only one aspect of a broader range of dialogue between the panels and interested parties. Ironically, the opportunity for public comment provided by EARP has been so successful that panel hearings have been used as a forum for

discussing a range of environmental and social issues which often go well beyond the potential effects of the project under review. Thus, as an example, a proponent for a project involving arctic shipping would expect to have a variety of nationally important issues raised at the panel hearings including native land claims, The National Energy Program, northern development policy and the sovereignty of Canadian arctic waters.

TRANSPORTATION AND ASSESSMENT

Nowadays, conducting an EIA for a large project is a major undertaking. It could involve significant investments in personnel, money and time. It almost always results in a multi-volume environmental impact statement (EIS) along with numerous support documents. Those who are burdened with preparing the voluminous environmental impact statements currently in vogue can probably blame a transportation project, in particular the Trans-Alaska Pipeline for which an EIA was conducted in the early 1970's. In that case, a federal judge ruled that an initial 8-page EIS for the 1900 km construction road was unnacceptable. According to Norton (1979):

> "Ever since that court's finding, and the granting of an injunction delaying a federal permit for a road, Environmental Impact Statements have been long, heavy, multiple-volume documents. The Final Environmental Impact Statement for the

> Trans-Alaska pipeline, for example, comprised six fat volumes of environmental text, plus three volumes of economic and security risk analyses, plus eventually four volumes of public testimony on the nine proceeding volumes."

In Canada we still suffer to some extent from the legacy of the Trans-Alaska Pipeline EIS. However, we have not had to cope with an "EIS production line" like that in the United States which has processed over 14,000 impact assessments since 1970. By contrast, less than 25 projects have been subjected to panel reviews under EARP since 1973 of which eleven were transportation projects or had large transportation components. Another three transportation projects are either under active review or are currently dormant within the process.

The transportation projects which have been, or will be, addressed under EARP cover the total spectrum of activities - ports, airports, highways, railroads, pipelines and shipping projects. They range from project-specific developments, such as an expansion to the Vancouver International Airport, to regional planning proposals, such as the South Yukon Transportation Study (FEARO, 1982a). The review process has involved large public hearings in major cities to "town-hall" sessions in isolated communities and, in the case of a proposed arctic shipping project, discussions with officials in other countries.

Our experience has led us to the following generalizations concerning environmental impact assessments for transportation projects:

(a) By their very nature, most transportation projects cover large geographical areas encompassing a wide variety of environments and societies. This broadens the scope of assessments both in terms of information requirements and review procedures.

(b) The movement of goods or people along determined routes raises difficult questions concerning cumulative impacts. For example, the effects of one pipeline crossing numerous rivers in a watershed or the long-term impacts of repeated ship passages along approved routes.

(c) Transportation projects often increase access to areas and thereby stimulate secondary developments which are difficult to predict and are seldom included in the project assessment.

(d) A transportation facility or route, once established, can be used to various levels of capacity. Assessing the environmental and social consequences usually requires

assumptions about levels of use which may not be valid in the longer term.

(e) Linear projects sometimes involve the movement of potentially hazardous materials over long distances, either continuously or on an intermittent basis. Since accidents can happen anywhere along the route at anytime, it is more difficult for assessments to satisfactorily deal with risk analysis and contingency planning.

(f) Due to the economic importance of transportation systems, particularly in Canada, there tends to be a high level of political interest in such projects. In this context, assessments for transportation developments are not unlike those for energy projects.

SOME BASIC CONSIDERATIONS

As previously indicated, transportation projects may pose unique problems or issues for those conducting and reviewing environmental impact assessments. At a more detailed level, these problems are often reflected in recommendations which may have an important bearing on the design and construction of transportation projects. Some of the general issues are discussed below with examples from Canadian experience where possible.

Routing

From an economic viewpoint, the preferred route for any linear project is a straight line. Deviations are tolerated to meet engineering and safety requirements. However, following the introduction of environmental assessment procedures, the selection of transportation routes has had to involve other criteria previously considered inconsequential.

Routing is often the most controversial issue in an assessment hearing. From the developer's perspective, changes in the preferred alignment means substantial additions to project costs. Within the context of impact assessment, rerouting may be the only mitigation measure which will prevent unacceptable environmental or social damage.

The EIA for the proposed Alaska Highway Gas Pipeline is a good example of the importance of routing considerations from an environmental perspective. In at least two instances, major changes in the proposed alignment were considered by the review panel. In both cases, the Ibex Pass and southern Kluane Lake area, the changes were proposed to protect sensitive ecological areas and to preserve aesthetic and recreational amenities (FEARO, 1979b). In the review of the proposed McKenzie Valley Pipeline conducted by Justice Berger (1977) it was the environmental sensitivities of the preferred route along the Yukon coast tnat contributed, in part, to the ultimate postponement of the project.

Sometimes, routing changes only replace one set of problems with another. For example, a rail relocation proposed in the EIA for the CN Twin Tracking Program in British Columbia would have reduced noise, vibration and dust problems and increased public safety. However, it was noted that the proposed relocation would jeopardize an ecologically sensitive area and would pass through a number of Indian reserves and private holdings (FEARO, 1983a).

In other cases, the only reasonable routing alternative could make the entire project uneconomical. Such was argued by the proponents of the Beaufort Sea hydrocarbon development who indicated that a proposed alternative shipping route which would add 150 km through more difficult ice conditions was not a viable option economically (Dome Petroleum Limited et al., 1983a).

In most cases the routing alternatives are suggested to avoid areas considered "sensitive" for environmental or social reasons. On the environmental side, it is often rare or endangered species or their habitats that are the issue. Socially the concerns often focus on the protection of traditional life styles, avoidance of historical or archaeological sites, or a perceived degredation of aesthetic values. Most of these concerns cannot be adequately addressed by cost-benefit analysis and the EIA procedure is viewed as a mechanism whereby the decision-makers can weigh the social benefits of routing changes against the financial costs.

Timing

EIA panels frequently make recommendations on the timing of construction or operation of transportation systems. In some cases the limitations imposed by such recommendations can have major impacts on project planning and logistical support requirements.

Concerns over timing may be related to general limitations imposed by seasonal events. For example, in sensitive terrain it may be necessary to confine construction activities on some sections to the winter months. In other cases, panels may recommend specific time windows for construction at certain locations along the route for biological reasons. This often applies to river crossings where the sequential use of the same waterway by a variety of fish species (for both migratory and spawning purposes) may leave only short periods available for in-water construction activities. Since different species may use different rivers at different times, scheduling a large linear project in most parts of Canada can become a rather complicated exercise. Similar constraints may be imposed by migrating mammals, both terrestrial (e.g. caribou) and marine (e.g. whales).

It is obvious that such limitations must be considered early in the planning process if realistic schedules are to be developed. It is in the best interests of the proponent to do so, particularly in cases involving major river crossings or activities that could impact fish habitat. This is so because under the

provisions of the Fisheries Act it is possible for authorities to withhold the required permits if there is a demonstrated risk to fish or their habitat.

Although environmental impact assessment procedures are not meant to duplicate the role of regulatory agencies, the major resource departments normally take advantage of public hearings to inform the proponents of regulated criteria or performance standards which would apply to their projects. In this manner, EIA procedures facilitate an early dialogue between government and industry, which is essential to good project planning.

Rehabilitation

Land transportation corridors nearly always involve major terrain disturbance which has emerged as a major environmental concern because of the impact on aesthetics and the increased probability of erosion. These problems become particularly acute in mountainous areas where the results of cut and fill construction techniques are difficult to hide and where steep slopes exacerbate the erosion problem.

In recent years, EIA panels have been requesting proponents to submit comprehensive reclamation programs as opposed to their plans for more isolated reclamation activities. Such programs have been required for projects involving highways, railroads, and pipelines.

For large linear projects, the development of a full-scale reclamation program can have serious implications for project costs and timing. For example,

the Revegetation Program submitted as part of the EIA for the Alaska Highway Gas Pipeline project (Foothills Pipe Lines, 1981) involved the following elements:

(a) the development of separate plans for six different Vegetation Management Areas along the proposed route;

(b) long-term research on the most appropriate species and fertilizer mixes and extended field trials at three locations along the route;

(c) the collection and storage of large quantities of seeds of various species;

(d) the establishment of nurseries to provide seedlings of the appropriate species and size at the times required; and

(e) the efficient integration of the above elements into the overall project schedule which extended over five years.

In addition to revegetation plans, a reclamation program could include comprehensive measures for slope control, surface water management and the long-term surveillance and maintenance of the right-of-way. Taken together these efforts represent a major commitment of money and resources and should be included as a major component of project planning.

Compensation

Due to their extensive geographic coverage, many transportation projects often incur high compensation costs. Such costs can be divided into two main categories. On one hand is compensation related to the purcahse of land or access to land. While this can be a major project cost, it is a one-time expenditure and market values and experience with other projects dictate reasonable terms.

On the other hand is compensation for the permanent or temporary loss of a natural resource or a social amenity which results from some project-related activity. For example, transportation corridors may interfere with historical hunting and trapping areas or accidental releases of hazardous materials may be linked to decreased populations or catches of commercially important species. In these latter cases, compensation depends on the degree to which cause-and-effect can be demonstrated. However, most natural populations vary markedly in abundance over space and time and it is seldom possible to relate certain project activities to changes in populations of specific species.

Nevertheless, compensation for environmental damage is becoming a common theme at EIA hearings and assessment panels often ask proponents to publicly declare their willingness to compensate certain sectors of the public who might be adversely affected as a result of environmental changes arising from the project. While

such declarations may be good public relations, experience has shown that compensation payments are usually made only when claimants can clearly and unequivocally show how environmental changes brought on by the project have decreased their level of income, health or peace of mind. Even with the application of the latest scientific techniques, such cause-and-effect linkages are very difficult to prove.

FUTURE EMPHASIS

A review of impact assessments conducted in Canada over the last few years reveals some changing approaches and priorities which have implications for future projects, including those with transportation components. Some of these are summarized below.

It is evident that risk analysis is being given more emphasis in EIA. While the probability of certain events occurring is implicit in most topics addressed in an EIS, in recent years it is being explicitly stated as a requirement by some assessment panels. The risk analysis conducted as part of the assessment for the Beaufort Sea project is an example. In that case disagreements over the oil spill probabilities presented by the proponent led to requests for more information from the panel. Eventually the proponents and their consultants tabled a special report on oil spill risk assessment (Dome Petroleum Limited et al., 1983b), the results of which

were still questioned by government experts and technical advisors to the panel.

It is clear from this case study that the probability of certain events occurring is a topic open to professional interpretation. Perhaps we should only expect to see risk analysis successfully applied in EIA in those topics for which a large amount of data is available based on actual experience under conditions similar to those under consideration.

Another area receiving greater attention at public hearings and from panels is the question of corridor development. The aggregation of services into major transportation corridors has occurred for a number of reasons. First is the fact that, in rugged terrain, there may only be a few routes which can physically accommodate transportation projects. Secondly, there is growing public pressure on government authorities to group linear projects into main arteries to prevent the development of multiple routes with their consequent longer-term effects on land use and future development. Unfortunately, bringing different transportation systems into close proximity to one another, sometimes leads to conflicts. Such was the case for the development of a second track through Glacier National Park where tunnel ventilation shafts had to be relocated to reduce the aesthetic impacts as viewed from the Trans Canada Highway (FEARO, 1983b).

There are indications that government agencies are beginning to recognize the potential problems associated

with corridor development. Thus, the Environmental Assessment Panel for the CN Rail Twin Tracking Programs in British Columbia was asked for its views on "the possible long term implications to the Fraser and Thompson corridors due to other transportation related activities" (FEARO, 1983a). The panel has indicated its intention to comply with this request.

A third major shift in emphasis is that which sees EIA as more of a land use planning process. Given the difficulty in managing environmental concerns on a project-by-project basis, there is a growing realization that EIA is best considered as a tool for regional planning. For example, the Federal Department of Transport has registered a proposal with FEARO titled The South Yukon Transportation Study. It is a consideration of alternative transportation systems in the Yukon, with possible links to British Columbia, Alaska and the Northwest Territories. It would include the study of several alternative development strategies including road and rail networks (FEARO, 1982). Although the study is currently dormant within the review process, the fact that it was registered is an indication of the changing role perceived for EIA.

CHANGES IN PROCEDURES AND REQUIREMENTS

Environmental impact assessment is changing in Canada as a result of these shifts in emphasis and evolving concepts. There are four major areas in which we can

expect to see significant changes in the near future. First, there will likely be procedural changes at the front end of the process. This will take the form of a public scoping exercise which is designed to give those people interested in a proposed project an opportunity to convey their thoughts, fears and suggestions to the panel before the development of EIA guidelines. In this manner, it is hoped to bring the public into the EIA process at the earliest time possible. A formal public scoping exercise has already been conducted as part of an EIA currently underway and it seems to have worked well.

The second major change will likely occur at the tail end of the process, namely in the area of environmental monitoring. The prime objective of EIA is to predict the environmental effects which could arise from a proposed project and design mitigative measures to alleviate such impacts. In the past, we have not paid much attention to the environment after the project is approved. However, all impact assessments for major projects in the last few years have included an environmental monitoring program. In some cases, panels have recommended the formation of committees to oversee all monitoring activities and ensure that recommended mitigative measures are successfully implemented (FEARO, 1978; FEARO, 1979; FEARO, 1982b). Over the next few years we can expect to see this aspect of EIA become better defined and to become well entrenched in the required procedures.

The above-noted changes were adopted, at least in part, as the result of initiatives to improve the scientific basis of impact assessment in this country. A recent report prepared under contract for FEARO (Beanlands and Duinker, 1983) calls for much greater attention to EIA as an effective vehicle for the application of proven techniques and procedures from the natural and social sciences. The report suggests that all impact assessments should be prepared and reviewed according to a framework which would require:

(a) a public scoping exercise to identify key social concerns;

(b) a definition of "significance" with respect to environmental impacts;

(c) the clear setting of time and space boundaries;

(d) the development and use of an overall study strategy to focus and coordinate individual study efforts;

(e) explicit predictions; and

(f) a commitment to an environmental monitoring program with clearly defined objectives.

There is growing evidence that government agencies are prepared to adopt these requirements as a basis for reviewing impact assessments. Presumably, if they are to

be used as a basis for review, they will quickly be adopted as a basis for organizing and conducting assessments.

Finally, as a result of one of the recommendations in the report by Beanlands and Duinker (1983), the Federal Minister of the Environment, Mr. Caccia, recently announced the formation of the Canadian Environmental Assessment Research Council (CEARC). Its mandate is to promote and encourage research in the natural and social sciences of direct relevance to environmental impact assessment. The Council is composed of members from government, industry, universities and the consulting community and is serviced by a secretariat provided by FEARO.

It is hoped that CEARC will provide the long-term leadership needed to ensure that our proven capabilities in scientific research are applied to some of the pressing problems being faced by environmental impact assessment in Canada.

ACKNOWLEDGEMENTS

The author wishes to express his thanks to Ms. Brenda Finn for typing the manuscript of this presentation.

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ESTIMATING THE RISKS OF TRANSPORTING HAZARDOUS MATERIALS BY RAIL IN CANADA & THE UNITED STATES

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ABSTRACT

This paper presents an overview of the subject of risk analysis and its application to the field of hazardous material transportation. The basic concepts of risk estimation and how they are applied to transportation are reviewed. Data on hazardous material accidents, releases and transportation activity is presented, assessed and statistically analyzed using Normal and Poisson distributions. Weaknesses and historical problems encountered with such data are highlighted. Future needs, directions and policy implications are outlined and discussed.

INTRODUCTION

The performance of North American hazardous material (HM) transportation systems has become a subject of in-

creasing concern in recent years. The problems associated with these systems have acquired new importance in view of the changing industrial patterns which demand ever increasing quantities of HM shipments, and the growing awareness of the potential risk of accidents and their threat to life and the environment.

In response to this concern, it seems appropriate to develop an appreciation and understanding of the subject of risk analysis and its application to the field of transport. Such an endeavor should focus on the railway industry; for railways, even with their sometimes questionable safety record, have traditionally been the principal shippers of HM. At present, the rail mode accounts for about 70 percent of the total HM transportation activity in North America.

This study can be considered as an overview of a subject which is generally recognized as being an under-researched area in Canada. By reviewing and statistically analyzing the available information associated with railway transportation of hazardous materials, the aim, rather than to provide conclusive findings, is to stimulate interest, awareness, and to provide a basis for more in-depth studies.

Risk Estimation Applied to Hazardous Material Transportation

Broadly speaking, with risk estimation approaches, two categories of empirical study are possible: (1) a disaggregated study, which typically examines risk for specific dangerous commodities on a specific route and by a specific mode of transportation; and (2) an aggregated study which encompasses all accidents related to HM without reference to particular commodities or specific routes. A review of various empirical studies revealed that the estimated risk, based on the disaggregated approach, varies according to a number of factors: e.g., the mode of transportation for the given types of HM, the characteristics of the route, the population density adjacent to the route, the type of dangerous good, the type of transport equipment utilized for a given mode, the speed of release of agent from the container and the nature, toxicity or strength of the chemical or radiation released.

Attempts to quantify the risks associated with the transportation of HM in North America, and in particular, Canada, have often been limited by a lack of basic and necessary historical data. This inherent problem is well recognized in literature and it is widely accepted that the absence of relevant information pertaining to accident

damage severity, amount of lading lost, speed of train(s) at time of accident, exact causes of puncture or release, speed of release, etc, has severely restricted researchers from producing detailed disaggregated analyses.

The following analysis can be considered an aggregated risk estimation overview. Its purpose is to provide general information on the overall likelihood or probability of future HM releases. By quantifying the risk levels of transporting these materials by rail, the frequency of intensive hazard events becomes more predictable.

The Data

A hazardous material accident in Canada is defined, in short, as any accident where an involved train carries at least one car of a regulated commodity. Table 1 provides an overview of these type of accidents in Canada since 1970. It should be noted that prior to 1980, one of Canada's two major railways had only been reporting their HM accidents when a leakage or release of material occurred. Meanwhile, the other major railway was properly reporting an accident every time the involved train was hauling a regulated commodity. As a result, only the years 1980 and 1981 show the actual number of HM accidents as defined.

Table 1

TRAIN ACCIDENTS INVOLVING HAZARDOUS MATERIALS
REPORTED TO THE CANADIAN TRANSPORT COMMISSION

	Collisions	Derailments	Crossing	Other	Total
1970	2	18	1	5	26
1971	4	29	0	0	33
1972	5	31	2	2	40
1973	10	28	2	5	45
1974	7	31	2	-	40
1975	6	30	0	-	36
1976	7	33	3	-	43
1977	7	36	1	-	44
1978	14	43	0	-	57
1979	17	41	2	-	60
1980	41	63	11	-	115
1981	62	130	7	-	199

Source: CTC - Safety and Services Branch, Railway Transport Committee

Table 2

NUMBER OF TRAIN ACCIDENTS RESULTING IN A RELEASE OF
HAZARDOUS MATERIALS (CANADA)

	MAJOR RELEASE				MINOR RELEASE				TOTAL NUMBER OF RELEASE ACCIDENTS
Year	Derail	Collision	Crossing	Total Major	Derail	Collision	Crossing	Total Minor	
1970	1	0	0	1	2	0	0	2	3
1971	8	0	0	8	3	0	0	3	11
1972	6	0	0	6	3	0	0	3	9
1973	3	1	1	5	5	0	0	5	10
1974	2	0	1	3	5	1	0	6	9
1975	1	0	0	1	5	1	0	6	7
1976	3	1	0	4	4	0	0	4	8
1977	4	1	0	5	10	1	0	11	16
1978	4	0	0	4	8	1	0	9	13
1979	4	0	0	4	6	2	1	9	13
1980	3	1	2	6	5	4	0	9	15
1981	1	1	0	2	4	0	0	4	6

Source: CTC - Safety and Services Branch, Railway Transport Committee

The data for the number of train accidents which resulted in a release of HM (Table 2) is complete because every release was consistently reported, by all railways, during this time period. A minor release includes fumes from an empty car, leakage (usually through vent valves) or a small spillage of a portion of the lading of one car (generally less than 25%). A major release includes any significant spill (greater than 25% of the lading of any car) or a release which results in fire, explosion or leakage.

A hazardous material accident in the United States is defined as a train accident in which a dangerous material (one regulated by the Department of Transport) is included in an involved train. Tables 3 and 4 summarize the HM accidents, releases and damaged cars which have occurred since 1975 in the U.S.

In order to get a true indication of the relative HM accident frequency, one must define these accidents in terms of the level of transportation activity. The most descriptive indication of overall HM railway traffic volume is provided by figures of net weight shipping distances. Describing the number of miles each ton of HM is shipped by rail, the product net ton miles takes into account both total volume and total distance of all shipments. Thus, net ton miles represent the best measure

Table 3

HAZARDOUS MATERIAL ACCIDENTS IN THE UNITED STATES

	Collisions	Derailments	Crossing	Other	Total
1975	82	637	16	1	736
1976	122	627	18	1	768
1977	122	673	22	47	864
1978	154	815	23	43	1 035
1979	141	765	23	28	957
1980	118	673	23	28	842
1981	81	479	15	26	601
1982	-	-	-	-	489

Source: Federal Railroad Administration Accident/Incident Bulletin.

Table 4

HAZARDOUS MATERIAL ACCIDENTS IN THE UNITED STATES

	CARS DAMAGED CARRYING H.M.					CARS RELEASING OF HAZARDOUS MATERIAL				
	Collisions	Derailments	Crossing	Other	Total	Collisions	Derailments	Crossing	Other	Total
1975	84	891	1		976	8	126	1		135
1976	106	736	5		847	14	152			166
1977	81	949	25		1 072	13	153	4	3	173
1978	92	1 097	25	15	1 229	15	205	4	8	232
1979	108	935	4	13	1 060	13	150	2		165
1980	98	866	2	23	989	9	160	1	3	173
1981	67	681	7	18	773	5	99	1	4	109
1982	-	-	-	-	655	-	-	-	-	131

Source: Federal Railroad Administration Accident/Incident Bulletin.

of the kind of activity which lead to the risk of HM train accidents.

Whilst complete net ton mile statistics are not consistently compiled for HM transport in either Canada or the United States, sufficient data is available to enable careful estimates to be made. As illustrated in Tables 5 and 6, such estimates have been compiled for both countries.[1] The forecasted net ton mile statistics for the years 1984 and beyond are based on projected HM traffic growth rates of 5 percent per annum. This figure was accepted as a reasonable projection after numerous discussions with officials of the FRA and CTC, and careful assessments of a number of rail freight growth studies.[2] It should, however, be noted that the U.S. figures include only the net ton miles of HM whose point of shipping originated inside the U.S. As a result, imports of these goods transported from the Mexican or Canadian borders are not included in the totals.

Methodology and Analysis

1) Release Frequencies

Observed frequency rates of HM accidents and releases per ton mile of transport can be computed for both Canada and the United States from the base data presented in Tables 2 to 6. The computed rates are shown in Tables 7

Table 5

ESTIMATED HAZARDOUS MATERIAL RAIL TRAFFIC IN CANADA

	Net Ton Miles (000's)		Net Ton Miles (000's)
1970	2 073 082	1983	6 665 868
1971	2 322 018	1984	6 999 161
1972	2 549 274	1985	7 349 119
1973	2 539 918	1986	7 716 575
1974	2 786 062	1987	8 102 404
1975	3 174 746	1988	8 507 524
1976	3 267 353	1989	8 932 901
1977	3 500 740	1990	9 379 546
1978	3 819 167	1991	9 848 523
1979	4 027 312	1992	10 340 949
1980	5 292 363	1993	10 857 997
1981	5 787 605	1994	11 400 896
1982	5 380 365	1995	11 970 941

Table 6

ESTIMATED HAZARDOUS MATERIAL RAIL TRAFFIC IN THE U.S.

	Net Ton Miles (000's)		Net Ton Miles (000's)
1975	21 965 569	1986	38 664 604
1976	24 065 606	1987	40 597 835
1977	25 976 415	1988	42 627 726
1978	27 002 483	1989	44 759 113
1979	29 357 100	1990	46 997 068
1980	28 543 980	1991	49 346 922
1981	30 294 729	1992	51 814 268
1982	31 809 465	1993	54 404 981
1983	33 399 939	1994	57 125 230
1984	35 069 936	1995	59 981 491
1985	36 823 433		

and 8. These rates are also plotted in Figures 1 to 4. Poisson statistical limits of one degree of freedom (68%) have been calculated and included in these graphs.

The purpose of Poisson statistical limits is to provide an area within which 68 percent of expected observations (accidents or releases) will occur. In other words, one can expect that given the estimated accident or release totals for the next 10 years, 7 out of 10 of these observations will fall within the statistical limits computed for one degree of freedom. If approximately three yearly totals fall outside the limits, they can be explained by the randomness of the process. If more than three occur outside these limits, their position cannot be explained by chance, or rather, by the randomness of the process alone. In the case of a series of consecutive points outside the limits, one must recognize this as a statistically significant trend.

Table 7 presents the observed frequency of minor releases, major releases and total releases of HM in Canada from 1970 to 1982. The figures illustrating this information show that there have been no prominent trends in either the minor or total release data. While major release frequencies did decrease during the 1972-75 and 1977-81 time frames, most observations lie within the statistical limits, and therefore must be considered a

Table 7

ESTIMATED TRAIN ACCIDENTS RESULTING IN A RELEASE OF HAZARDOUS MATERIALS PER BILLION TON-MILES OF H.M. TRANSPORTATION IN CANADA

	Major Release	Minor Release	Total Releases
1970	.482	.965	1.447
1971	3.445	1.292	4.737
1972	2.354	1.176	3.530
1973	1.969	1.969	3.938
1974	1.077	2.153	3.230
1975	.315	1.899	2.214
1976	1.224	1.224	2.448
1977	1.428	3.142	4.570
1978	1.047	2.357	3.404
1979	.993	2.235	3.228
1980	1.133	1.701	2.834
1981	.346	.6911	1.037
Mean	1.317	1.733	3.051
Standard Deviation	.863	.627	1.104

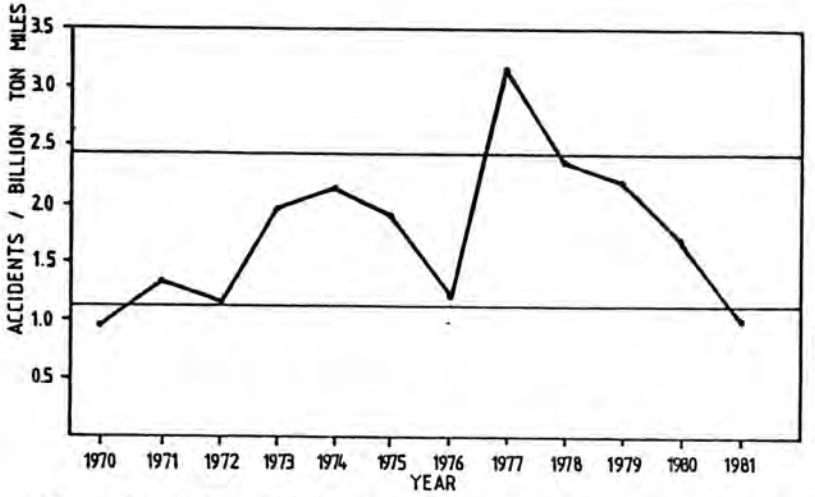


FIG. 1 RELEASE FREQUENCY PER BILLION TON MILES OF H.M. TRANSPORT - MINOR RELEASES.

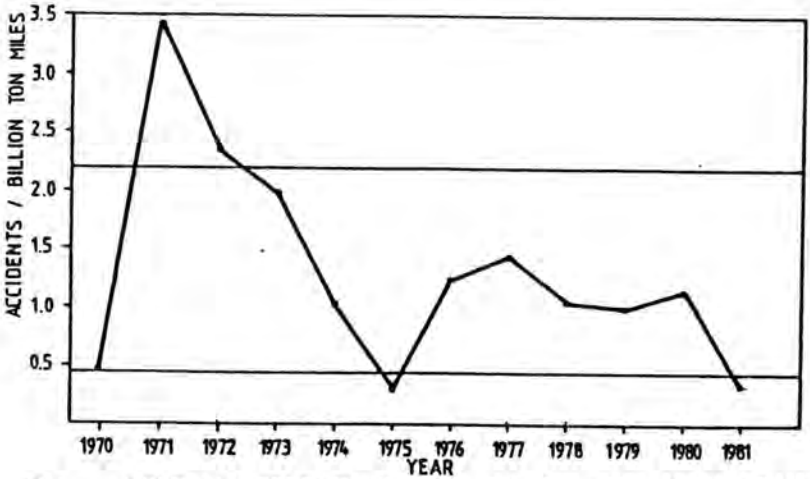


FIG. 2 RELEASE FREQUENCY PER BILLION TON MILES OF H.M. TRANSPORT - MAJOR RELEASES.

result of the randomness of the process rather than a true trend.

Table 8 shows the 1975-82 observed frequencies of: (1) HM accidents, (2) damaged HM tank cars, and (3) total cars releasing HM, per ton mile of HM transport in the United States. As can be seen from Figures 3 and 4, the frequency of accidents and releases peaked in 1978 and has been decreasing since. However, this peak can be attributed to a change in the definition of HM freight. Due to financial restrictions, the Federal Railroad Administration decided to omit batteries and small containers of

Table 8

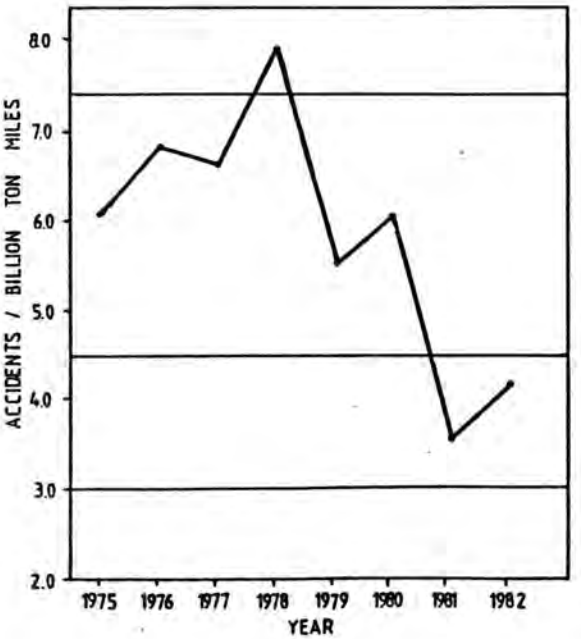
OBSERVED FREQUENCIES OF HAZARDOUS MATERIAL ACCIDENTS/RELEASES IN THE U.S. PER BILLION TON MILES OF TRANSPORT

	H.M. Accidents	Damaged H.M. Cars	H.M. Releases
1975	33.507	44.433	6.146
1976	31.913	35.195	6.898
1977	33.261	41.268	6.660
1978	38.330	45.514	8.592
1979	32.599	36.107	5.620
1980	29.498	34.648	6.061
1981	19.838	25.516	3.598
1982	15.373	20.591	4.118
Mean	29.290	35.409	5.962
Standard Deviation	7.213	8.189	1.476



FIG. 3 FREQUENCY OF HAZARDOUS MATERIAL ACCIDENTS PER BILLION TON MILES IN THE U.S.

FIG. 4 FREQUENCY OF HAZARDOUS MATERIAL RELEASES PER BILLION TON MILES IN THE U.S.



paint from the HM list in 1978. Because this left too large an unexplained drop in the data, accidents of this type were 'averaged in' on a decreasing magnitude for 1979 and 1980. HM accident data for 1981 and subsequent years does not contain any accidents where batteries or small cans of paint were involved.

Table 9 presents the estimated number of HM releases in Canada per year, over the next decade. These estimates are the product of the mean historical release frequencies

Table 9

EXPECTED NUMBER OF HAZARDOUS MATERIAL RELEASES IN CANADA PER YEAR

Years	Forecasted Mean Ton Miles/Yr.	Expected Yearly Releases Minor	Major
1982-1985	6 436 424 000	11.388	8.476
1986-1990	8 527 799 000	15.026	11.231
1991-1995	10 883 861 000	19.178	14.344

of Table 7 and the HM ton mile forecasts of Table 5. The data has been grouped to smooth out yearly fluctuations from the mean growth rate, and averaged.

Table 10 presents the estimated number of HM releases per year in the United States over the next decade. These estimates are also the product of the mean historical release frequencies (Table 8) and the HM net ton mile forecasts (Table 6). Once again, the data has been grouped to smooth out the year to year fluctuations from the mean growth rate, and averaged.

Table 10
EXPECTED NUMBER OF CAR RELEASES OF HAZARDOUS MATERIAL PER YEAR IN THE U.S.

Year	Expected Mean Ton Miles/Year	Expected Releases/Year Mean	Std. Deviation
1982-1985	33 479 500 000	199.604	13.763
1986-1990	42 729 269 000	254.753	17.566
1991-1995	54 534 578 000	325.133	22.420

At this point, it must be emphasized that it is not possible to make direct comparisons of American and Canadian HM accident and release frequency statistics. Differences exist between the two government's methods of obtaining, classifying, and using the accident or traffic information. This renders the data as generally incompatible; and as a result, any comparisons that may be made must be very general. Realistically, with the data used, one cannot expect to get more than a rough indication of how the two countries may stand in relation to each other.

From Tables 7 and 8, one can see that over the last 12 years, Canada has experienced an average of 3.051 HM releases per billion ton miles of HM transport while over the last 7 years, the United States has had to contend with an average of 5.962 of these releases per billion ton miles of HM transport. This suggests that the frequencies of Canadian and American HM releases are essentially similar, even though they do appear to occur somewhat more frequently in the U.S. However, in addition to the general inconsistencies, it must be remembered that the American data may be somewhat inflated as (1) not all HM ton miles (i.e. imports received from the Mexican and Canadian borders) are included in the denominator of the frequency, while all reported accidents are included in the numerator, and (2) American release data is based on the actual number of cars releasing a HM, while Canadian

data is based on the number of accidents where a release occurs (accidents where more than one car experience a release are recorded as a single release accident).

2) Risk Estimation

There are a number of established methods for quantifying release probabilities from observed frequency data. Many people feel that, given the problems with many historical data bases, a simple statistical format is sufficiently accurate. MacKay and Kostas state that: "...the required statistical mathematics is quite simple, requiring nothing more than a hand calculator." Their approach was to use one of two distribution functions, the normal or Poisson, to analyze the rates of events.[3]

In general, if a large number of accidents occur each year and there is very rarely zero accidents in a year, then a normal distribution can be used. If there is a fair probability that there will be zero accidents than a Poisson distribution is needed. Poisson distribution is commonly used to analyze risk levels of transporting certain chemicals when the specific chemical does not have a large number of accident observations.[4]

Since, from Table 9, there is a relatively small number of HM accidents expected in Canada (i.e., 17 in

1983), one would use Poisson distribution to find the probabilities of these expected releases actually occurring. Poisson distribution is defined as:

$$P(n) = \frac{f^n}{n!} e^{-f}$$

where P(n) = the probability of a HM release,
f = the expected number of accidents, and
n = the number of HM releases

The Poisson distribution values can be computed or found in Cumulative Poisson Distribution Tables. In this case, tables were used to find the probability of a certain number of HM releases occuring in Canada, in a given year. The results, summarized in Table 11, illustrate that for any given year between 1982 and 1985, there is a probability of .444 (44.4% chance) that there will be between 10 and 13 minor releases, and a probability of .377 (37.7% chance) that there will be between 11 and 13 major releases. However, in this same period, there is only a .06 probability that there will be less than 5 major releases.

To compute the probabilities of occurrence for the American release data it is necessary to use a normal distribution. This is because of the large number of expected releases in the United States (i.e. 200 in 1983).

Table 11

POISSON DISTRIBUTION FOR HAZARDOUS MATERIAL RELEASES IN CANADA

Period	MINOR RELEASES		MAJOR RELEASES	
	No. of Releases/Yr.	Probability	No. of Releases/Yr.	Probability
1982-1985	Less Than 7	.060	Less Than 5	.074
	7-9	.229	5-7	.312
	10-13	.444	8-10	.377
	14-16	.191	11-13	.186
	More Than 16	.076	More Than 13	.051
1986-1990	Less Than 10	.070	Less Than 7	.079
	11-13	.293	8-10	.381
	14-17	.386	11-13	.321
	18-20	.168	14-16	.163
	More Than 20	.083	More Than 16	.056
1991-1995	Less Than 13	.061	Less Than 10	.088
	14-17	.317	11-13	.325
	18-21	.347	14-16	.298
	22-25	.202	17-19	.190
	More Than 25	.073	More Than 19	.099

Using the normal statistical limits, it is possible to determine the range of possible occurences at 68 and 95 percent intervals. The statistical limits for one (68%) and two (95%) standard deviations are approximately:

$$(\bar{x} - \sigma_x) < x < (\bar{x} + \sigma_x) \quad \text{with probability of 68\%}$$

$$(\bar{x} - 2\sigma_x) < x < (\bar{x} + 2\sigma_x) \quad \text{with probability of 95\%}$$

where $\bar{x}$ is the population mean and σ_x is the population standard deviation.

Table 12

NORMAL DISTRIBUTION CONFIDENCE INTERVALS FOR HAZARDOUS MATERIAL RELEASES IN THE U.S.

Years	CONFIDENCE INTERVALS FOR EXPECTED MEAN RELEASES/YEAR	
	68%	95%
1982-1985	186-213	172-227
1986-1990	237-272	220-290
1991-1995	303-348	280-370

Table 12 presents the 68 and 95 percent confidence intervals for the expected number of hazardous material releases in the United States. These intervals show the range in which a release may be expected to occur in a given year. For example, for any individual year in the 1981-85 period, say 1982, 68 percent of the time, the range of 186-213 will include the true 1982 release frequency value. At the same time, 95% of the so constructed 172-227 interval would encompass the actual number of 1982 HM releases.

The results of the risk estimation represent a statistical quantification of the likelihood, or probability of future HM releases in Canada (Table 11) and the United States (Table 12). Because it was necessary to use different statistical approaches for the two countries, the results should be taken on an individual basis; i.e., in any given year, one can identify the likelihood of a given

number of releases in Canada and a given number of releases in the United States. As can be seen from Tables 11 and 12, the differences in the format of the Poisson and Normal methods do not allow for direct comparisons.

Policy Implications and Conclusions

Risk analysis offers one of the planning tools necessary to cope with the anticipated problems related to public safety. Risk analysis, therefore, provides a prediction model from which regulators might benefit by obtaining the following information: (i) description of a sequence of events leading to an accident; (ii) description of the inter-relationships of human factors, vehicle/equipment performance, environment (weather, road conditions, etc.), and managerial infrastructure (procedures including rules and regulations); (iii) determination of the points at which traffic flows could be terminated or redirected to moderate the consequences by considering population density surrounding terminal areas (as these are the highest risk areas); and (iv) a means for the comparison of risks between modes of transportation and/or between routes. This could include a framework for quantitative assessment of vulnerability and also counter measures by comparing sensitivity test results for certain safety improvement measures (e.g., affect of increased rail car inspection in lowering risks).

To further improve safety associated with the transportation of hazardous materials, regulatory agencies both in Canada and in the U.S. may require a comprehensive system of safety measures which would include (i) the development of data base programs, (ii) the development of risk analysis and evaluation programs, and (iii) the implementation of safety programs. The interface of such a comprehensive system is illustrated in Figure 5.

Accident occurrence by location, material, mode, type of container, severity level and associated costs of property damage are the kinds of basic information needed for risk analysis. Such data enable estimation of the type and severity of the incident, as well as the likelihoods and costs of the loss, which are required for the

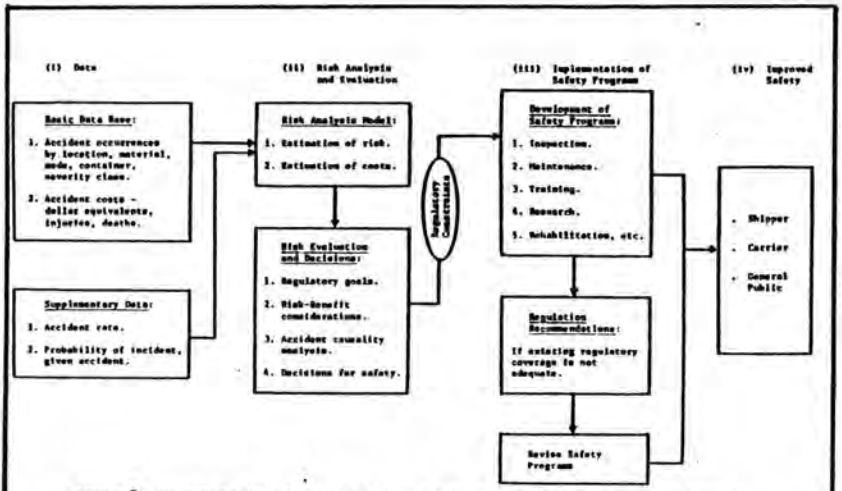


FIGURE 5: INTERFACE OF ACCIDENT DATA, RISK ANALYSIS, AND SAFETY REGULATIONS

Source: Doswell, Uhm, et al. [1]

risk analysis model. Supplementary data such as the causes of certain types of accident over time are also needed to develop predictive models for the causes and effects of accidents. Data requirements for such a causality model are freight-train activities (e.g., train hours of operation, miles of track, freight car-miles, operating expenses, traffic volumes of dangerous commodities, etc.).

FOOTNOTES

1. Doswell, S., Uhm, I., de Malherbe, R. and de Malherbe, M., Risk Analysis of Hazardous Materials Transportation by Rail in Canada and the United States, Transport Canada, Transport Dangerous Goods Directorate, 1984. Pages 20-29.

2. see for example:

   i) Transport Canada, Freight and Passenger Forecasts February, 1981, P. 13.

   ii) Transport Canada, Canadian Freight Transportation System Performance and Issues.

   iii) Transport Canada, Freight Forecasts to 1990, May, 1980.

   iv) Wolf, R.N. and Kuczer, C., The Future of the Truck and Rail Modes as Carriers of Freight in Canada, August, 1979, P. 278-280.

3. MacKay, Donald and Kostas, Ann. "Transporting Hazardous Materials: An Analysis of the Issues", Symposium on the Transportation of Hazardous Materials, University of Toronto, April, 1980.

4. see for example:
   i) Menzie, Charles A., "An Approach to Estimating Probabilities of Transportation Related Spills of Hazardous Material", Environmental Science and Technology, Vol. 13, No. 2, Feb. 1979.

   ii) Fairley, William B., "Assessment for Catastrophic Risks", Risk Analysis, Vol. 1, No. 3, 1981.

   iii) Glickman, T.S., Risks of Catastrophic Derailments Involving the Release of Hazardous Materials, U.S. Dept. of Transport, March, 1982.

CANADIAN TRANSPORTATION RESEARCH: A SHIPPER'S PERSPECTIVE

W. H. Sheffield *

INTRODUCTION

The spring of 1981 in Charlottetown, P.E.I. proved both stimulating and irritating. It was there at the CTRF conference that the seeds of this paper were planted. As a shipper the seeming overemphasis on public policy research and limited shipper/carrier participation in the research process was disturbing. Was this an isolated, uninformed reaction?

METHODOLOGY

To determine whether other shippers perceived Canadian Transportation research in a like manner a questionnaire was developed and in 1982 mailed to all members of the Canadian Manufacturers Association's (CMA) Transportation Committee and all principal members of the Canadian Industrial Traffic League (CITL). The mailing list numbered 557; the responses 84. Allowing for overlap resulting from dual memberships we estimate the response rate to be 16%.

The questions put to shippers revolved around -

(1) a profile of their company and traffic department

(2) their perception of what research is done and by whom

(3) their perception of what research should be done and by whom.

Note:*Transportation Manager, Central Region, Stelco Inc., Hamilton, Ontario.

The opinions in this paper are those of the author, and should not be construed as those of Stelco, the CMA, or the CITL.

A simple ranking system was utilized to better quantify comparisons and demonstrate shipper weightings. A value of 1.0 would signify unanimous agreement.

RESULTS & DISCUSSION

Respondent Profiles

As exhibits I & II demonstrate, a cross section of industry sectors, geographical locations, and firm sizes are represented in the sample. Very small companies (4% under 100 employees) and very large (10% over 10,000 employees and 19% with annual sales over $500,000,000) are included. Quite a few firms have disperse geographical representation, including the north. Traffic departments from "one man shows" to large organizations are included with a variety of backgrounds. The incidence of traffic personnel with post secondary education at 31% is higher than the writer expected but still rather low when one considers good traffic management is heavily dependent upon management science.

EXHIBIT I

INDUSTRY SECTOR

Primary Mfg.	33%
Secondary Mfg.	31%
Retail/Wholesale	23%
Resource Based	8%
Service Based	5%

LOCATION

B.C.	12%	
Alberta	11%	Western Canada 35%
Sask.	3%	
Manitoba	8%	
Yukon/NWT	1%	
Ontario	35%	
Quebec	21%	Central Canada 56%
New Brunswick	3%	
Nova Scotia	4%	Maritimes 9%
P.E.I.	1%	
Newfoundland	1%	

Number of Employees

<100	4%
>100, <500	27%
>500, <1,000	17%
>1,000, <5,000	40%
>5,000, <10,000	2%
>10,000	10%

ANNUAL SALES

$< \$1 \times 10^6$	0%
$> \$1 \times 10^6$, $< \$100 \times 10^6$	42%
$> \$100 \times 10^6$, $< \$500 \times 10^6$	39%
$> \$500 \times 10^6$,	19%

EXHIBIT II

Number of Traffic Staff		Background		
1	5%	Industry Experience	51%	
>1, <5	45%	University/College	18%	31%
≥5	18%	C.I.T.T.	13%	
≥10	19%	Carrier Experience	12%	
≥25	13%	Other	6%	

Researcher Recognition

Exhibit III demonstrates a very clear belief that most research is done by government (at the federal level). Neither this perception, second place for academic institutions, nor the remaining rankings are surprising.

Within the University subgroup shippers were asked to identify schools with a specialty in Transportation. A 50% recognition level was attained by U.B.C. and the joint U of T/York program if we accept reference to either school as a vote for tne joint program. McGill was identified by 25% of the respondents while a 5-10% recognition level was bestowed upon Carleton, Concordia, Queens, Simon Fraser, the University of Montreal, Western and Waterloo. To me these results suggest tnat contact between most university researchers and the shipping community is minimal.

EXHIBIT III

SHIPPER PERCEIVED RESEARCH PARTICIPATION

1.	Government	0.74	
2.	Universities/Colleges	0.63	
3.	Transportation Associations	0.57	
4.	Consultants	0.54	Within Government
5.	Carriers	0.54	
6.	Shippers	0.46	
7.	Transportation Equipment Suppliers	0.29	

1.	Transport Canada	0.83
2.	Canadian Transport Commission	0.70
3.	Provincial Governments	0.62
4.	Municipal Governments	0.26

Anotner technique used in the questionnaire to check shipper recognition of research activities was question #26.

"What do the following initials stand for?

CIGGT _____ Uncertain__

CTRF _____ Uncertain__

CTS _____ Uncertain__"

Of these abreviations the Canadian Transportation Research Forum fared the best with 23% of the sample correctly identifying the group. U.B.C.'s Center for Transportation Studies was only recognized by 10%, and the Canadian Institute for Guided Ground Transport by 7%. These paltry recognition levels support the conclusion that shipper contact is low.

Why are researchers and shippers at a distance? Are researchers uninterested in shipper input? Are shippers unwilling to participate? What communication vehicles are utilized between the two communities? A partial answer to the last question is revealed in shipper responses to "Where do you learn about Canadian research activity?" The information sources ranked as follows:

Trade Magazines	92%
Shipper organizations	73%
Government communications	44%
Research journals/publications	43%

The fact that less than half the shippers get information from research publications suggests that if researchers wish to communicate better with the shipping community they will need to increase their use of methods with less academic status. Interface with widely distributed trade magazines and shipper organizations is tne key. If, on the other hand, researchers simply wish to communicate with each other present methods are sufficient.

When asked about their own participation 48% of the shippers said they had engaged in transportation research but only 17% had sponsored it. 75% believed their firm would sponsor research of direct benefit to their company and 29% even believed they might participate in research of general benefit. The most prominent reason for willing involvement was ROI based.

What Research is Done?

To get details on shipper perceptions on this topic a number of questions classifying research in different ways were used. Modal preference in research was viewed by respondents as being heavily rail biased.

Rail	0.84
Highway	0.59
Air	0.56
Marine	0.43

Shippers believe freight transportation gets less attention than it deserves, ranking evenly with intercity passenger travel. (Exhibit IV) Further within freight transportation, operations research is viewed as being the most important and emphasis on it should be doubled. Similarly qualitative research should be given significantly increased priority; equivalent to public policy research. Of those shippers having engaged in research OR was the most popular (42%) followed by qualitative research (22%), applied technology (19%), public policy (10%), and pure technology (7%). It is interesting that the quantitative values given for public policy, applied and pure technology research remained relatively unchanged when the question switched from perception to preference.

EXHIBIT IV

WHAT RESEARCH IS DONE?

The Way It Is		The Way It Should Be	
1. Urban transportation	0.71	1. Freight transportation	0.81
2. Intercity passenger travel	0.57	2. Intercity passenger travel	0.76
3. Freight transportation	0.56	3. Urban transportation	0.54

Within Freight Transportation Research

1. Public policy	0.56	1. Operations research	0.65
2. Applied technology	0.56	2. Public policy	0.57
3. Operations research	0.37	3. Qualitative	0.56
4. Pure technology	0.33	4. Applied technology	0.54
5. Qualitative	0.33	5. Pure technology	0.39

Examples given for clarification in the questionnaire -

Pure technology	- solar energy
Applied technology	- special railcar design
Public policy	- level of regulation
Operations research	- mathematical modelling on costing or scheduling
Qualitative research	- service levels

Funding and Research/Researcher Selection

Although the majority of shippers seem to agree with research dominated by federal and provincial government funding they appear to favour increased carrier and shipper involvement (Exhibit V). They concede Transport Canada priority in research selection decision-making but want significantly increased input for transportation practitioners, i.e. the shipper and carrier (Exhibit VI). Ranking practitioners above Provincial governments, the CTC and universities when selecting the research projects to be undertaken, to the writer, indicates a dissatisfaction with present choices. A resounding 95% of the respondents declared shippers should have input on what research is done. As well 87% felt shippers should have input on who does the research.

Obviously if shippers or carriers sponsor research, selection is theirs. However for government funded projects input to my knowledge

is presently limited. Although research selection by a mixed group of experts was not preferred (Exhibit VI) I can't formulate another practical method for the shippers' voice to be heard. Perhaps a Canada Council-like procedure for evaluating proposed research is worth consideration.

EXHIBIT V

FUNDING

The Way It Is		The Way It Should Be	
1. Federal government	0.71	1. Federal government	0.84
2. Provincial governments	0.60	2. Provincial governments	0.69
3. Universities	0.35	3. Carriers	0.58
4. Carriers	0.33	4. Shippers	0.46
5. Transportation associations	0.26	5. Transportation associations	0.36
6. Shippers	0.26	6. Universities	0.34
7. Transportation equipment suppliers	0.26	7. Transportation equipment suppliers	0.33
8. Municipal governments	0.19	8. Municipal governments	0.23
9. Consultants	0.10	9. Consultants	0.14

EXHIBIT VI

WHO SELECTS RESEARCH TO BE DONE/FUNDED?

The Way It Is		The Way It Should Be	
1. Transport Canada	0.68	1. Transport Canada	0.62
2. Provincial governments	0.51	2. Shippers	0.57
3. Canadian Transport Comm.	0.46	3. Carriers	0.51
4. Universities	0.36	4. Transportation associations	0.45
5. Carriers	0.30	5. Provincial governments	0.40
6. Transportation associations	0.29	6. Canadian Transport Commission	0.37
7. Transportation equipment suppliers	0.20	7. Universities	0.28
8. Shippers	0.19	8. Mixed group of experts	0.20
9. Mixed group of experts	0.18	9. Transportation equipment suppliers	0.19
10. Municipal governments	0.17	10. Municipal governments	0.13
11. Consultants	0.16	11. Consultants	0.11

CONCLUDING REMARKS

Shippers wish to exert greater influence on transportation research in Canada. Earlier in this paper the questions, "Why are researchers and shippers at a distance? Are researchers uninterested in shipper input? Are shippers unwilling to participate?" were posed. The answer to the last question, based on questionnaire responses, is NO. It could be argued that each recipient of the questionnaire that didn't bother to return it demonstrated unwillingness to even recognize research activity but I choose to discount that possibility. So given that shippers are willing to participate more, why don't they?

To participate in something you don't sponsor, you must be invited and then you must accept. Researchers may not invite shipper participation because they do not value it. If so they should find a new line of work. Researchers may invite shipper participation but be rejected because the invitee does not value the proposed research. This could occur because, (1) the shipper is blind to its benefits, (2) the researcher has done a poor selling job, or (3) the project has limited value.

Research in medicine, the physical sciences, etc. may generate by-product results far more important than the original objective. Consequently letting the marketplace determine what research is done would impede progress. Transportation research, in contrast, is unlikely to produce such valuable side discoveries so a marketplace evaluation could prevent inefficient allocation of research resources and funding. Rejection of participation by a shipper should signal to the researcher he/she should have a long hard look at his/her plans. The sheer desire to publish is not justification enough to proceed.

The preceding helps to define the shippers' perception of transportation research in Canada. It identifies the desire for greater input to the research activity but highlights the present lack of shipper participation and awareness. As with all research it poses further questions. Perhaps the most important question: How does the shippers' perception compare with the facts?

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URBAN TRANSIT R & D: A COORDINATED APPROACH

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Canadian Urban Transit Association

ABSTRACT

This paper describes the present efforts and future plans of the Canadian Urban Transit Association (CUTA) to develop a coordinated approach to urban transit R & D in Canada. The results of Phase I of CUTA's efforts are examined including an overview of the current level of R & D activity and the nature of the R & D currently underway and/or completed by transit operators, government agencies, manufacturers, and private research organizations. In addition, the methodology to be used for an analysis of the value of the above R & D from the perspective of the various agencies conducting, funding or administering urban transit R & D projects is outlined. The work planned for Phase II of CUTA's efforts namely the identification of R & D needs, and the definition of the R & D priorities and strategies for the urban transit industry will be described as well as a preliminary assessment of the alternative roles for CUTA's future involvement in the coordination of urban transit R & D.

INTRODUCTION

Urban transit research and development in Canada has evolved in an ad-hoc fashion resulting largely from provincial initiatives aimed at improving the technological capability and consequently the operational efficiency of transit systems and the efforts of transit operators to solve day-to-day operational and technical problems. R & D initiated by the Federal Government is aimed at managing the application of science and technology towards a more efficient national transportation system with no dedicated source of funding for urban transit R & D. Research conducted by manufacturers is in response to present demand requirements, anticipated market trends and the need for internal product improvement while university research is limited to the availability of research dollars in specific areas of interest to the researchers. The above diversity of efforts, the overlapping mandates of the various agencies, the lack of a clear federal responsibility for urban transit R & D, and the fact that no national organization or association has fully accepted responsibility for coordinating urban transit R & D has led to a number of problems. Little coordination is evident on a national basis, duplication of effort is commonplace, rarely are the overall needs and priorities of the industry addressed when projects are initiated and the dissemination of results has been poor.

As a result of the above problems and concerns, CUTA initiated activities aimed at developing a coordinated approach to urban transit R & D in Canada. For background information, the Canadian Urban Transit Association (CUTA) is a national Association which has represented the interests of the urban transit industry in Canada since 1904. The Association represents urban transit operators (regular and disabled), government agencies involved in providing subsidies to the industry, equipment manufacturers and suppliers, consultants, educational institutions, and individuals interested in urban transit.

The purpose of the Association is to acquire, compile, and distribute information and data of value to the transit industry; to represent the industry on public matters of general concern; to advance the interests of the urban transit industry in Canada by the interchange of experience, ideas, and technology; and to aid in the development of a meaningful environment for the discussion of industry problems and opportunities.

Members participate in CUTA through working committees (including an R & D Coordinating Committee), national conferences and seminars, and management training courses designed to improve transit management in Canada. Through the above mechanisms, CUTA members exchange information and experience on a wide range

of policy and technical issues. CUTA is governed by a Board of Directors elected from the membership. The Board appoints an Executive Committee responsible for the day-to-day management of the Association's activities. The Association's office is located in Toronto and its staff is headed by an Executive Director responsible for the general supervision of the affairs of the Association.

INITIAL CUTA INVOLVEMENT IN R & D COORDINATION

CUTA's initial involvement in the area of R & D began in November 1979 with the adoption of a position paper on urban transit R & D. The position paper noted that Canadian cities had obtained a world wide reputation for technical expertise in the planning, development, operation, maintenance, and management of transit systems. This reputation was the result of innovation in a wide variety areas. As well, there was a considerable amount of research and development underway in Canada at the time. In Ontario, testing was proceeding on a powered steerable truck for rail transit vehicles and a diesel/flywheel hybrid drive train for buses was being developed. An articulated bus was being developed for Canadian manufacture and a paratransit vehicle was being developed in Montreal. A Canadian Light Rail Vehicle was being

designed and built in Ontario. However, in comparison to transit research and development programmes in other countries, Canada's efforts were still relatively meager. There was obviously room for added initiative.

At that time, the federal government provided some coordination and sponsorship for transit research and development in Canada, but it was limited. More communication and commitment was needed among the transit opertors, manufacturers, consultants, and researchers. There was also a lack of financial support. More financial incentives, both direct and indirect, was necessary to help develop the potential for selling Canadian transit equipment off-shore. International sales would enhance economies of scale, ensure a continuing source of supply for Canadian transit operators, and produce a beneficial effect on Canada's balance-of-payments deficit.

In order to encourage coordination and expansion of research and development activities in the transit industry across Canada, the CUTA position paper recommended that the following steps be taken:

(i) That CUTA act as a forum for the interchange of information on transit research and development by sponsoring seminars on relevant subjects, provide a clearinghouse for information, and encourage innovative activity.

(ii) That members of CUTA take an active role in supporting Canadian manufacturers in their research and development activities by taking part in test programmes, supplying data, and using the equipment when it is developed, provided it is competitively priced.

(iii) That the federal government provide more significant financial support for transit R & D and take an active role in forming consortia to market the results internationally, in conjunction with transit operators and the private sector.

(iv) That CUTA take an active role in establishing overall priorities in an expanded national research and development programme in transit, which would include technology, hardware, operational, and policy R & D.

(v) That CUTA be designated to represent Canadian transit operators in the federal government's efforts to implement and expand international joint technology sharing agreements as they relate to transit.

As a result of CUTA's position paper, the CUTA Executive Committee met several times with federal and provincial officials and in June 1981, CUTA was asked to comment on a draft report prepared by the Department of Industry, Trade and Commerce entitled "Urban Transit R & D - A Federal Perspective". This led to the formation of an R & D Task Force to prepare the Association's response and to recommend alternative mechanisms for an expanded CUTA role in urban transit R & D coordination. In March 1982, the Task Force report was released and approved by the CUTA Board of Directors.

As shown in Exhibit 1, the task force report concluded that the involvement of transportation agencies in urban transit R & D activities was not satisfactory with six areas identified as being deficient. Based on this analysis, the Task Force identified four alternative mechanisms for increased transit industry involvement in R & D. A brief description of the mechanisms shown in Exhibit 2 is as follows:

EXHIBIT 1

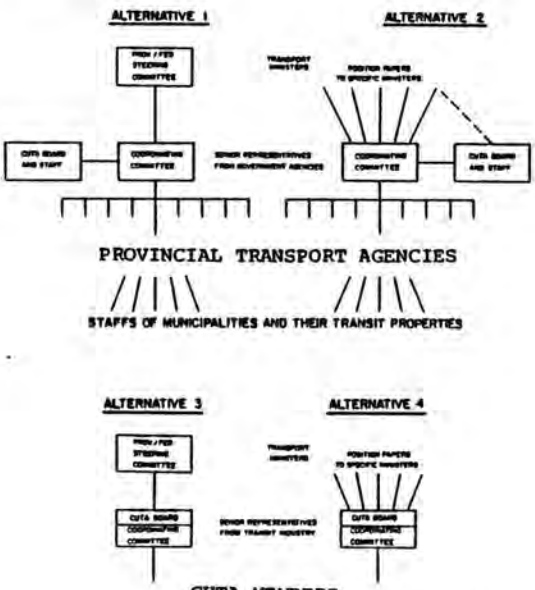
CURRENT INVOLVEMENT OF TRANSPORTATION AGENCIES IN TRANSIT R & D ACTIVITIES

	TRANSIT PROPERTIES	FEDERAL GOVERNMENT	PROVINCIAL GOVERNMENT	MUNICIPALITIES	MAJOR DEFICIENCIES
1. OPERATIONAL R & D ACTIVITIES:					
1.1 Monitoring Trends	●	0	0	.	
1.2 Establishing National Priorities	.	.	.	.	←
1.3 Technical Advice on Projects					
- Planning	0	.	●	0	
- Design	0	.	●	0	
- Implementation	.	.	0	.	←
- Evaluation	.	.	0	.	←
1.4 Initiating Projects of National Interest	.	.	0	.	←
2. TECHNOLOGICAL R & D ACTIVITIES					
2.1 Monitoring Projects	0	0	0	.	
2.2 Establishing National Priorities	.	.	.	.	←
2.3 Operational Advice	.	.	.	.	←
2.4 Assistance on Projects	0	0	0	.	

Legend: ● Extensive Involvement 0 Selective Involvement . Limited Involvement

EXHIBIT 2

ALTERNATIVE MECHANISMS FOR INCREASED TRANSIT INDUSTRY ROLE IN RESEARCH AND DEVELOPMENT



Alternative 1 - This alternative would establish a Steering Committee of Transport Ministers. The Steering Committee would formulate policy for government approval and obtain information for policy formulation from a Coordinating Committee of senior representatives from each government transportation agency. Each government transportation agency would assemble information and advise on priorities drawing on the municipalities and their transit properties as appropriate. The Coordinating Committee would draw on the CUTA Board and staff for policy advice as appropriate, request technical and operating advice from specific transit properties, and suggest R & D projects of national interest.

Alternative 2 - Same as Alternative 1 except that there would be no Steering Committee of Transport Ministers. Position papers on policy would need to be prepared by the Coordinating Committee, and submitted directly to each Minister.

Alternative 3 - Same as Alternative 1 except that a Coordinating Committee would be created within CUTA to complement the functions of each government transportation agency. Further, CUTA members would have a direct reporting relationship to the Steering Committee rather than through the municipalities and provinces as in Alternative 1 and 2.

Alternative 4 - Same as Alternative 3 except that there would be no Steering Committee of Transport Ministers. Position papers on policy would need to be approved by the CUTA Board and submitted directly to each Minister.

Alternative 4 was approved and an R & D Coordinating Committee was established. Generally, the purpose of the Committee is to provide the transit industry with a forum to collectively influence the formulation of transit R & D policies; to ensure that transit R & D in Canada is coordinated; to ensure that the priority needs of the industry are being addressed and; to ensure that duplication is minimized.

More specifically, the objectives of the R & D Committee are as follows:

- to assist CUTA staff in developing a work program and budget for its R & D activities;
- to set research and development priorities for the urban transit industry in Canada;
- to promote specific projects of high priority by motivating transit properties, manufacturers, and governing agencies to initiate programs and share the workload required in areas where common interests are identified;

- to advise the appropriate interest groups on funding sources for R & D programs;
- to assist the appropriate interest groups in the planning and design of R & D programs and in reviewing the programs during and after implementation;
- to make funding requests to senior governments for projects best handled through CUTA;

The membership of the Committee includes senior officials of transit operators, government agencies, manufacturers, and consultants.

As its first task the R & D Coordinating Committee agreed to initiate work aimed at obtaining a clearer picture of the number and type of agencies involved in urban transit R & D, their type and level of R & D activity, funding sources, etc. A report entitled "The Current Status of Urban Transit R & D in Canada" was prepared by CUTA staff. A total of 133 agencies were contacted and 55 responded that they were involved in conducting, funding, and/or administering urban transit R & D projects. Over 175 projects were underway representing R & D budgets of over $22.2 million. The report concluded that despite significant R & D activity in the area of urban transit, little coordination existed on a national basis. This resulted in duplication of effort and

an unnecessary waste of scarce R & D funds. In addition, R & D was initiated on an ad-hoc basis with little regard for the overall needs and priorities of the urban transit industry. The dissemination of project results was poor and seriously undetermined the overall effectiveness of industry R & D efforts.

CUTA'S CURRENT INVOLVEMENT IN R & D COORDINATION

Based on the above conclusions, CUTA submitted a three-phase proposal to Transport Canada for a $72,000 study to coordinate urban transit R & D in Canada. This study was approved and work began on Phase I in September 1983. Basically, CUTA's efforts in Phase I are in two major areas:

1) Inventory of Projects

Over 400 agencies (both public and private) have been asked to provide a detailed list of all urban transit related R & D projects underway and/or completed in 1983 or 1984. As shown in Exhibit 3, the information requested includes information on the purpose of the research, a detailed description of the work to be completed, the current status of the work to date, conclusions of the research, expected completion date, estimated cost, and funding sources.

EXHIBIT 3

URBAN TRANSIT RESEARCH AND DEVELOPMENT

PROJECT DESCRIPTION FORM

1. Project Title: _____
2. Title of Report: _____
3. Funding Source(s) and % Share: _____
4. Consultants/ Contractors Used: _____
5. Total Project Cost: (all years) _____ 6. Total Project Cost: (1983 only) _____
7. Start Date: _____ 8. Completion Date: _____
9. Project Manager: _____
10. Dissemination of Results: (How and to whom) _____

---

11. Project Objective, Scope, Background, and Methodology:

---

12. Project Results/Conclusions/Preliminary Findings:

---

13. Further Research Work Identified:

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14. CUTA USE ONLY:

Subject: _____ Project Number: _____
Notes: _____

2) Value Analysis

In the completion of this task, the value of the R & D being conducted will be evaluated from the perspective of government agencies, manufacturers/consultants, and transit operators. A simple rating scale will be developed along with evaluation criteria developed in cooperation with the respective groups. The value analysis will be elicited through face-to-face meetings and/or regional workshops.

Phase I is currently underway and will be described in more detail in the following pages. Phase II, for which funding has been requested from the Provinces of Alberta, British Columbia, Ontario, and Quebec, involves the completion of two tasks. While conducting Phase I, the R & D Coordinating Committee requested that CUTA staff prepare a discussion paper on CUTA's long term R & D activities. The content of the discussion paper, which is discussed in more detail later on has changed the intent of Phase II. The activities described for Phase II are those which were originally envisioned.

1) Identification of R & D Needs

Using the results of Phase I, certain gaps, opportunities, or problem areas should become evident. To determine the

R & D needs of transit operators, a survey will be distributed to define broad subject areas which are not currently being researched adequately. The responses will be analyzed and a representative sample of the CUTA membership will be selected for more detailed discussions. These discussions would involve face-to-face meetings to identify (in general terms) the R & D required to address the current or future needs of transit operators. In addition, the federal and provincial governments and manufactures would be asked to comment on the R & D needs of the transit industry from their respective positions. Again face-to-face meetings would be required with an emphasis on identifying a general framework for future R & D efforts rather than the identification of specific research projects.

2) Definition of R & D Priorities and Strategies

A regional workshop will be organized (or a session at a CUTA meeting) to arrive at a consensus with respect to the priority to be attached to the identified needs. The methodology for completing this task will include a brief survey prior to the workshop. The results of the survey would be presented as the basis for discussion. The purpose of the workshop would be achieve a consensus on the strategies needed to address the needs and priorities, the

agencies which could carry out and/or fund the identified research and the framework required to ensure an expanded and coordinated program for R & D is maintained.

Phase III, which is primarily administrative in nature, will be carried out by CUTA staff and include support services for the R & D Coordinating Committee, the organization of an R & D conference to highlight the results of Phases I and II, and a newsletter on R & D activities in the urban transit industry.

a) INVENTORY OF PROJECTS

As mentioned previously, over 400 agencies have been contacted and asked to provide detailed information on their research activities. Agencies contacted for the inventory of projects include transit operators (regular and disabled), government agencies (municipal, provincial, and federal), manufacturers of transit equipment, consultants, privately funded research organizations, universities, etc. In requesting R & D information, a very broad definition of R & D was used. This was done for two main reasons resulting from previous work.

1) Pure scientific research activities represent only a portion of the total R & D conducted for the urban transit industry. Many projects are operational, policy, and/or planning related. While these projects are not R & D in the

conventional sense, they are attempting to solve the operational problems of the urban transit industry and, therefore, should be reported as R & D activities.

2) It is operational type research which usually produces the most direct benefits to urban transit operators. As well, this type of research is consistently not documented in a formal manner, is poorly disseminated, and generally not well-known within the transit industry.

Since the operational problems of transit operators have some universality, albeit on different scales, it is was decided to define R & D in a broad context and to encourage respondents to be as comprehensive as possible when reporting R & D activities. As shown in Exhibit 4, the definition of R & D includes basic and applied research and development and demonstration projects provided that the research activity has significant application to the urban transit industry i.e. the primary focus must be the improved movement of persons within urban areas by public transportation systems and the improved efficiency of those systems.

The response to the request for R & D information for the project inventory has been significant. Of the 400 agencies that were contacted, well over half have responded. The vast majority of agencies that did not respond are small transit operators,

EXHIBIT 4

DEFINITION OF RESEARCH AND DEVELOPMENT

Research and Development refers to creative and systematic investigation by means of experiment or analysis. Transit R & D includes operational, policy, technological, and systems research for regular transit and disabled transit operations including all forms of paratransit.

In order to qualify as transit R & D, the research activity must have significant application to the urban transit industry. In other words, the primary focus of the R & D should be the improved movement of persons within urban areas by public transportation systems and the improved efficiency of those systems.

More specifically, R & D includes four distinct but related types of activity:

a) Basic Research - Research aimed at increasing or advancing the stock of scientific and technical knowledge without a specific application in mind.

b) Applied Research - Research aimed at increasing or advancing the stock of scientific and technical knowledge with a specific application in mind. Includes work to determine possible uses for the results of basic research, or to determine methods of achieving some specific objective. Usually involves the consideration of available knowledge and its extension in order to solve particular problems.

c) Development - The use of the results of basic or applied research for the purpose of creating new or improved existing materials, devices, products, processes, techniques, methods, equipment, and systems.

d) Demonstration - The design, construction, testing, and evaluation of new or improved materials, devices, products, processes, techniques, methods, equipment, and systems.

Research and development can cover the whole of the above innovation cycle or parts thereof. Related activities of an R & D project may include operations, analysis and dissemination of state-of-the-art technical data, and socio-economic analysis, if the above are related to the planning of R & D activities or to the assessment of the products of R & D activities.

manufacturers, suppliers, etc. which were not expected to be involved in any significant R & D activities. Over 90 agencies indicated that they were currently involved in conducting, funding and/or administering urban transit related R & D projects. Over 200 R & D projects were carried out in 1983-84 relating to the urban transit industry. This does not include the research activities of several large manufacturers (eg. General Motors) whose R & D activities were considered proprietary. While the R & D Project Inventory had not been finalized at the time of writing this paper, some preliminary conclusions are as follows:

- there is considerable R & D activity and much of it is not well-known within the transit industry. Many of the R & D projects reported are large scale research efforts which were previously not documented and disseminated to the industry especially R & D conducted by universities.
- the majority of research is funded in whole or in part by government agencies at the municipal, provincial, and federal level.
- duplication of effort in urban transit R & D is evident to some degree. This duplication is apparently due to two factors:

1) Dissemination of information has been poor and agencies involved in urban transit R & D are simply not aware of the recent activities of other organizations. This is despite regular meetings of CUTA, RTAC, CTRF, etc., which promote the exchange of R & D information.

2) In some cases, R & D efforts have been duplicated due to a reluctance to transfer the R & D conducted by one organization to another jurisdiction.

- the subject matter and focus of the industry's R & D activities is diverse with the majority of activities concentrated in the area of vehicle and component technology. Service demonstration, socio-economic research, software development, and modeling activities were also fairly numerous. Policy research and strategic planning research activities are still rare within the transit industry.

- overall, there appears to be no focus, on a national basis, for the industry's R & D efforts.

b) VALUE ANALYSIS

Due to a number of factors, including the lack of a national focus for urban transit R & D, there is concern that some of the R & D currently underway is unnecessary and/or not valuable to the industry particularly to the transit operator. The purpose of conducting an analysis of the value of current research efforts is to provide researchers with constructive feedback on their R & D efforts and to promote the conduct of R & D which more effectively addresses the needs and priorities of the industry.

While there is considerable literature on the evaluation of R & D activities and a number of techniques that can be used, there are a number of problems associated with this type of analysis. Research, whether it be basic or applied, is usually performed to advance understanding in a given area. While such research is necessary for more directed development and eventually demonstration, the research itself may not be directly related to a particular development opportunity and the development and demonstration of a particular product or service may not result in innovation or change. For instance, R & D can result in the acquisition of new knowledge, contribute to an organization's overall strategy or objective, increase a company's competitive edge in the market place or in the case of the transit operator, make it more efficient and more effective. On the other hand, R & D may not produce any immediate scientific, technological or policy opportunities but may lead to later benefits. With the above in mind, CUTA recognizes that there are a number of problems associated with conducting a value analysis.

1) Defining "success" for a given R & D project or program is very difficult. The loose linkages between outcomes and specific product, policy, service or process improvements makes the evaluation of research extremely difficult.

2) The multiple responsibilities, issues, impacts, objectives, etc. of a particular R & D effort makes the design of an evaluation methodology which satisfies the technical, political, economic, institutional, and personnel values of various groups extremely complicated.

3) Evaluation of an R & D program or activity cannot be achieved simply by aggregating evaluations of constituent groups. This would be misleading as some activities are undertaken to establish a network of researchers, to provide technical or information support to a given group or to coordinate efforts with other research programs.

4) When using qualitative analysis, objectivity cannot be achieved and conclusions are inherently biased. Value analysis must be recognized as the product of the organization who are collecting, sorting, and analyzing the data to make a point.

Many techniques have been used to analyze the value of R & D activities. The techniques span the spectrum from simple ranking/rating models with minimal data requirements to complex programming models. Due to limited resources, CUTA intends to develop a simple methodology which can be used to evaluate research in broad subject areas (rather than specific research projects). Preliminary plans call for the following methodology to be used. (See Exhibit 5 & 6).

1) Government agencies, transit operators, and manufacturers will be asked to develop their own criteria to evaluate the current research efforts as described in the project inventory.

2) Using these criteria, selected government agencies (maximum 5), transit systems (maximum 10), and manufacturers (maximum 5) will be asked to rank the R & D being conducted in broad subject areas using a three point rating scale (1 = limited value, 2 = moderate value, 3 = high value).

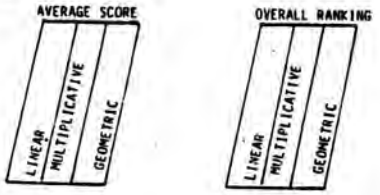
3) Points will be assigned to each cell of a matrix and a total score calculated using 3 methods:

   i) Linear - add values for all criteria
   ii) Multiplicative - multiply value in each cell
   iii) Geometric - use scale of 1, 4, 9 (instead of 1, 2, 3) for low, medium, and high value.

EXHIBIT 5 - VALUE ANALYSIS (FOR ILLUSTRATION PURPOSES ONLY)

SUBJECT AREA	CRITERIA - TRANSIT OPERATORS						TOTAL		
	INCREASED COST-EFFECTIVENESS	INCREASED PRODUCTIVITY	REDUCED AUTO USAGE	REDUCED ENERGY CONSUMPTION	ETC.	ETC.	LINEAR	MULTIPLICATIVE	GEOMETRIC
TECHNOLOGY DEVELOPMENT									
Bus and Paratransit Vehicle Technology	1	3	3	2	2	2	12	48	26
Bus and Paratransit Operational Technology	2	3	1	2	1	1	10	12	20
Rail and Construction Technology									
New Systems and Automation									
New Systems Application									
Safety and Product Qualification									
Socio Economic Research and Special Projects									
SERVICE AND METHODS DEMONSTRATION									
Transportation Services for Special User Groups									
Fare and Pricing Policy									
Conventional Transit Service Innovations									
Paratransit									
TRANSPORTATION PLANNING AND MANAGEMENT									
Planning Methods and Support									
Special Planning Studies									
Transportation Management									
POLICY DEVELOPMENT AND RESEARCH									
Policy and Program Development									
Training Programs									
OTHER									
Other types of R & D Projects									

EXHIBIT 6 - SUMMARY TABLE



SUBJECT AREA

TECHNOLOGY DEVELOPMENT

Bus and Paratransit Vehicle Technology
Bus and Paratransit Operational Technology
Rail and Construction Technology
New Systems and Automation
New Systems Application
Safety and Product Qualification
Socio Economic Research and Special Projects

SERVICE AND METHODS DEMONSTRATION

Transportation Services for Special User Groups
Fare and Pricing Policy
Conventional Transit Service Innovations
Paratransit

TRANSPORTATION PLANNING AND MANAGEMENT

Planning Methods and Support
Special Planning Studies
Transportation Management

POLICY DEVELOPMENT AND RESEARCH

Policy and Program Development
Training Programs

OTHER

Other types of R & D Projects

4) The scores for each subject area will be aggregated (for each type of agency) and averaged. The average scores for government agencies, transit operators, and manufacturers will be ranked and analyzed for areas of agreement and disagreement. Conclusions on the value of current research efforts will be made based on the above analysis.

It is hoped that the results of the value analysis will include the following:

1) a better understanding and recognition of the criteria used to evaluate R & D activities and the importance placed on current R & D efforts by government agencies, transit operators, and manufacturers.

2) Recognition of areas of research which are important to the industry and areas which are currently being researched which have limited benefit to the transit industry.

3) the re-evaluation of current research efforts and the re-orientation of R & D funds towards areas identified as being valuable.

CUTA'S FUTURE R & D ACTIVITIES

CUTA has become increasingly involved in response to members' concerns about how R & D is initiated, prioritized, and coordinated. While the intent of CUTA's current R & D efforts is to alleviate the above concerns and to identify the alternatives for an ongoing program of coordination, currently, CUTA has no formal dedicated funds for research projects and/or staff resources to carry out a coordination role. At the conclusion of Phase II, CUTA will require additional funds to continue its activities in this area. As a result, a discussion paper has been prepared for distribution to provincial agencies involved in subsidizing urban transit as well as Transport Canada. The discussion paper proposes that CUTA establish a formal program for urban transit research with federal and provincial assistance.

Obviously, the creation of a formal research program must include a process whereby both CUTA and RTAC can be regularly involved in R & D activities reflecting their respective Association's mandate and expertise. The need for this process stems from the fact that both CUTA and RTAC have a strong interest in the area of R & D. As well, the funding agencies involved in supporting both organizations are anxious to ensure that there are no duplications or gaps in their respective activities.

RTAC's multi-modal interests and CUTA's transit interest inevitably could lead to some duplication of activities and programs. This could be avoided by CUTA leaving the multi-modal and long range issues to RTAC and having CUTA concentrate on operational, policy, and technological issues affecting the transit industry in the short and medium term. Even this distinction does not guarantee that efforts will not be duplicated. Only a cooperative approach between RTAC and CUTA will avoid this.

The decision to establish a formal research program was based on a recognition that RTAC's R & D program and the limited role played by Transport Canada was not adequate to address the needs of the transit industry. Transport Canada's efforts in the area of urban transit R & D are significant, however, their mandate is not sufficiently broad to address the full range of the industry's research needs. The advantages of RTAC's effort include a commitment of staff resources, the existence of a well-recognized formal R & D program, a dedicated source of funding for transportation research and limited government involvement in the initial assessment of priorities. As well, RTAC's program draws on a wide variety of professional and academic expertise through its Committee structure.

On the other hand, from the perspective of the transit industry, RTAC's current R & D program has a number of drawbacks. Firstly, there is no dedicated source of funding for urban transit R & D. While some transit related projects have been funded by RTAC over the past several years, the fact remains that transit is only one of many interests that RTAC must address. Secondly, the current composition of the Council on Cooperative Research and RTAC's various Committees does not adequately represent the interests of the transit industry. Thirdly, not all provincial ministries of transportation have responsibility for urban transit, as in some provinces responsibility for transit rests with a separate government agency (eg. BC Transit), with provincial Ministries of Municipal/Urban Affairs (eg. Saskatchewan, Manitoba, Newfoundland, Nova Scotia), or in the case of New Brunswick no financial responsibility for urban transit at all. Fourthly, RTAC's R & D program and its Committee structure are seen to be somewhat bureaucratic. It can take several years for a project to be completed due to the involvement of various Committees during the study process.

Given that the current method of addressing the R & D concerns of the transit industry is not adequate, a number of alternative structures for coordinating R & D are possible. In developing alternatives to the present arrangement, a number of objectives are seen as being important. In summary, any program

to coordinate urban transit R & D must:

- attempt to solve short-term problems, needs, and concerns of the transit industry with particular emphasis on the needs of the transit operators;
- maximize the involvement of transit industry professionals across Canada;
- ensure that the needs and priorities of the industry are addressed independently of the R & D required for other modes;
- provide a suitable vehicle for the involvement of government funding agencies and universities;
- make effective use of CUTA staff resources;
- make effective use of available research funds;
- avoid duplication of effort;
- recognize the relative expertise and mandate of CUTA and RTAC;
- minimize bureaucracy and paperwork for all parties involved.

The activities which are seen as essential in any future urban transit related R & D program are as follows:

1) A project inventory of all urban transit related R & D with particular emphasis on operational, policy, and technological R & D conducted by transit operators (regular and disabled), funding agencies, manufacturers and universities.

2) An ongoing assessment of the needs and priorities of the industry including the identification of specific research projects which are required to solve pressing industry wide problems.

3) The creation of an information clearinghouse and resource centre on urban transit related research projects, demonstration projects, transit studies, etc.

4) A process to coordinate the efforts of all organizations in terms of the development, assessment, and prioritization of R & D projects and the collection and dissemination of R & D information.

Discussions on the specific mechanisms for carrying out the above activities are currently ongoing and should be completed by July 1984. Following agreement on the content on CUTA's R & D program, CUTA intends to submit a formal proposal to Transport Canada for the necessary staff resources to carry out the above activities. As well CUTA will be requesting from Transport Canada and all provincial governments involving in providing subsidies to the transit industry, a yearly grant of $100,000 to carry out research projects identified as a result of (2) above.

CONCLUSIONS

In conclusion, CUTA has become increasingly involved in the coordination of urban transit R & D over the past several years. Future plans call for CUTA to be more intensively involved in acting as a clearinghouse for R & D information and in identifying and carrying out research projects. CUTA will make every effort to keep CTRF and other transportation research organizations informed of its activities and progress.

TRAVEL PATTERNS IN AUSTRALIAN CAPITAL CITIES

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ABSTRACT

This paper descirbes and compares some significant trip length characteristics of urban travel undertaken in the six major capital cities in Australia - Sydney, Melbourne, Brisbane, Adelaide, Perth and Canberra. The proportion of trips taking under 10 minutes or over 30 minutes are compared in respect of all trips and trips by purpose, by mode and by start times. The basis of this analysis is the home interview survey data collected in connection with urban transportation planning studies. Since these data sets were obtained over a period of six years, further analysis was undertaken to compare trip length characteristics for one city with data interval of 10 years to appraise of the bias in the results due to different timing of data collection.

It has been seen that although city size is a key determinant of trip length distribution, it fails to explain all variations especially for public transport trips as well as non-work trips.

INTRODUCTION

Home interview survey data has been a traditional source of information for urban transport planning studies. In Australia, such studies have been periodically carried

out in all major urban centres in the past two decades.

As a part of a major passenger transport-energy system modelling project, travel patterns have been analysed for most principal Australian cities on a comparable and uniform basis. The trip characteristics considered include trip frequency, trip length, trip segments, travel mode, trip purpose and trip start time. The distribution of these characteristics with the age, sex, major activity, occupation and vehicle availability of the trip-maker has been analysed. Although the analysis has been completed for a large number of cities covering a period from 1966 to 1978, the following data sets have been used for the purpose of this paper: Sydney (1971), Melbourne (1972), Canberra (1975), Perth (1976), Adelaide (1976) and Brisbane (1977). Comparison of travel patterns is also made for Perth (1966) and Perth (1976) to study the effect of time and growth. The objective of this exercise was to appraise of the bias in the results which covered a period of 6 years.

This paper deals with some of the results of trip length analysis. Comparison of trip length has been undertaken for studying the

- variation within large cities (between Sydney and Melbourne);
- variations within medium-sized cities (between Adelaide, Brisbane, Canberra and Perth);
- variations among all cities (between large cities and medium-sized cities);

. temporal effect on trip length (between Perth 1966 and Perth 1976)

METHODOLOGY

This research has involved the acquisition and analysis of millions of records of home interview survey data for Australian cities. Use has been made of advanced data base management systems and statistical packages.

A number of problems are associated with this exercise as with any survey data analysis. In addition to the well known random sampling errors and the systematic errors underlying the data collection procedures which are common to most survey data, the secondary users of such data are faced with progressive loss and potential corruption of data (Wigan, 1983). Another serious problem in utilising the home interview survey data is the evidence of under reporting found by Barnard (1983). Not withstanding the serious nature of the problems associated with the use of these data sets, the analysis has been undertaken with a view to gaining a general appreciation of travel behaviour and their systematic variations among principal cities and with time.

Although the trip pattern analysis has been carried out at a highly disaggregated level, the results of comparing a few key trip length characteristics are reported here. There include trip length variations for:

(i) all trips

(ii) trips by purpose - work, education, shopping

(iii) trips by mode - car, public transport

(iv) trips by start time - before 8 am, after 8 am.

Trip length is measured by the time duration taken from the commencement of the trip at a true origin to its completion at a true destination for the accomplishment of a true purpose. To make the discussion meaningful, the proportion of short trips (taking under 10 minutes), and long trips (taking over 30 minutes) are compared.

DESCRIPTION OF TRIP LENGTH CHARACTERISTICS

Table 1 shows the results of some key trip length characteristics for the six capital cities. These results are exhibited in Figures1-5.

Figures 1 and 2 show these variations for all trips, work trips, shopping trips and education trips. Figure 3 exhibits trip length variations for trips by cars and public transport while Figure 4 shows the proportion of short and long trips for trips starting before and after 8 am. Finally Figure 5 presents a comparison of trip lengths for Perth in 1966 and 1976.

The legend used in the figures is as follows:

- Adelaide
- Brisbane
- Canberra
- Melbourne
- Perth 1976
- Perth 1966
- Sydney

The comparison and interpretation of the variation in trip length characteristics is discussed below.

TABLE 1: Trip Length Characteristics for Six Capital Cities

City	All Trips	Work Trips	Education Trips	Shopping Trips	Car Trips	Public Trans. Trips	Starting Before 8 am	Starting After 8 am
	Proportion of Trips Taking Under 10 Minutes							
Adelaide 76	42.6	22.7	47.2	57.0	43.5	2.8	21.9	47.4
Brisbane 77	48.9	29.2	56.1	62.3	52.1	4.4	37.6	56.9
Canberra 75	48.5	30.0	53.2	66.2	48.0	17.7	25.0	51.4
Perth 76	47.4	26.8	48.3	63.8	48.7	8.3	28.9	41.9
Perth 66	37.0	21.3	41.5	53.9	43.0	6.8	23.2	41.1
Melbourne 72	32.5	13.0	28.4	52.9	37.0	6.8	13.6	38.1
Sydney 71	33.8	16.4	37.5	47.1	38.3	6.4	16.7	42.4
	Proportion of Trips Taking Over 30 Minutes							
Adelaide 76	13.6	23.7	11.2	7.7	9.7	59.4	27.4	9.9
Brisbane 77	11.6	21.3	10.8	5.9	7.4	55.5	20.1	7.2
Canberra 75	6.6	9.9	6.2	3.4	5.7	25.2	13.5	5.0
Perth 76	9.6	17.1	7.6	5.5	7.5	38.4	17.2	7.0
Perth 66	11.5	15.0	11.7	7.0	6.6	32.7	16.9	8.7
Melbourne 72	36.7	60.2	46.6	17.7	30.3	74.1	61.2	29.6
Sydney 71	38.4	55.8	27.8	29.2	34.1	69.4	57.5	28.5

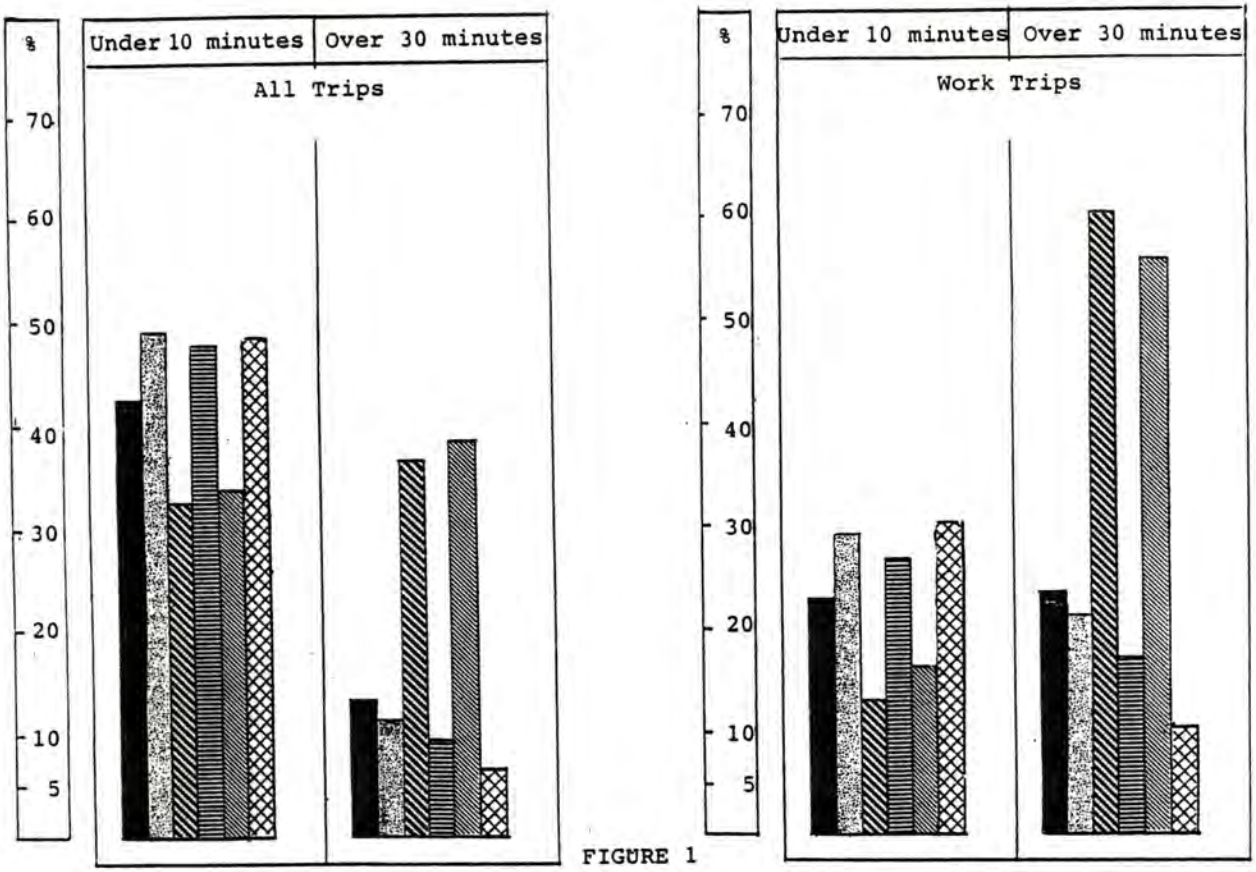
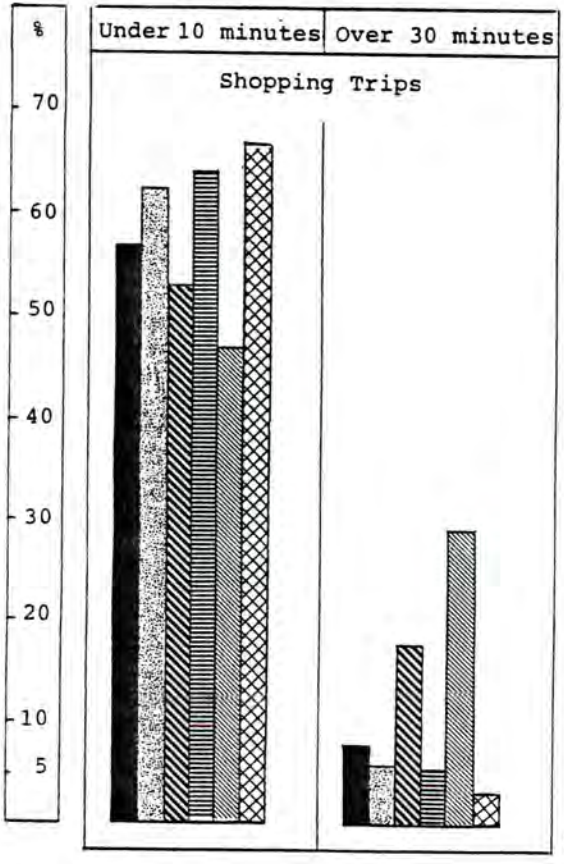

%
70
60
50
40
30
20
10
5
Under 10 minutes
Over 30 minutes
All Trips
%
70
60
50
40
30
20
10
5
Under 10 minutes
Over 30 minutes
Work Trips

FIGURE 1


%
70
60
50
40
30
20
10
5
Under 10 minutes
Over 30 minutes
Shopping Trips

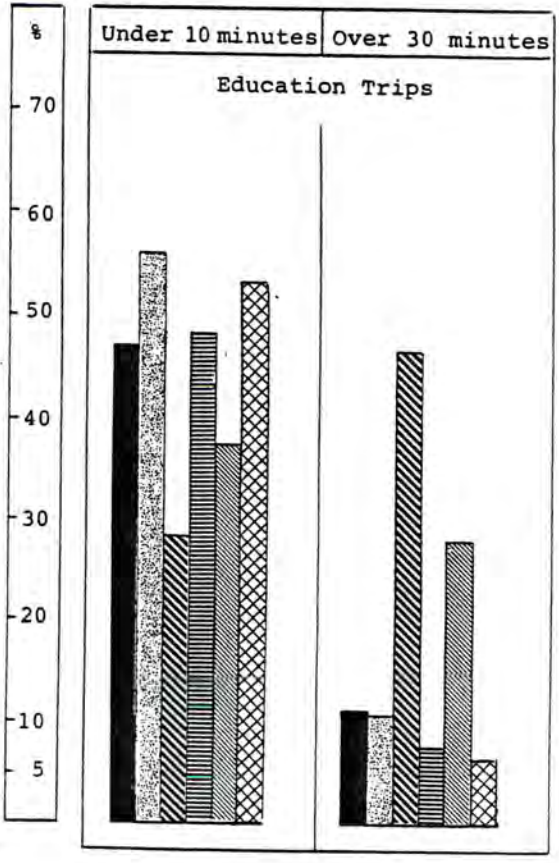
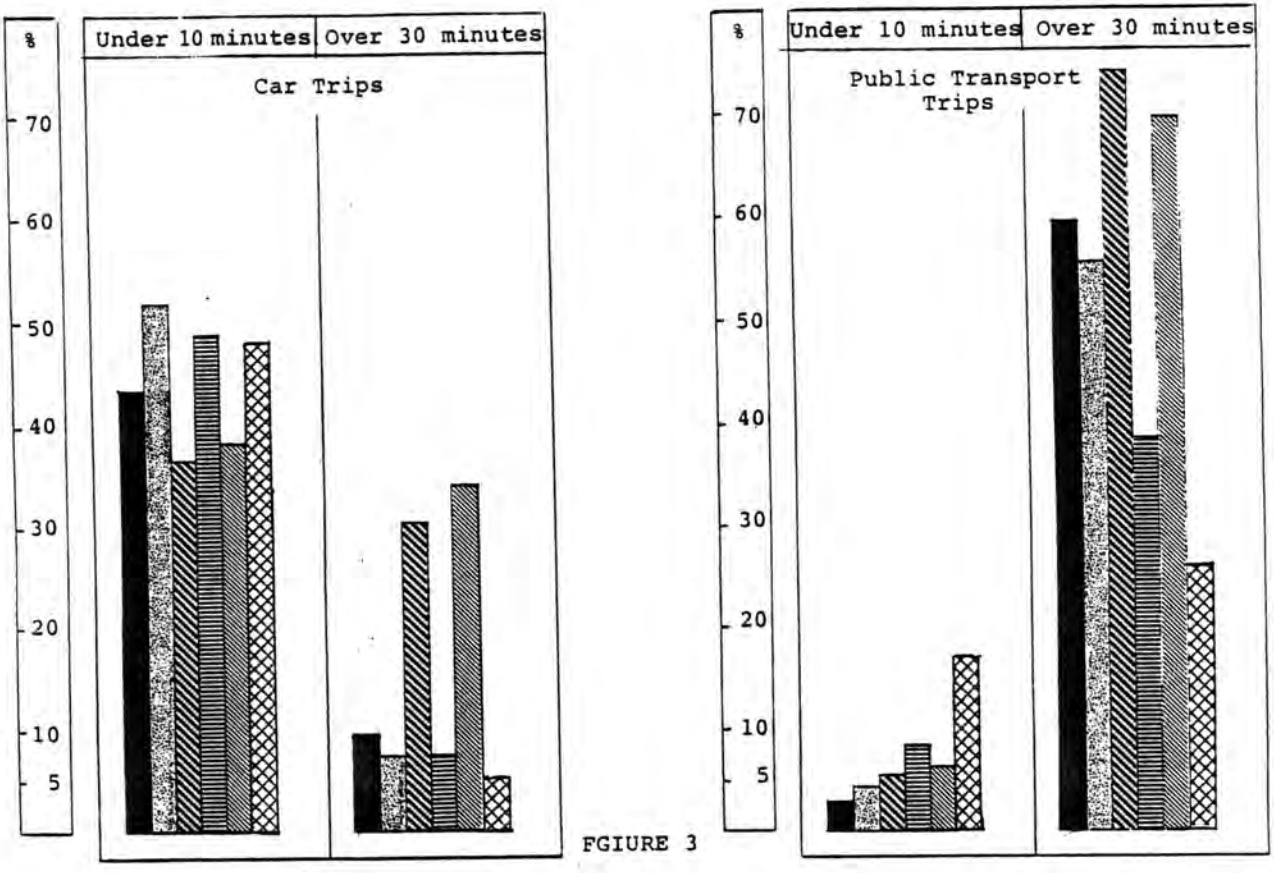
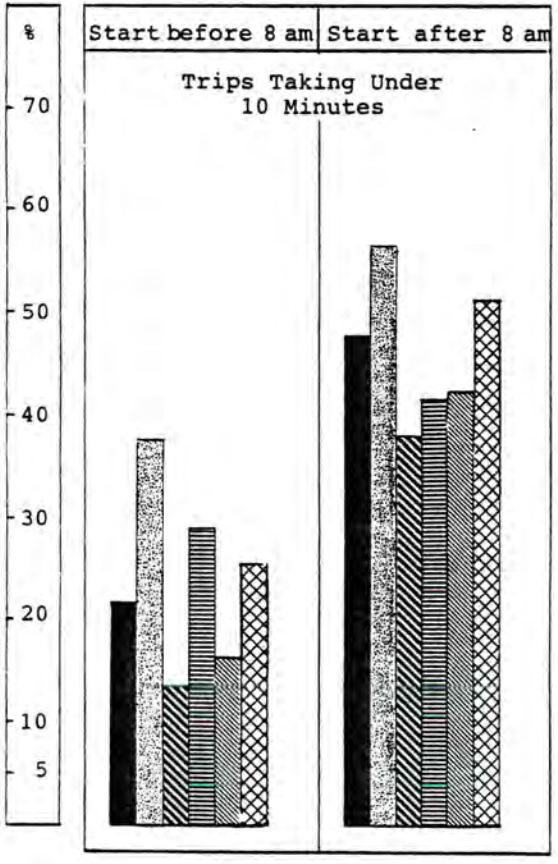

%
70
60
50
40
30
20
10
5
Under 10 minutes
Over 30 minutes
Education Trips

FIGURE 2


%
70
60
50
40
30
20
10
5
Under 10 minutes
Over 30 minutes
Car Trips
%
70
60
50
40
30
20
10
5
Under 10 minutes
Over 30 minutes
Public Transport Trips

FGIURE 3


%
70
60
50
40
30
20
10
5
Start before 8 am
Start after 8 am
Trips Taking Under
10 Minutes

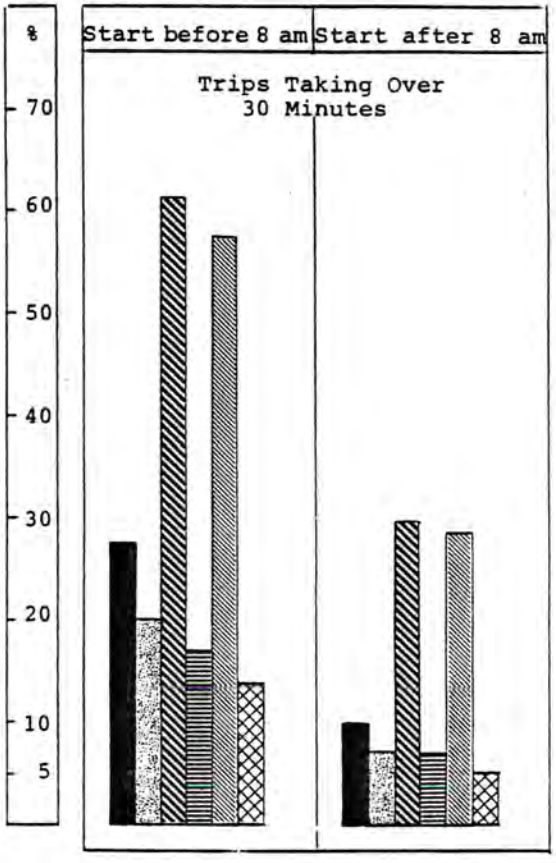

%
70
60
50
40
30
20
10
5
Start before 8 am
Start after 8 am
Trips Taking Over
30 Minutes

FIGURE 4

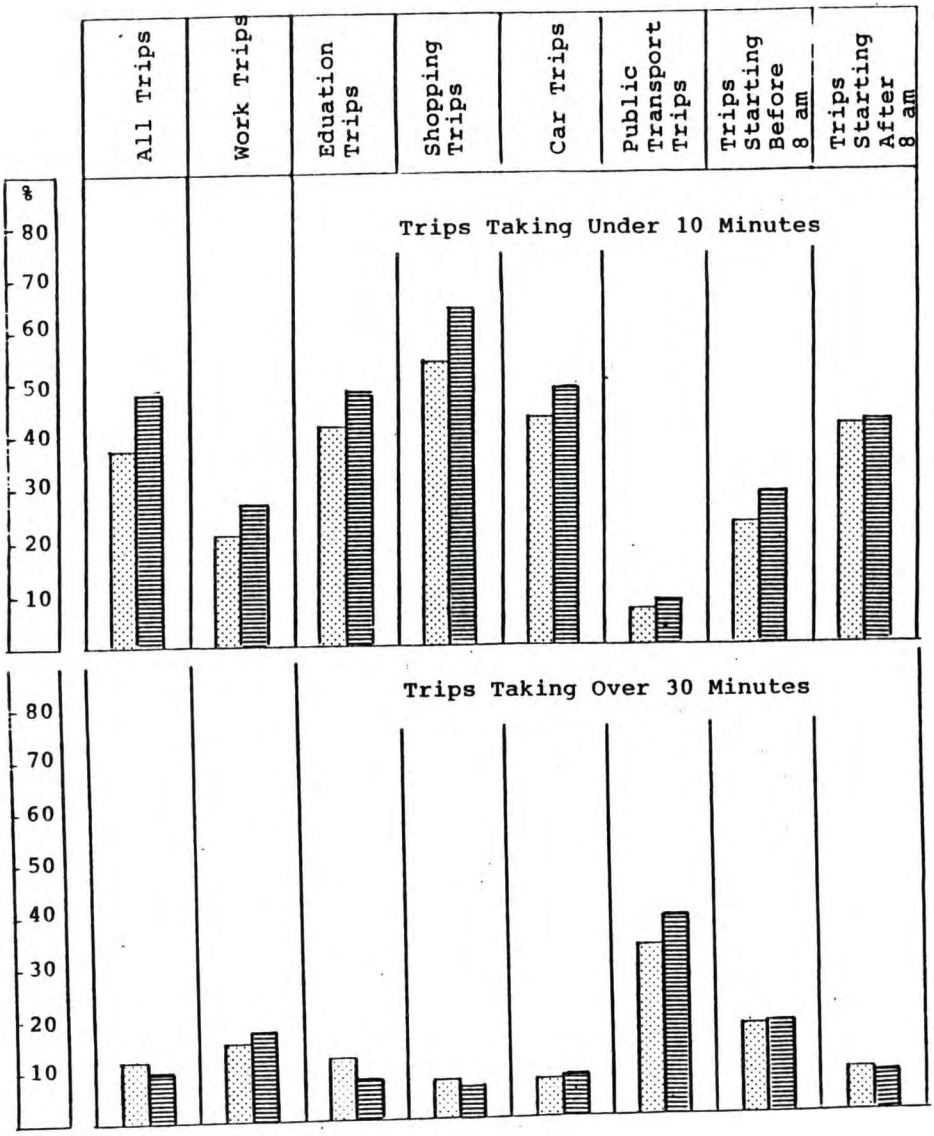

All Trips
Work Trips
Eduation Trips
Shopping Trips
Car Trips
Public Transport Trips
Trips Starting Before 8 am
Trips Starting After 8 am
%
80
70
60
50
40
30
20
10
Trips Taking Under 10 Minutes
Trips Taking Over 30 Minutes

FIGURE 5

COMPARISON OF TRIP LENGTH CHARACTERISTICS OF LARGE CAPITAL CITIES

Sydney and Melbourne are the two largest capital cities in Australia with survey date population of between 2.5 to 3 million. There are at least three mass public transport modes available in these cities. In the comparison that follows, Melbourne figures are given first followed by values for Sydney

Some trip characteristics are almost identical

The proportion of trips taking under 10 minutes or over 30 minutes is quite similar for Sydney and Melbourne in respect of the following:

All trips	(< 10 minutes)	32.5%, 33.8%
Car trips	(< 10 minutes)	37.0%, 38.3%
Public trans. trips	(< 10 minutes)	6.8%, 6.4%
All trips	(> 30 minutes)	36.7%, 38.4%
Trips starting after 8 am	(> 30 minutes)	29.6%, 28.5%

Variations in the proportion of short trips are insubstantial

The proportion of following trips taking under 10 minutes is higher in case of Sydney compared to Melbourne.

Work trips	13.0%, 16.4%
Eduction trips	28.4%, 37.5%
Trips starting before 8 am	13.6%, 16.7%
Trips starting after 8 am	38.1%, 42.4%

On the other hand, the proportion of shopping trips taking under 10 minutes is slightly higher for Melbourne (52.9%) than for Sydney (47.1%).

Proportion of long trips is generally higher for Melbourne

The proportion of long trips is slightly higher for Melbourne compared to Sydney.

Work trips	60.2%, 55.8%
Public transport trips	74.1%, 69.4%
Trips starting before 8 am	61.2%, 57.5%

In case of education trips, the proportion of significantly higher for Melbourne (46.6%, 27.8%).

However the proportion of car trips taking longer than 30 minutes is slightly higher for Sydney (34.1%) compared to Melbourne (30.3%), while the proportion of shopping trips is significantly higher for Sydney (29.2% against 17.7% for Melbourne).

Digression

There is a great deal of similarity in the proportion of short or long trips by purpose, mode or start time for Sydney and Melbourne. However trips in Melbourne tend to be generally longer than in Sydney especially education trips while only shopping trips follow an opposite trend.

COMPARISON OF TRIP LENGTH CHARACTERISTICS OF MEDIUM-SIZED CAPITAL CITIES

Capital cities of Adelaide, Brisbane, Canberra and Perth are considered to be medium-sized cities. At the time of home interview surveys, the population of these cities, with the exception of Canberra, varied between 800,000 - 1,000,000. In addition to being much smaller city, Canberra has only one mass public transport mode -

Bus whereas the other medium-sized cities have at least two mass transit modes.

Comparison of trip length characteristics for these four cities reveal the following:

Proportion of short trips is fairly similar

As seen below, the proportion of trips taking under 10 minutes, except those made by public transport, are fairly similar

All trips	42.6 - 48.9%
Work trips	22.7 - 30.0%
Education trips	47.2 - 56.1%
Shopping trips	57.0 - 66.2%
Car trips	43.5 - 52.1%

The proportion of such trips by start time has wider spread but Canberra values fall within this range.

Trips starting before 8 am	21.9 - 37.6%
Trips starting after 8 am	41.9 - 56.9%

Proportion of long trips is also similar (Canberra excepted)

The proportion of trips taking longer than 30 minutes are in the same general range for Adelaide, Brisbane and Perth. The proportion for Canberra is outside these ranges and consistently lower. This is shown in parentheses.

All trips	9.6 - 13.6% (6.6%)
Work trips	17.1 - 23.7% (9.9%)
Education trips	7.6 - 11.2% (6.2%)
Shopping trips	5.5 - 7.7% (3.4%)
Car trips	7.4 - 9.7% (5.7%)

Trips starting after 8 am 7.0 - 9.9% (5.6%)

The range is much wider for trips starting before 8 am but Canberra behaves in the same general manner.

Trips starting before 8 am 17.2 - 27.4% (13.5%)

Public transport trip lengths are quite dissimilar

Trips length variation for public transport trips are shown in Table 2.

TABLE 2

Public Transport Trip Lengths for Medium Cities

City	Trips Taking	
	< 10 Minutes	> 30 Minutes
Adelaide	2.8	59.4
Brisbane	4.4	55.2
Canberra	17.7	25.2
Perth	8.3	38.4

Although once again, trips by public transport in Canberra tend to be much shorter, no similarity is found in the case of other medium-sized cities.

Digression

It can be safely stated that trip lengths are much shorter in Canberra than in other medium-sized cities. The factors influencing this could include small population and efficient road network with interchanges and higher speed limits.

The shorter trip times by public transport are explained by the fact that bus is the only mass transit mode in Canberra while train or tram are also important public transport modes in other cities. Train trips tend to be much longer than trips by other mass transit modes.

COMPARISON OF TRIP LENGTH CHARACTERISTICS OF LARGE VS MEDIUM-SIZED CAPITAL CITIES

A simple perusal of trip length characteristics of travel behaviour in all capital cities establishes the similarity within the large cities of Sydney and Melbourne and also within the group of four medium-sized cities. This has been discussed in the previous sections. An intergroup comparison between the trip length characteristics of large cities versus medium cities follows.

Highly significant differences between large and medium-sized cities

Highly significant differences in the proportion of most long trips and some short trips are shown in Table 3.

As discussed earlier, Canberra has dissimilar proportion of long trips when compared to other medium-sized cities and is excluded from figures for long trips in this and subsequent sections.

Significant differences between large and medium-sized cities

In some trip characteristics, the differences between large and medium-sized cities is significant but not as

large as shown below. This is shown in Table 4.

TABLE 3

Highly Significant Variation between

Large and Medium Cities

Trip Characteristic	Average Proportion for	
	Large Cities	Medium Cities
Work trips (< 10 minutes)	15%	29%
All trips (> 30 minutes)	37%	10%
Work trips (> 30 minutes)	58%	20%
Car trips (> 30 minutes)	32%	8%
Trips starting before 8 am (> 30 minutes)	60%	20%
Trips starting after 8 am (> 30 minutes)	29%	8%
Trips starting before 8 am (< 10 minutes)	15%	28%

TABLE 4

Significant Variation between Large and Medium Cities

Trip Characteristic	Average Proportion for	
	Large Cities	Medium Cities
All trips (< 10 minutes)	33%	47%
Education trips (< 10 minutes)	33%	51%
Car trips (< 10 minutes)	38%	48%
Shopping trips (< 10 minutes)	50%	63%
Trips starting after 8 am (< 10 minutes)	40%	50%
P/trans. trips (> 30 minutes)	72%	51%

Minor variations between large and medium-sized cities

Insignificant variations have been observed in the proportion of short trips by public transport between large cities (average 6.6%) and medium-sized cities (average 5.2%).

Digression

The above results show that in most cases, there are significant or major differences in trip length characteristics between large and medium-sized cities. The comparison cannot be carried out for shopping and education trips which take longer than 30 minutes because of their significant variation between Sydney and Melbourne.

COMPARISON OF TRIP LENGTHS OVER 10 YEAR INTERVAL

Trip length characteristics for 1966 and 1976 for Perth were compared to assess the extent and direction of variation over time. During this period, the population of Perth increased from 559,000 to 820,000.

Proportion of short trips increased over time

A general increase in the proportion of trips taking under 10 minutes has been observed between 1966 and 1976.

All trips	37.0 - 47.7%
Work trips	21.3 - 26.8%
Education trips	41.5 - 48.3%
Shopping trips	53.9 - 63.8%
Car driver trips	43.0 - 48.7%
Public transport trips	6.8 - 8.3%

Trips starting before 8 am	23.2 - 28.9%
Trips starting after 8 am	41.1 - 41.9%

Changes in the proportion of long trips minor but irregular

The proportion of trips taking over 30 minutes increased slightly for work trips and trips made by car and public transport. A significant drop in the proportion of long trips occurred for all trips as well as trips for education and shopping.

No regular or systematic pattern of change in trip length can be established from the results of this analysis.

Digression

Based on this comparison, it can be argued that some reasonably valid results can be obtained by comparing the trip length characteristics of six capital cities for which data was collected not simultaneously but over a six year period (1971-77).

CONCLUSIONS

1. The trip length characteristics for Sydney and Melbourne are quite similar. While a large number of trip characteristics are almost identical, the proportions of some short trips are only slightly different. However, the proportion of long trips is generally higher for Melbourne. Only shopping and education trip lengths are dissimilar.
2. The proportions of short trips for all medium-sized cities are fairly similar. If Canberra is excluded

from considerations, the proportions of longer trips are also similar.

3. The trip length distribution for public transport trips varies significantly among the four medium-sized cities.
4. There are significant or major differences in trip length characteristics between large and medium-sized cities.
5. The proportion of short trips is seen to increase with time while the changes in the proportion of long trips are minor and irregular.
6. Reasonably valid results can be obtained by comparing trip characteristics of several cities even if the data is not collected at the same point in time. It is possible to examine systematic variations and obtain general appreciation of travel behaviour.
7. Significant variations in some trip length characteristics within large cities and within medium-sized cities clearly indicates that city size alone is not able to explain all trip length characteristics.
8. The substantial differences in trip length distribution of public transport trips for all four medium-sized cities reveal the significance of variety, quality and quantity of public transport available on trip behaviour.
9. The proportion of long trips is seen to increase with city size. However, although Sydney is larger in population than Melbourne, the proportion of long trips is slightly higher for Melbourne than Sydney.

This again shows that factors other than city size influence trip lengths.

ACKNOWLEDGEMENTS

The results presented in this paper are part of an on-going project supported by the Australian Department of Energy and Resources. Mr G. Pegoraro and Mr R. Hughes undertook most of the data analysis, while various State Transport and Main Roads Departments provided the home interview survey data tapes.

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INTERMODAL SURFACE PASSENGER COMPETITION AND COORDINATION IN SOUTHERN ONTARIO 1983

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INTRODUCTION

This report summarises findings on the presence of intermodal surface passenger transportation competition and coordination in Southern Ontario in 1983. The original research was done under contract #75160 for the Ministry of Transportation & Communications, Ontario. As a "supply side" view, demand factors are not fully considered. Looking at six links, the report finds little evidence of coordination but a fair degree of competition which varies by time of day. The report restricts itself to the 0600 - 1800 time period on week-days. The report examines the economics of competition in general and relates these to the topic.

Recently, concerns have been expressed about the viability of the intercity bus mode, in light of the alternatives available by rail, air, and the automobile. The report looks at some policy options that might be available to Ontario to ensure the continued presence of intercity bus services.

BACKGROUND - Literature Regarding the Region

In the last twenty years much work has been done to examine the potential for service amendments within the corridor. At the Provincial level a project entitled "The South Western Ontario Intermodal Passenger Ground Transportation Study" acted as background

and input to a joint federal - provincial study entitled "Southern Ontario Multi-modal Passenger Study" or SOMPS (1980). SOMPS quickly developed into a study of the need for further air terminal facilities in Toronto, having assumed away any problems in bus and rail.

In 1979 the Science Council of Canada issued a working paper on "Opportunities in Canadian Transportation: Intercity Passenger Transport". The authors correctly identified some trends which are emerging including potential expansion of the role of the automobile, and the threat to the bus mode of predatory pricing by the railway.

In 1981 the Economic Council of Canada examined competition in transportation in Canada and pleaded for less regulation.

Some non-governmental work, such as that by Dr. Julius Lukasiewicz of Carleton University, indicates changes should be made to public transportation in the Corridor; and that of the the Canadian Institute of Guided Ground Transport (CIGGT) in Kingston provides a cogent argument for high speed rail serving Toronto - Kingston - Ottawa - Mirabel - Montreal. The conclusions arrived at by SOMPS and CIGGT are, however, at variance with one another. VIA Rail in 1984 is now planning for high speed rail service in this corridor.

Competition from air appears to be of little consequence to the bus mode, given the fare and quality differentials -travel time in particular. The automobile acts as a carrier of last resort and as a benchmark for price, quantity, and quality of service available by bus and rail. Rail pricing is perhaps unintentionally predatory to the bus mode for while trying to attract ridership from the automobile in so doing is posing a threat to the continued provision of bus services without governmental subsidy.

THE DIMENSIONS OF INTERMODAL COORDINATION

The suggestion of intercarrier co-ordination raises the joint spectres of illegal joint monopolization and of collaborating with the enemy to one's own disadvantage -giving away one's clientele. But intermodal passenger transportation need not be a zero-sum game in that one can only gain what the other loses. Co-ordination, by providing the travelling public with more options, can elicit new ridership.

Intercity passenger transport is clearly not a zero sum game. Total traffic demand is not perfectly inelastic, a change in price will affect total demand. So will altered service. Besides being a function of price charged, quantity demanded is also determined by the prices and availability of substitutes as well as by population size and income. Thus better overall service is likely to increase the size of the entire pie, not only one portion. In addition, in Ontario a prime objective is to reduce oil demand. Attracting riders out of their automobiles and on to more oil-efficient transport is to be encouraged. On these grounds, then, one can justify joint rail/bus efforts toward coordination to draw ridership from the auto, and to better serve the riders of both.

Figure 1 suggests that there are circumstances when co-ordination may and may not be advantageous to a carrier. One could draw upon queueing theory and the Poisson distribution in fitting such a curve. Providing connections to a competitor's service is only unattractive when either travel time or the time to one's next departure is short. Passengers obviously benefit from intermodal co-ordination so long as such does not jeopardise existing service levels. This improved attractiveness will increase demand.

THE DIMENSIONS OF COMPETITION AND THEIR INTERACTIONS

There are four main dimensions to competition in intercity passenger transport:price competition, time in transit, arrival and departure time convenience, and comfort qualities. These dimensions interact, with price becoming the common denominator. When fares are not free to respond to changing market circumstances, then other dimensions come into play; but often what results is that carriers will replicate the service provided by their competitors. Only in the air mode in this corridor is there more than one supplier in a given mode. In all cases except Sudbury - Toronto competing carriers offer side - by - side service during high demand periods.

1. PRICE COMPETITION

In the study, fares are invariant as regarding departure time or day of week for single fares, and are departure time invariant except for certain return tickets which sometimes preclude Friday afternoon or Sunday afternoon travel. This invariance is usually a requirement superimposed on the mode by the regulatory body. The modes also are largely price invariant as to service quality - trips involving a change of vehicle or those not offering food or beverage service command the same fare as their superior counterparts. Each mode has its exception: rail has Club car, air has First Class and Third Level services , and bus has some Hostess service. Bearing this in mind then, price competition can be said to exist more intermodally and than intramodally.

On February 15, 1983 VIA Rail Canada, Inc., advertised 40% discount fares in the Toronto - Windsor zone of the subject corridor (1). These fares were not applicable at certain times or on certain

trains. Almost immediately, Eastern Canadian Greyhound Lines, Ltd., announced similar fare reductions for intercity service within the zone. Interestingly, Gray Coach Lines, Ltd., which provides service between Toronto and Stratford did not match VIA's discount fare on this link.

One possible reason for VIA's decision to initiate a price war could be the chronic unemployment in this zone, and declining business activity. It would be interesting to find whether this fact was instrumental in VIA's decision to reduce fares here only. A further statement in the advertisement suggests that the main reason for this price cutting action was the encouragement to riders to leave their car and take the train instead.

Unfortunately this price cutting is likely to have severe effects on the intercity bus industry also. Rail may, even at the lower fares, be covering its out-of-pocket costs. Not so bus.

2. TRAVEL TIME COMPETITION

Studies by Quarmby (2), and Lee and Dalvi (3) disagree as to whether perceptions of travel time value differ among waiting, walking, and being seated. Travel time variations are in evidence both within and between the surface modes. These are greater than is

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(1) Advertisement whole of page 21, Globe and Mail, Toronto Monday February 21, 1983 (a repetition of previous ads.)
(2) Quarmby, D. A. (1967) `Choice of travel mode for the journey to work: some findings', Journal of Transport Economics and Policy, vol. 1, pp.1-42.
(3) Lee N. and Dalvi M.Q. (1969) `Variations in the value of travel time', Manchester School, vol.37 pp.213-236

found in the air mode (see Table 1). A typical flight time range within the study corridor is the 50 to 55 minutes for the Montreal - Toronto link. Such differences could hardly be called significant, although on the same link the difference between a four and half hour train trip and a six and a half hour bus trip could well be significant in modal choice.

Time differentials of the lower of one hour or 25% of the longest elapsed time are considered inconsequential; the fare differentials between bus and rail tend to be of that magnitude also - rail being both faster and more expensive as a rule, although there are exceptions.

The yardstick is travel time by automobile. In computing this, posted speed limits and distance are combined together with an allowance for a 15 minute driving break every two hours and an extra 15 minutes every four hours. These figures do not include allowance for rush-hour congestion nor do they allow for detours.

3. ARRIVAL AND DEPARTURE CONVENIENCE COMPETITION

In modal selection, one must decide on one's willingness to wait for one's preferred mode. A headway sometimes adopted is that the waiting time is equal to the travel time. As the community of interest between Toronto and Montreal is high, one finds a maximum time between rail departures of three hours during the business day. Clearly the Headway equals Travel time guide (H = TT) is inappropriate in this instance. Such a guide, modified by the time to next departure of a substitute mode, may be more appropriate; or, in this instance Headway roughly equals one half Travel Time (H = 0.5 TT). Given a wait of say three hours for a rail departure to

Montreal, not only is the air mode an option, but if completed before the train pulls out. Three hours wait plus four and one half hours train trip totals seven and one half hours - longer than the six and one half hour drive.

The business traveller accounts for the major share of corridor traffic, a share fairly constant year round. The value of the business traveller's time is larger than the value of time for most other riders. Hence, executives are unwilling to pass inordinate lengths of time waiting for transport, thus providing the high propensity to ride the more expensive mode - air.

One other aspect of importance is that of punctuality. A transportation rule is that departures are never early although they may be late. Late arrivals, on the other hand tend to alienate riders. Punctuality is a management matter with realistic schedules being the key to perceived reliability.

When a traveller is "ready-to-go", the first convenient departure will have an advantage, other factors being equal. Similarly, at certain times the arrival hour is the more important, particularly for onward connections or starting times for meetings.

For this report, arrival and departure times for the various modes will be assumed to compete if no more than one hour separates the competitors.

4. SERVICE QUALITY COMPETITION.

The main differences in service quality can be separated into those boarding and before, those on - board the vehicle, and those pertaining to onward connection availability.Among the former one can include the ease of booking space. Only recently has VIA offered the

same booking convenience with the same effectiveness afforded the air traveller. This has taken place since VIA joined with Air Canada in using the same 'Reservec' computer system. Buses do not typically offer reserved seat service, although there is one such service, a 'Hostess' service on the Toronto - Sudbury link available at a premium fare. In past years, VIA in Toronto saw fit to have pre-reserved travellers waiting up to forty five minutes to pick up their tickets. A further weakness of the intercity bus industry is its unwillingness to accept credit card purchases. With such inconveniences and the high value of executives' time the total cost premium associated with air travel rapidly becomes worthwhile and air becomes more attractive.

Another pre-boarding difference is the holding area comfort. Shelter from the elements as necessary with the provision to obtain snacks while waiting can provide an important consideration in modal choice. The present waiting space in the Bay Street bus terminal in Toronto for intercity services is much less comfortable than either its rail or air counterparts, particularly when considering that bus seats are not reserved and that one must choose between queueing outside for the bus, and waiting inside until the bus starts loading and then taking one's chances on seat preference availability.

The level of comfort available in airports is rarely matched by the ground modes. In some locations there are few, if any seats for travellers nor a temperature controlled holding and boarding area. Mostly, the traveller is lucky to be afforded shelter from precipitation in both waiting and boarding areas. To a large extent the differences in real estate costs and in relative fares paid by riders accounts for these differences.

Luggage checking ability is probably not an important consideration for the business traveller, although it is for the VFR (visiting friends and relatives) type traveller.

If the ground modes wish to attract more riders from the air and automobile, as opposed to each other, they will be forced to recognise and resolve the above issues as well as the one of intermodal co-ordination discussed previously.

Turning now to on-board comforts, an enforced 'non - smoking' section coupled with the availability of snacks can also be key differences in modal selection. Non-smoking rules tend to be enforced only sporadically.

The business executive tends to gravitate away from noisy travellers where possible, preferring instead to do some preparation or reading. A mode which offers segregability will have an advantage. Largely this is accomplished by premium price service for example Club Car or VIA 1 for rail, and Hostess services for bus.

Regarding onward connections, timely and convenient transfers are desirable. In some cases in the corridor connections are frustrating. As an example one Kingston - London connection misses by ten minutes, necessitating a two hour wait. In another instance in this small sample of O-D pairs a possible intermodal service is frustrated by time and distance between bus and rail termini in Toronto.

MODAL CHARACTERISTICS IN THE CORRIDOR

1. The Intercity Bus Industry

The key characteristics that will be reviewed are ownership, regulation, pricing and ridership. In the corridor there are four carriers, two Greyhound subsidiaries, Eastern Canadian Greyhound

Lines serving Toronto - Windsor, and Greyhound Lines of Canada serving Toronto - Sudbury; Voyageur Colonial Lines, owned by Canada Steamship Lines and Power Corporation; and Gray Coach Lines, owned by Toronto Transit Commission. Voyageur serves the Toronto -Ottawa and Toronto - Montreal Corridors, Gray Coach Serves the Toronto - Stratford link and shares the Toronto - Sudbury link with Greyhound.Clearly none of these carriers is small, unable to look after its own best interests. But this is not to say that the existing intercity links are unimportant to these carriers. Regulation permits and in fact requires the cross-subsidization of more lightly travelled routes with excess profits obtained from the better patronised ones, and from charter services. Hence their whole systems can be disproportionately dependent on the busy routes which happen to be those in competition with railway as well as automobile.

Regulation in the corridor basically allows one carrier only to serve each link, with one notable exception. Greyhound is only allowed to provide closed door service between Toronto and Sudbury as part of their Trans Canada service alongside Gray Coach, which is not closed door restricted. The regulatory agency is the Ontario Highway Transport Board which assumes an essentially passive and reactive posture. There is no rate-of-return analysis and no on-going financial analysis of company performances (4). While regulation affords some protection for carriers from new entrants, the threat of such results in a tendency to overinvest in coaches so that the public necessity and convenience that would need to be proven by a prospective entrant would be very difficult.

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(4) G. B. Reschenthaler, Performance Under Regulation:The Canadian Intercity Bus Industry, Consumer & Corporate Affairs Canada, Research Monograph #10, 1981 page 18.

One more cause of overinvestment is that at main points the bus also acts as public carrier of last resort. Greyhound's Overflow fleet is estimated to be 25% provides for both these policies (5). Presumably other regulated carriers are similarly burdened, unless short term rentals are possible. An added source of semi-regular bus services is the presence of regular specific point charters. It is not, however, believed that this is a significant factor in the intercity market. It would, however, serve to weaken the less profitable links of the licensed carriers, causing even more reliance on sustained excess revenues from lucrative services.

Two separate demand studies for the intercity bus industry in Canada show surprisingly large elasticities of demand of the order of -1.5 and -2.08, a price reduction of 10 per cent will bring about a 20.8 per cent ridership increase, and a concomitant revenue increase of roughly 9 per cent in the case of -2.08, and 3.5 per cent in the smaller case -1.5 (6). If this relationship holds in the corridor, then price reductions would draw riders out of the automobile. In the week following the VIA advertisement many bus fares were reduced by up to 40%. Time will tell whether this elasticity estimate is borne out in the corridor, or whether, instead, the fears of Paul Martin of Canada Steamship Lines (owner of Voyageur Colonial Limited) who stated that "VIA has dropped its fares as AMTRAK has done in the U.S. and is seriously threatening the viability of the bus industry" will more accurately reflect the elasticity in the corridor (7).

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(5) op.cit. p 103.
(6) op.cit. p.11 [calculation: (1+%change in revenue) = (1+ %change in quantity)*(1+%change in price)]
(7) The Science Council of Canada, Opportunities in Canadian Transportation: Intercity Passenger Transport, Ottawa, 1979

Reschenthaler also points out that " the confined and cramped quarters, stuffiness, rough motion of the vehicle and the possible presence of undesirable fellow travellers for long time periods" discourages long distance bus ridership, (over 400 miles). In efforts to overcome these problems the bus industry has been experimenting with luxury bus services in Alberta which offer airline type service including liquor en route, stereo, snacks and open seating. This "Red Arrow" service commands a 20% price premium $25 instead of $21 in 1979 but Reschenthaler states that not a single case can be cited of a luxury bus operating at a profit. In the study area there is one Hostess service Toronto - Sudbury.

Both double decker and articulated buses have been tried recently in Canada for intercity service. The former by Voyageur on the Toronto - Montreal link, the latter by Pacific Coach Lines on the Vancouver - Victoria ferry run via Swartz Bay - Tsawwassen ferry, roughly one and one half hours on the bus interspersed by a two hour ferry ride. Double deck buses tend to be more jerky and jolty on the upper deck than single deckers. While one hour may be acceptable at a stretch, the longer rides in this corridor, up to and over six hours, may be less tolerable.

Bus prices tend to follow rail price leadership in the corridor. But curiously buses do not accept credit cards, not even at the main termini. Taxicabs manage to do this, as does the railway. This is a discouragement to bus ridership.

2. THE INTERCITY RAIL INDUSTRY

In Europe rail is the public carrier of last resort, if all else fails one can usually buy a ticket and stand, even for a trip of

several hours although such is rarely necessary. In North America rail could be the public carrier of last resort as well, but it has chosen not to be, preferring instead the problems of no-shows and unoccupied (and unpaid) seats. A recent discussion with a VIA agent revealed that VIA can and will fill seats on a stand-by basis, the reservation holder having been admonished to arrive 30 minutes prior to departure. This would seem to be singularly hard to enforce, particularly at intermediate stops. The agent stated that VIA trains are rarely full and the stand-by question seldom arises. If so, then a publicising of rail as a carrier of last resort would be cheap publicity for the rails, and would also benefit the bus through a trickle-down action as motorists would no longer be afraid to leave their cars at home and take public transport.

VIA has identified a number of objectives and opportunities within the corridor. These include:

*continued federal funding
*increased train speeds to 125/150/300 mph
*diversion of air/auto traffic between largest cities
*segregated local/regional services
*150 mph electrification
*upgraded or new routes:
    `Ottawa - Kingston
    `Kingston - Toronto
    `Toronto - Windsor via St. Thomas or London
    `Toronto - Stratford - London

VIA, however, has severe financial problems. Among them some 70% of expenses are outside VIA's control, being payable to CN and CP; in 1981 only 29% of revenues came out of the farebox, this compares with 100% for bus; the 1981 cost of VIA to the federal government amounted to $400 million, the 1982 estimate is between $500 and $600 million and rising. The Auditor-general stated that "Transport officials responsible for making contract payments to VIA are not always

provided with adequate information, as required under the contract, to ensure that the services are provided by VIA with due regard for economy and efficiency (8).

If one puts together VIA's costs and load factors, the following table ensues:

link	load factor range	revenue/cost	cost/seat-mile
Toronto to:	1972 - 1977	1977	1977
Montreal	46.0 - 55.6%	46.0%	$0.077
Windsor	31.5 - 40.8	40.0	$0.062
Stratford	18.5 - 26.0	14.0	$0.084

One can readily believe that trains are seldom full. Comparative load factors in the air industry are typically in the 60 to 70% range. Higher load factors for VIA would alter its financial picture. The present loss incurred by VIA's underpricing would be exacerbated by the greater market share concomitant with such higher load factors.

3. AIR AND AUTOMOBILE SERVICES

Air Service is generally more luxurious, much more expensive, subject to the vagaries of weather, and is usually not a downtown service and therefore requires ground transport as well. Short Take Off and Landing services (STOL) are presently offered downtown to downtown Ottawa to Toronto Island, and may come to other routes shortly. These provide travel time savings in airport access, but incur longer flying times in less comfort than is provided by CTOL jet service.

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(8) Auditor General Kenneth Dye -Federal Spending estimates tabled in the House of Commons February 22, 1983

Automobile Services are the benchmark against which all other services are measured. They allow the driver the freedom of choice of departure time, of the ability to smoke other than cigarettes, and of stereophonic entertainment of his own choice. The cost assessed by many drivers for intercity trips is usually not the average total cost for reasons that will be given later, rather the marginal cost or even a portion thereof is used. As an example an average cost of 15 cents/kilometre might be appropriate, as the Government of Saskatchewan's "Hot Can" program suggests for a two year old car using present fuel prices ($0.45/litre) Using only fuel costs and a consumption rate of 10 litres per 100 km, the fuel cost is only 4.5 cents/km just one-third of average cost.

Compare then the fares per km for the other modes between Toronto and Montreal and we find bus: 6.0 cents, rail 7.0 cents and air 21.1 cents. But with a loadfactor of 40% (two persons in a five passenger car), the automobile average cost per km drops to 7.5 cents, quite comparable with rail. For reasons best known to themselves, the public frequently assesses the cost by auto as being best represented by the cost of fuel only, probably because this component of total cost is the most contemporaneous, other components of variable cost -tire replacement, re-tuning, and new batteries for example- are usually less readily ascribed to specific trips.

Multiple person trips, and those requiring an automobile at either end, or to convey large amounts of luggage, are unlikely to find services offered by bus and rail appealing at present prices and at present degrees of convenience.

The appeal of the auto may be further enhanced in the future. Because the automobile assembly and parts industries are sizeable

employers in Southern Ontario, Governmental support for the industry could result in more efficient automobiles, and lowering private costs, to the disadvantage of the intercity public modes. Auto already has the lion's share of the market, and any major changes will have a much greater proportional impact on bus and rail.

POLICY OPTIONS

The Province appears to have three basic goals in this corridor. The first is the continued availability of public transport. The second is to keep the bus services which are necessary for goal one financially viable. The third is to encourage oil conservation.

Given the present competition on the major links in the corridor and the fact that these links are "bread and butter" links for the carriers, some effort must be made to ensure their survival. The present environment of stable oil prices, along with VIA Rail's seat sale practices prevent the bus carriers from increasing their prices.

Since 1971 the railways have fallen far short of covering their costs from the farebox. If they were to attempt to bring their fares up to a level more commensurate with their costs, as well as to keep their costs down, then their fare changes would allow Ontario's bus carriers a higher rate of return. The threat is there, though, that higher prices may erode the overall market in such a way as to reduce their revenues. This study outlines five options as follows.

OPTION 1 -LEAVE THE MARKET TO ITS OWN DEVICES.

Because the market is apparently already badly distorted with non-compensatory rail rates, and with distorted perceptions of automobile costs, there would seem to be little justification for laissez-faire for one mode only.

OPTION 2 -PETITION THE FEDERAL GOVERNMENT FOR RELIEF

and to cease predatory pricing as is discouraged by the Combines Investigation Act, or alternatively to obtain financial compensation for those bus carriers hurt by such behaviour. For the second option to be successful, it would be necessary to convince the federal government that VIA's pricing is in fact predatory and that bus carriers are being jeopardized. The mode with the largest proportion of variable costs should be the price leader. Bus is in that position; and rail could be advocated to price competitively to bus, in opposition to what currently transpires.

OPTION 3 -SUBSIDIZE CARRIERS.

Ontario could start subsidizing these carriers itself, should they be able to prove insolvency or the danger of such. This would seem a bad policy, as the burden would fall upon non-users of the bus, itself a victim of federal , and not provincial policy.

The third option has income re-distributive effects. It is rather difficult to make a case for the taxpayer in Schreiber to have to cross-subsidize, say, bus service between Toronto and Windsor.

A variant on this option is to exempt bus carriers from Provincial sales taxes on motor fuel, on luxury options to make the ride more attractive, or on vehicles themselves. Motor fuel is not a

large element of the operating costs of buses; accordingly, tax reductions would have only minimal effect on the operating budgets of bus carriers. Making luxury options sales tax free might encourage carriers to offer better ride quality, but should this be done while still charging sales tax on the necessary parts is debatable. Seven per cent on a $200,000 vehicle is $14,000, the interest alone on the tax at 10% amounts to $1,400 a year. This would help carriers improve their rolling stock by upgrading. As new highway coaches are not built in Ontario, a side effect of this would be export employment as well.

A variant of this option, subsidisation from motor fuel receipts, would be the one most acceptable to economists. Increased fuel taxes would reduce automobile travel and hence wear on roads, thereby reducingrepair and expansion expenses. Automobiles are not, however, the vehicles which inflict the greatest damage on the road system. Trucks are. A small increase in the fuel tax could be earmarked for bus subsidization, much as is done in British Columbia where fuel sold in the Greater Vancouver Regional District attracts a special tax levy to subsidize the urban regional bus system. The biggest danger to avoid is removing the need for carriers to be efficient in providing their services. In the GVRD 100% of the losses are picked up by the Province out of the special tax levy -no incentive for efficiency. The fourth option is a logical offshoot of the topic mentioned above.

OPTION 4 -"GO INTERCITY"

This option would be to pursue the GO Bus concept on an intercity scale. Like GVRD farebox revenues could be augmented from fuel tax to

finance a GO Intercity service, but GVRD is an amalgam of three administrations and is reputed to be unwieldy. The same criticism would probably be attracted on an even bigger scale for a GO Intercity. In Ontario GO Transit is perceived as encroaching on the markets of private carriers. This would follow on an even larger scale if GO Intercity were not careful. It is recommended that a feasibility study be undertaken to assess the merits of GO Intercity.

OPTION 5 - CATALYTIC INTERMEDIATION

The fifth option is the present thrust of the Province. Such further efforts as helping to facilitate the issuance of through tickets and the possible development of intermodal termini together with efforts to obtain schedule co-ordination both between carriers and within carriers are highly laudable and tend to be economically effective and efficient. Even a small amount of out-of-pocket expenses could reap rich rewards for the Province in its endeavours to attain the goals mentioned previously.

An adjunct to Provincial involvement in the market might be to encourage the acceptance of credit cards by bus carriers, and also as in Alberta allow the liquor licensing of Hostess type services. The staff would obviously not partake any more than do the crew on airliners.

FINDINGS OF THE STUDY

An examination of Table 1 reveals in some cases wide variations in elapsed time for both rail and bus services, some are "milk runs". Here follows a link - by - link summary of findings.

A. TORONTO - OTTAWA

Reasonable competition is in evidence between bus and rail with some four competitive westbound slots and five eastbound time slots daily. Where an intermodal transfer is necessary, the inconvenience may be offset by the availability of food and beverages while moving. The air mode seems to have five instances of inter-carrier competition in each direction, although in some cases the competition is between a first and a third level carrier with substantially different attributes.

B. TORONTO - MONTREAL

There seem to be four instances of intermodal competition westbound for the surface modes and intense intra-air competition in the early morning period represented by eight flights in two and a quarter hours by four carriers.

C. WINDSOR - TORONTO

There are three instances of intermodal competition in each direction. The rail has the shortest time in all cases. It is interesting that VIA's "Way to Go" fares are less than auto fuel costs.

D. STRATFORD - TORONTO

A former rail divisional point, Stratford's local allegiences are still with the railway, despite the pitiful load factors shown earlier (14%). That the railway has this historical connection leads one to cast a jaundiced eye upon the five instances of competition. It seems rather telling that Gray Coach has not matched VIA's discount fare. In all instances the railway has the shorter time and provides on board refreshments to go along with the cheaper price off-peak.

E. SUDBURY - TORONTO

There are no instances of ground competition, with perhaps the exception of the overnight service in both directions.

F. LONDON - KINGSTON

In the westbound direction, there are two buses leaving Kingston in the first time block, between 0600 AND 1000. There is only one intra-rail service taking less than seven hours in this time period, and one additional intermodal service-rail to Toronto and bus onward to London.

In the middle of the day, 1000 to 1600 there are five intramodal services, although the connections at Toronto, unlike eastbound are very poor. At 1530, for example, the train from Kingston arrives at the same time as the onward connection pulls out, thus necessitating a ninety minute wait. At 1740 the miss is by 10 minutes, the wait two hours less 10 minutes. There is one possible inter-modal connection bus out of Kingston at 1420 arriving Toronto Bay Street 1705 with an onward connection from Union Station at 1730, <u>if</u> one can cover the distance in rush-hour in enough time to buy ticket and board. In no cases are there any services competing at the same departure time. The main competition would be either air or the automobile. Five hours by car compares with at best five hours thirty seven minutes and at worst six hours forty minutes by public ground transport.

Eastbound the service seems more respectable. From 0600 to 1000 there are no fewer than six intramodal services plus one intermodal. Two of the former are timed under five and one-half hours, as is the intermodal again with a twenty-five minute transfer, but this time at 1105 -not rush hour. But notably three of the rail services make

exactly the same connection in Toronto as does a fourth departure at 1030 from London. In this case the 0900,0905 and 0925 departures from London should not really be considered as through services, other than departure competitive.

From 1000 to 1600 there are six departures. One bus, after leaving at 1030 along with the previously mentioned train, arrives in Kingston over seven hours later; its competition having covered the distance in four hours forty five minutes, having thereby arrived some two hours and twenty minutes earlier- no real competition. In one instance 1330 and 1340 both bus and train cover the ground and arrive five minutes apart, some five and three quarter hours later. This seems to be the only instance where the public transport traveler can really express his preference without selecting a different departure time.

In the London - Kingston case it seems that the service is hardly competitive, bus with rail. Westbound only one service, the 0955 train, comes within one-half hour of the auto travel time; eastbound there are four plus one rail/bus intermodal possibility. A minor conveniencing change could attract more riders from the automobile, that being a Union Station - Bay Street Terminal bus pick-up for the above mentioned connections.

In all, there seems plenty room for improvements.

TABLE 1 RANGE OF TRAVEL TIMES BY LINK AND MODE

A. TORONTO - OTTAWA
B. TORONTO - MONTREAL
C. WINDSOR - TORONTO
D. STRATFORD - TORONTO
E. SUDBURY - TORONTO
F. LONDON - KINGSTON

LINK		A	B	C	D	E	F
AUTO		5h00	6h30	4h50	2h00	5h30	5h00
BUS	from	4h55	6h25	4h50	2h30	4h40	5h30
	to	6h30	6h45	6h40	3h10	5h15	7h05
RAIL	from	4h50	4h30	3h55	2h10	7h30	4h40
	to	6h00	6h10	4h20	2h20	- -	6h50
AIR	max	1h15	1h16	0h46	- -	0h50	2h45

Sources: Published timetables 1983 -various carriers

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TABLE 2 SUMMARY OF DISTANCE, TIME & COST ON MAJOR LINKS.

LINK	A	B	C	D	E	F
LENGTH (km)	395	540	380	155	335	440
DRIVING TIME (hrs)	5.0	6.5	4.5	2.0	5.0	5.0
AUTO FUEL COST ($) (1)	18	24	21	7	15	20
AUTO TOTAL COST @ $0.15/km	59	81	57	23	50	66
SINGLE BUS FARE -REGULAR	27	32	23	12	30	31
COMPETITIVE BUS SPECIAL FARE	-	-	16	-	-	27
SINGLE RAIL FARE - REGULAR	34	40	29	13	29	36
"WAY TO GO" SPECIAL RAIL FARE	-	-	17	7	-	31
SINGLE AIR FARE	100	114	94	-	96	140

(1) Predicated on $0.45/litre, 10 litres/100 km

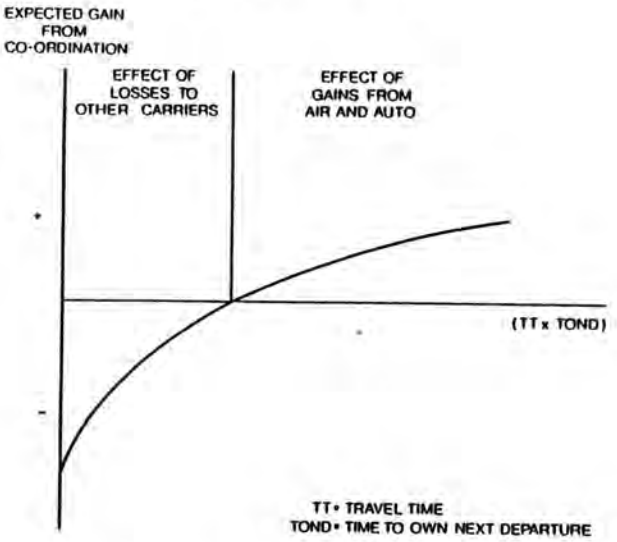
TABLE 3 SUMMARY OF COMPETITION AND CO-ORDINATION

passenger services Southern Ontario February 1983

	Surface Modes			Air Mode	
Link	Competing		Non-competing	Competing	Non-comp.
TORONTO-OTTAWA		(slots)		(slots)	
eastbd	4x2	(4)	6	4x2,1x3 (5)	5
westbd	3x3,1x2	(4)	4	1x4,2x3,3x2 (6)	2
TORONTO-MONTREAL					
eastbd	1x2	(1)	10	2x8,3x2 (5)	5
westbd	4x2	(4)	4	1x8,1x4,2x2 (4)	9
WINDSOR-TORONTO					
eastbd	3x2	(3)	6	(0)	2
westbd	3x2	(3)	2	(0)	2
STRATFORD-TORONTO					
eastbd	2x2	(2)	5	nil	
westbd	3x2	(3)	3		
SUDBURY-TORONTO					
northbd		(0)	6	(0)	2
southbd		(0)	7	(0)	2
LONDON-KINGSTON					
eastbd	2x2	(2)	7 + 1 co-ord.	(0)	3
westbd	2x2	(2)	4 + 1 co-ord.	(0)	3)

Sources: Carrier timetables for weekday services 0600 - 1800, latest current edition February 28, 1983.

FIGURE 1
EXAMPLE OF EXPECTED PROFITS FROM CO-ORDINATION (NO REVENUE SHARING)



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HIGH SPEED RAIL PROJECTS IN NORTH AMERICA

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ABSTRACT

The past three years have seen an impressive growth of interest in high speed passenger rail in the U.S. and initiatives aimed at introduction of Japanese, French and maglev technologies in North America. The present status of these technologies and of the current high speed rail projects in the U.S. and Canada are examined; technical, financial and institutional aspects are considered. The problems of high speed rail technology transfer to North America and the prospects for its successful development are discussed.

INTRODUCTION

The term "high speed rail", as used here, refers to systems on which trains operate at an average speed greater than about 160 km/h, performance that requires a maximum speed capability in excess of 200 km/h. The era of thus defined high speed rail started with the inauguration in 1964 of the shinkansen bullet train service in Japan. Seventeen years later high speed rail made its appearance in Europe with the opening, in September, 1981, of the TGV (Train Grande Vitesse) Paris-Lyon line.

So far these developments had no counterpart in North America where traditional, slow passenger trains, operated by Amtrak in the U.S. and Via Rail in Canada continue to attract minimal traffic, generate exorbitant losses and absorb correspondingly large subsidies (at a level of over 150 per cent of revenues in the U.S. and 300 per cent in Canada; Lukasiewicz, 1979, 1982, 1983). However, in the wake of successful and profitable high speed rail operations in Japan and France and with the help of marketing efforts by these countries, the last three years have seen a rapid growth of interest in North America in the high speed rail option for intercity travel. Several candidate routes are actively studied, meetings on high speed rail are being held, there is participation by industry, legislators, state, provincial and federal governments. In this paper the high speed rail

"state of the art" is reviewed, the current initiatives are examined and future prospects for high speed rail in North America are assessed.

HIGH SPEED RAIL: THE STATE OF THE ART

As a result of development of road and air transportation after World War II, the railway lost its near-monopoly for intercity passenger travel. In North America, due to favourable geo-demographic and economic conditions, the impact of the newer transportation modes was particularly severe. The car, much more affordable than in Europe, was owned by relatively more people and, given cheap fuel and early development of a network of excellent highways, was much more extensively used. Much larger intercity distances in North America than in Europe favoured air travel.

In spite of exorbitant subsidization of train passengers, the railway share of intercity travel in North America shrunk to a negligible 1 to 2 per cent. The traditional train, moving at an average speed of 80 km/h, was irrevocably superseded by the more convenient and faster automobile and jetliner. The performance and availability of the newer modes have redefined the technical characteristics of a viable passenger rail and circumscribed the market for which it can compete.

The high speed rail has been the answer. To compete with the automobile and the bus and, on distances up to about 500 km, with the jetliner, an average speed of at least 160 km/h (or about double the traditional train speed) is required. But, although high speed rail operates at double the road speed, it is not always competitive with the car. Given the door-to-door convenience and total schedule flexibility, the automobile offers a generally superior service on distances shorter than about 150 km. As for the long distance travel, the jet speed cannot be challenged by high speed rail or by any other mode while the bus is the cheapest and the car the cheapest and the most convenient mode for tourist and family travel. Furthermore, the high speed rail as a mass travel mode requires large traffic to ensure high load factors and frequent service, and is therefore restricted to routes between major population centres. To sum up, the competitive edge of high speed rail can be realized only in high traffic corridors over distances in the 150 to 500 km range, approximately.

The high speed rail is also subject to technical limitations. It cannot tolerate interference from the much slower passenger and freight

trains, and share the same tracks. Moreover, the curvature and super-elevation of conventional track and its quality, the obsolete signalling, the presence of level crossings and the need for costly maintenance render high speed operations on existing tracks unsafe and uneconomical.

The above limitations and requirements of high speed rail have been recognized in Japan and France and resulted in construction of new lines exclusively dedicated to high speed operations between major population centres.

In Japan, after only 5 years of construction, 210 km/h bullet train service was inaugurated between Tokyo and Osaka (515 km Tokaido line) in 1964; it was extended in 1975 to Hakata (additional 553 km Sanyo line). Lines from Tokyo to Morioka (496 km Tohoku line) and to Niigata (270 km Joetsu line) were opened in 1982. The shinkansen network is to be eventually extended to all four islands (5 additional lines) for a total length of 3380 km.

The shinkansen operation has no parallel in the history of passenger rail. On the Tokyo to Hakata line electric train sets, each consisting of 16 cars (1345 seats), run on dedicated tracks at a frequency of up to 10 departures per hour (in each direction) and a speeds up to 210 km/h; the operation is highly automated. The possibility of increasing the maximum speed to 260 km/h is considered and equipment faster than now in use is being developed. In November, 1979 a type 961 shinkansen train set reached 306 km/h.

Shinkansen's 210 km/h maximum speed in regular service has been surpassed by the French 260 km/h TGV (Train Grande Vitesse), in hourly service between Paris and Lyon since September 27, 1981 (RGI, 1981). The new TGV Paris-Sud-Est line was approved in 1974 and construction started in 1976. Five years later the first 275 km segment came into operation with new TGV equipment. The double track alignment was designed with a minimum radius of 4000 m and, taking advantage of high speed and tractive power, with a ruling grade of 3.5 per cent; since no tunnels were necessary, substantial savings were realized. The line was designed for 300 km/h, a speed that is being considered for the future and which is within the TGV capability. Since February, 1981, a TGV train set holds the speed record for trains at 380 km/h (The previous 1955 record of 331 km/h was also held by SNCF).

Since the completion of the Paris-Lyon line in September, 1983, the maximum <u>average</u> scheduled speed has increased to 212 km/h, i.e.,

slightly above the present maximum speed of the shinkansen. A special TGV train, touching a maximum of 292 km/h, completed the Lyon-Paris run in September, 1983 at a record average speed of 231 km/h.

Expansion of the TGV services to the west and south-west of Paris was approved in September, 1983. The Y-shaped TGV Atlantique system will provide a 2 hour connection from Paris to Rennes and Nantes and, on its southern leg, a 3 hour connection to Bordeaux. The line will first come into service in 1988 and the whole scheme will be completed in 1990 (RGI, 1983b).

Another area, in addition to technology, in which North America lags modern railway practice, is that of work and payment rules of employees engaged in the operation of trains (i.e., of "running trades"). The system generally used dates back to the steam locomotive times and defines a full day's work in passenger service as 100 miles of train travel or 5 hours, conditions which correspond to a speed of 20 mph (Lukasiewicz, 1976). These antiquated rules would make high speed train operations exceedingly costly and will have to be replaced with normal hourly wages. In the U.S. some progress has been already made in this direction when in 1982 Amtrak signed 40 hour week contracts with locomotive engineers and other train services employees in the Northeast Corridor. Such progress has yet to be made in Canada.

The approach embraced by Japan and France in developing high speed trains resulted in success and profitability; attempts to conduct high speed operations in mixed traffic on conventional tracks did not succeed.

The Advanced Passenger Train (APT), under development by British Rail since 1969 (at a cost of 42 million pound sterling), is a prime example of such an attempt. The 260 km/h train featured articulated design and an active tilt mechanism to allow fast travel on curves. Because the mechanism could not anticipate the transition into and out of a curve, it did not reduce passenger discomfort. Standing passengers found themselves in jeopardy of falling and many experienced travel sickness.

Three APTs were built but, due to several equipment problems, will not enter passenger service. Instead, modifications are considered which would drop articulation and other features but - surprisingly - not the tilt. The APT concept was flawed and its realization has failed; the APT is not likely to see revenue service (Hamer, 1982).

MAGLEV: THE MAGNETICALLY LEVITATED TRAIN

For speeds of 400 km/h and above, guided systems employing magnetic levitation and linear motor propulsion are under development in Japan and Germany. One of the main differences between the Japanese and the German systems is the technique of levitation. The Japanese use superconducting electromagnets while the Germans make use of ordinary conduction.

This creates, between the two systems, an important distinction. The Japanese vehicle achieves a levitation height of over 100 mm, whereas the German system maintains a gap between the vehicle and the guideway of only 6 to 12 mm. At high speeds when guideway imperfections and aerodynamic forces buffet the vehicle this slight clearance will not be enough to guarantee a comfortable and safe ride.

The maglev system of the Japanese National Railways is undergoing testing on a 7 km track in Miyazaki. In December, 1979 one of the experimental vehicles attained 517 km/h and established the world speed record for guided ground transporation. On September 2, 1982 a speed of 262 km/h was achieved in a manned test run of a new maglev design.

A maglev system offers several distinct advantages as compared to wheel-on-rail technology. They include:

- ability to climb steep grades (10 per cent) thus permitting more flexibility in the choice of route alignments;
- low noise levels, both outside and inside the vehicles, in the absence of contact between the vehicle and the guideway;
- good riding quality at very high speeds;
- low structural costs of the vehicles;
- high energy efficiency; and
- low operating and maintenance costs.

In regards to safety, a maglev system makes possible operation at 400 km/h-plus speeds without danger of derailment, the vehicle structure being wrapped around the guideway or shrouded by it. On the other hand, because at such high speeds the impact of even small objects creates a serious hazard, a super-speed ground-level guideway must be enclosed for protection.

As for the "market fit" of the maglev system, its higher speed would render it commercially viable over distances longer than those appropriate for high speed rail. The economic assessment of maglev must await accumulation of experience with prototype systems.

INADEQUATE INITIATIVES OF 1970s

In the United States, the potential of passenger trains gained some recognition in 1976, when electrification and upgrading of the Northeast Corridor (Washington-New York-Boston) was authorized. But the 1978 decision to keep freight trains in the NEC doomed the project to inevitable mediocrity. With slow, heavy freight trains sharing the tracks, provision of comfortable, fast and economical service in the NEC is not possible. When the $2.5-billion project is completed, the average speed will be increased to 135 km/h (2 hr 40 min trip time) on the Washington-New York run and to 100 km/h (3 hr 40 min) on the New York-Boston run, levels that are far below the high speed rail performance and offer little competition to the automobile and the jet. Trains in the NEC will not even match the speed of British Rail diesel HSTs which operate in mixed traffic at speeds up to 200 km/h.

The Canadian approach to the modernization of passenger rail was influenced by the British APT project. Since 1967, the LRC (for Light, Rapid and Comfortable), a diesel-electric train featuring, like the APT, an active body tilt, is being developed. The rationale behind the LRC and the APT has been similar, stressing the ability (through higher speeds on curves) to run significantly faster on existing track than conventional trains.

However, these are illusory advantages. With speeds constrained by risk of collision on numerous unprotected at-grade crossings and by signalling designed for low speeds, the LRC's schedules cannot be significantly shorter than those of ordinary trains. Moreover, the speed of LRC trains is limited for more fundamental reasons. At over 25 tonne, the LRC axle load is "too high to permit running at speeds over 150 km/h without excessive track damage from dynamic loads". The generally accepted solution is to reduce axle loads (they do not exceed 17 tonne in Japanese and European practice) and to keep the unsprung mass to a minimum through use of frame-hung motors. The LRC, as is the American practice, uses axle-hung motors (CIGGT, 1980a).

CURRENT STUDIES OF HIGH SPEED RAIL

The success of the shinkansen has been largely responsible for generating interest in high speed rail in the U.S. Amtrak presidents Paul Reistrup and Alan Boyd visited Japan in 1976 and 1979 respectively; they returned convinced that shinkansen was a safe and efficient system, profitable by conventional business standards. High speed

rail drew also the attention of the U.S. Congress.

Legislation passed in 1980 enabled AMTRAK to investigate rail potential in 25 corridors. The Joint Economic Committee of U.S. Congress and the Subcommittee on Transporation, Aviation and Materials of the House Committee on Science and Technology made extensive studies of high speed rail and recommended development of fast rail travel on exclusive right-of-way. The J.E.C. emphasized that "one part of America's infrastructure should be a high-speed rail system", and that

> revitalising the nation's railroads would provide an excellent start in re-industrialising America because it would require the creation of a major industry. For the next generation, Americans could be busy making rail, rolling stock, new track, electrification systems and other things needed to redevelop our entire rail system. Just as the automobile helped make the 1920s prosperous, the decade of the 1980s could see an American revival based upon the railroad.
>
> (Prouty, 1983)

The Subcommittee recommended: that Congress explore methods of expediting the transfer of high speed rail technology from other countries to the U.S. in order to revitalize the industrial and technological base of the U.S. rail industry and economy; that NASA propulsion expertise be used to develop American magnetic levitation (MAGLEV) technology; that both public and private financing should be encouraged to develop high speed rail systems in high population density corridors through the authorization of loan guarantees or other financing mechanisms; and that Congress develop a method of analysis to test the feasibility of establishing a national high speed rail right-of-way system, and to explore the development of a balanced transportation system using advanced high speed rail systems.

A Japan-U.S. Rail Congress, attended by a powerful Japanese delegation, was organized by the J.E.C. and meetings were also held with the House Subcommittee. Similar contacts were established with the French Railways. The Federal Railroad Administration plans to extend them to Britain and West Germany. Several high speed rail feasibility studies are supported by federal grants; however, no federal funds are authorized for engineering and construction costs.

In September, 1983 the first conference in North America on high speed rail was convened by the Railway Progress Institute in Washington, D.C. The meeting proved that the potential of high speed rail for intercity travel is being recognized by transportation interests

in industrial, government, financial and legal sectors, and provided a forum for review and discussion of high speed rail projects under consideration in the U.S. This will be also the subject of the First Convention for High Speed Rail, to be held in Philadelphia in May, 1984 under the auspices of the Interstate High Speed Rail Compact and the High Speed Rail Association.

One of the first to study high speed rail potential in North America was Northrop Services, a subsidiary of the Northrop Corp. Their long-range concept envisaged a country-wide high speed rail network.

In Ohio, the Rail Transportation Authority had been making plans for a statewide high speed rail passenger system. An 880 km network of electrified lines had been envisaged linking Cleveland with Cincinnati as a backbone. The hope was that co-operation with neighbouring states would have produced a Detroit-Toledo-Cleveland-Youngstown-Pittsburgh route. This activity was broadened in 1981 to include the states of Illinois, Indiana, Michigan and Pennsylvania through organization of the Interstate High Speed Rail Compact which represents private and public interests. However, a referendum to raise money for high speed rail lines was defeated by voters in November, 1982.

Introduction of high speed trains in the 560 km Philadelphia - Pittsburgh corridor is under study since August, 1983. All options, including maglev, are to be examined. A group in Milwaukee is working with the Department of Transport on a high speed corridor plan for Chicago-Milwaukee; the German owned Budd Co. has a contract for a study of maglev route between these cities.

In Florida, a High Speed Rail Committee has been formed to promote a 500 km network of new lines linking Miami, Orlando and Tampa, including the airports. The committee has called upon consortia interested in designing and building such lines to submit proposals; the Japanese appear to be in the lead. The optimistic schedule calls for a study contract to be let in May, 1984 and for start of construction in 1985. Last year a federal grant of $500,000 was awarded the Florida Department of Transport for further high speed rail feasibility studies.

In Texas, a study of high speed line between Houston and Dallas is planned.

The City of Las Vegas, Nevada is engaged in planning a "super-speed" line to Los Angeles (Budd, 1983). According to a study by Budd Co., a high speed rail system (2 h 15 min trip time) is not

financially viable but a faster (1 h 15 min) maglev system is. The cost of the two systems was estimated to be the same while the ridership for the maglev to be about double that of the high speed rail. The study was based on application of the German maglev design.

The distance of 370 km is to be covered by maglev trains at an average speed of 300 km/h, running on a single guideway with two passing sections. Hourly service is envisaged with a total of 22 round trips per day. A return fare of $65 (1982 dollars) was found to produce the best return on equity (20 per cent), with a ridership of 2.8 million round trip passengers. Of this, only 13 per cent were presumed to be diverted from the existing modes; 87 per cent were new "induced" passengers. The maglev was estimated to account for 38 per cent of the total Los Angeles - Las Vegas traffic, compared to 36 per cent by car and 18 per cent by air. The "induced" traffic represented about one-half of all traffic in the absence of maglev.

The total cost of the project was estimated at $1.9 billion (1982 dollars) with development and construction extending over 9 years. In December, 1983, the City of Las Vegas was awarded a federal grant of $1.25 million for continuation of the feasibility study.

The American High Speed Rail Corporation's proposed shinkansen between Los Angeles and San Diego is the most advanced among the high speed rail projects.

In 1981, the Japanese National Railways have initiated under a contract funded by the Japanese Shipbuilding Industry Foundation, feasibility studies of exclusive bullet train routes in the United States. The following four routes were selected as the most promising: Los Angeles-San Diego, Dallas/Fort Worth-Houston, Miami-Orlando-Tampa, and Chicago-Detroit. AMTRAK expects that bullet trains running at speeds up to 260 km/h can be operated profitably in such high density corridors. "If such preliminary projections of profitability can be confirmed, it is AMTRAK's intention to seek private financing for bullet train construction, avoiding the need for any direct government subsidy" - stated AMTRAK's president Alan S. Boyd.

In April, 1982, the American High Speed Rail Corporation was formed to develop and operate fast rail passenger service between Los Angeles and San Diego, initially, and later on the other three routes. The new company was given a loan of $750,000 by AMTRAK. The 210 km line would consist of 1,435 mm gauge double track laid at 3.9 m centres and electrified at 25 kV 60 Hz for use by eight-car trains similar to

those used on the shinkansen. Ruling gradient would be 1.5 per cent with 4,000 m horizontal and 15,000 m vertical curve radii. Sharper curves down to 400 m radius and 2.5 per cent gradients would be used on the approaches to terminal stations.

The Los Angeles to San Diego line is expected to cost $3.1 billion (U.S.). This involves $2.05 billion in capital costs and $1.05 billion for inflation and interest during construction.

First Boston Corp. of New York, financial adviser to the project, has declared it to be "viable and financeable" on the private investment market.

The financial plan, prepared by First Boston and a Japanese consortium led by the Bank of Tokyo, calls for three-quarters of the total to be raised in the United States and one-quarter in Japan. No direct government subsidy is envisaged.

Fluor Corp. of Irvine, Calif., is handling the detailed design. About 38 per cent of the electrified route will be constructed as elevated viaduct; 12 per cent will run in tunnels.

The bullet trains are expected to attract 12 per cent of travel in the corridor.

The trip time will be 59 minutes, compared with 2½ to three hours by car or Amtrak train. Service is planned every half-hour, with 20-minute intervals between trains at rush periods.

The current one-way air fare is about $40, and it costs about $65 to travel by car. The proposed fare for the California High Speed Train is $27.

First Boston predicts a pretax profit of $957 million on revenue of $1.6 billion by 1999, 10 years after the system starts full operation.

If these expectations are realized, the first American shinkansen will be undoubtedly replicated in other corridors. It has been suggested that bullet trains will have the most substantial impact on intercity travel and commuting patterns since the advent of the automobile and commercial aviation.

The optimistic forecasts of the economic viability of the Los Angeles-San Diego project have been severely criticized (Richmond, 1983). It was pointed out that the major fraction of the estimated traffic is accounted for by local short trips, a type of travel accomplished most conveniently, in the shortest time and for the least cost, by private automobile; only 11 per cent of the trips would be made

between Los Angeles and San Diego. Also, the estimated capital costs of the project were questioned. It appears that the Los Angeles-San Diego project reached an impasse and will have to be reassessed before the necessary financing can be arranged.

In Canada, an extensive investigation of three high speed options (a 450 km/h maglev system, a 260 km/h high speed rail of the TGV type and a 200 km/h diesel-electric) in the Toronto-Ottawa-Montreal corridor was completed by the Canadian Institute of Guided Ground Transport in 1980 (CIGGT, 1980b). The study indicated that between Toronto (via Kingston, Ottawa and Mirabel) 260 km/h electric trains (Toronto-Montreal in 2 hr 44, Ottawa-Montreal in 1 hr) would compete effectively with jets, autos and buses and generate a traffic of over 5 million passengers per year (compared to 1.2 million carried by VIA Rail in 1980 on the same route). An economic assessment showed that such fast rail is highly desirable and practical, in spite of $1.5 billion (1978 dollars) estimated investment.

The 1980 CIGGT study, commissioned by the government, met with official silence and its recommendations were ignored. A similar investigation was undertaken in 1981 by Via Rail; completed in early 1984, it confirmed the results of the 1980 study but offered no plan for implementation of the high speed line.

The only other recent initiative in Canada concerned with significant increase of train speeds is a 1982 proposal by Major Jean Drapeau to investiage a high speed service linking Montreal and New York (605 km) in 3 h 15 min, at an average speed of 185 km/h; the present trip takes almost 9 hours. This is a joint study funded by the Province of Quebec and the States of Vermont and New York, and supported by a U.S. federal grant.

PROBLEMS AND PROSPECTS

There are not many fields of technology that are totally foreign to North America, but high speed rail still belongs in this unique category. As pointed out by L. Fletcher Prouty (1983, 1984), not a single group among those involved in the promotion of high speed rail schemes in North America has an adequate understanding of the complex technology and marketing potential of a modern high speed railway, nor can it draw on competent personnel. The enthusiasts who have become sponsors are forced to create or hire a "think tank" for support. The latter, lacking experience in the field, is not qualified to make

realistic plans. These are by far the most serious problems facing the current high speed rail initiatives.

The Northeast Corridor Improvement Project suffered the same difficulties. It should have launched the United States into the era of high speed rail travel at a time when Japan was putting the finishing touches to the Tokyo-Osaka shinkansen and 160 km/h was already feasible for the best trains in Europe. The outcome was very different. A mountain of paperwork was generated by various agencies and their consultants, but no fundamental changes were made in technology or operating philosophy.

Realism and experience appear to be also lacking in the two most advanced projects, the Los Angeles-Las Vegas and Los Angeles-San Diego proposals.

The first envisages the use of German maglev technology, inferior to the Japanese system and much less developed. Extrapolating this very limited experience to the full-scale guideway and train operations is not likely to produce reliable construction schedule and costs data. Both projects appear to suffer from inflated estimates of traffic.

Also, the use of radically different technologies on the San Diego - Los Angeles and Las Vegas - Los Angeles lines would prevent both projects from taking advantage of the economies of scale which could be realized if the same system were used on both routes.

In contrast to the above proposals, Japan's shinkansen and France's TGV successes have crowned many years of systematic development of new technologies by the very organizations that were later responsible for commercial implementation. There can be little doubt that their previous experience was largely responsible for their ultimate success.

The appreciation of the economic and social impact of high speed rail is also lacking in North America. As high speed rail schemes are being considered, their commercial viability, amply demonstrated in Japan and France, is in doubt.

The shinkansen operations in Japan have been highly profitable (Takayama, 1982). Beginning with 1968, the third year of operation, shinkansen has achieved operating ratios below 60 per cent. Its cumulative operating ratio up to 1979 was 58 per cent. These figures are based on expenditures which include operating expenses as well as repayment of loans (principal and interest) and pro-rated costs of research and development.

The performance of the shinkansen system was described by Representative Mutsuki Kato at the first session of the Japan - U.S. Rail Congress in November, 1981, as follows:

> The shinkansen's revenue in 1980 was $3.3 billion and the expenditures were $1.95 billion, yielding a profit of $1.35 billion. Its daily average ridership is 340,000 people with as many as 800,000 on peak days. Its annual ridership is 130 million passengers.
>
> A special characteristic of the shinkansen operating budget is that the personnel costs are extremely low, only 18 percent. The interest and depreciation costs consume 34 percent. These figures could lead one to consider the shinkansen to be fully-systematized, automated machine, the profit from which could be increased by lowering construction cost and operating it as efficiently as possible.
>
> Some people may question these figures and may even suggest that JNR manipulates them by hiding shinkansen expenses in the expenses of other lines, but I can assure you that this is absolutely not the case. The JNR calculates its balance sheet according to standard industrial accounting principles, and in addition, we in the Diet scrutinize its financial report each and every year.

In France, the TGV operations are a financial success. In the first year, receipts were double the operating costs. For 1984, an operating ratio of 0.81 was forecast (based on operating expenses, depreciation and all financial charges). By 1989, cumulative operating profits should have equalled the cost of constructing the new lines and the trains (RGI, 1983a).

The Japanese and the French have discovered that their new high speed rail passenger services have generated many new riders. During the first five years of the shinkansen services, one-quarter, or 75.6 million of the 278.5 million passengers who rode the trains were newly generated riders. These were travellers either from other modes or new riders entirely. On the new line to Niigata, a total of 12.85 million passengers (35,000 per day) were carried with a load factor of 70 per cent during the first year. This was 17 per cent higher than JNR's original expectations.

In France, during the first two years of operations, 14 million passengers were carried on the Paris-Lyon TGV line; 15 million are expected to be carried in the third year. The TGVs have generated or diverted to rail more than 8,000 extra journeys a day, which represent a 20 per cent increase in traffic (Weber, 1983).

Given a general lack of appreciation of high speed rail potential there is a danger that, as pointed out by L. Fletcher Prouty (1983 ,

1984), in North America the high speed rail study contracts, which have already consumed millions of dollars, become an industry in their own right, soak up the available funds and lead nowhere. Although the American approach represents a healthy and uninhibited attitude toward adoption of superior foreign systems, more effective mechanisms than used so far will have to be devised to achieve transfer of technology and experience.

As stated by the Joint Economic Committee of the U.S. Congress, the development of high speed rail corridors in the U.S. is the responsibility of the private sector with government cooperation; significant financial involvement by federal and state governments or development of an overall industrial policy on the Japanese or French models, are not to be expected. Success is likely to depend on the ability of the private sector to exploit in North America, in cooperation with the public sector, the foreign high speed rail technology.

ACKNOWLEDGEMENT

Contributions of L. Fletcher Prouty to the evaluation of high speed railway projects in North America are gratefully acknowledged by the author.

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COSTS OF RAIL PASSENGER SERVICE IN CANADA: AN EXAMINATION OF INSTITUTIONAL PROBLEMS

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INTRODUCTION

Rail passenger transport in Canada has had a contentious past and faces an uncertain future. Debate on the viability of rail passenger services in Canada has been highly polarized. Some simply dismiss the potential for improvements and continue to view large subsidies as inevitable, as long as rail passenger services cannot be abandoned altogether. Recognizing some of the institutional problems, others (notably VIA Rail) advocate a clean break from the existing system by building a dedicated high-speed system.[1] In contrast to these arguments, this paper attempts to identify the potential for substantial cost savings for existing services by examining a number of the more important financial and institutional issues that characterize the present system.

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1 See, for example, Julius Lukasiewicz, "Passenger Rail in North America in the Light of Developments in Western Europe and Japan". Paper presented at the World Conference of Transport Research, Hamburg, April 1983.

Historically, passenger services (as well as other railway services) have been considered an obligation of the railways, even where these services were uneconomic, in return for various concessions granted by government during periods of rapid railway development. As a result, the concept of **cross subsidization** (wherein profits from remunerative railway and commercial services were expected to compensate for losses on unremunerative freight and passenger services) evolved and became an accepted modus vivendi. However, in the face of competition from other modes of transportation following the Second World War, and in the face of large general railway deficits, it became clear that the burden of uneconomic passenger services could not continue to be carried by the railways alone, without major negative impacts on both the Canadian transport sector and the economy as a whole.

The National Transportation Act of 1967 reflected a significant departure from the traditional principle of cross subsidization. Under this Act, transportation services which incur a deficit (at least those under federal government control) were no longer to be subsidized by profits from remunerative services. They would simply disappear unless service adjustments could be made to eliminate losses. However, where such services were considered to be in the public interest, the Act

dictated that direct payments could be made by the government to offset losses on a route-specific basis. In principle, these payments would be treated by the transportation company as income from service performed on behalf of the government.

In this manner, discontinuance of essential services would be avoided, and the competitive position of the railways in other markets would not be eroded by the burden of unrelated money losing services. To guard against possible abuses of the new principle, the Act also stipulated that only 80 percent of railway losses would be compensated. To be eligible for subsidy on a particular route, for example, a railway was required to post notices of its intention to apply for abandonment. The application for discontinuance of service, once filed, usually then became the subject of public hearings held by the Canadian Transport Commission for purposes of establishing first, the extent of the actual losses and second, the extent to which subsidization of those losses was deemed to be in the public interest.

By its decision to establish VIA Rail Canada as the national railway passenger authority, the federal government lost the initiative taken by passage of the National Transportation Act. As with the National Transportation Act, it was a giant step with respect to rail passenger services, at least for the railways,

because it relieved them of all responsibility to improve either the quality of service or the efficiency with which existing services might continue to be provided.

THE INSTITUTIONAL SETTING

The origins of VIA Rail are not entirely clear. Some viewed the decision as nothing more than an attempt to mimic the establishment of Amtrak, the national railway passenger authority in the United States. Others believed that the architects of VIA (all housed within the upper echelons of the Ministry of Transport) genuinely felt that the railways had been unresponsive to the principles of the National Transportation Act and that as a result, change could only be achieved through the creation of a new organizational structure. Yet others considered the creation of VIA as a mindless attempt to relieve the railways of all responsibility for passenger services and burden the government with the extra costs of superimposing additional overhead on an already uneconomic system.

To understand the impact on today's rail passenger system, however, what is important are the mechanisms by which the railways, the federal government and VIA interact to provide rail passenger service. Four principal groups are involved, namely, VIA, the Minister of

Transport, both major railways, and the Canadian Transport Commission.

VIA essentially acts as a broker. It is responsible for route and service planning as well as pricing. It contracts with the railways for train operation over track owned by the railways, as well as for station and equipment maintenance. (VIA is now building its own maintenance facilities.) VIA provides the railways with locomotives and passenger cars, purchased on its behalf by the federal government and VIA personnel provide on-board services not directly associated with train operation. VIA also operates its own ticketing and reservations service (subcontracted from Air Canada) and engages in its own marketing, advertising and promotional programs.

The Government of Canada, through the Minister of Transport, owns VIA Rail. Through the budget approval mechanism, the Minister has ultimate decision-making authority with respect to route and service planning.[2] Moreover, because the Government of Canada provides the capital for equipment purchases, the Minister effectively specifies the type of rolling stock to be used by VIA.

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2 In the summer of 1981, for example, the Minister, with neither public hearings nor parliamentary debate, directed VIA Rail to eliminate approximately 30 percent of its service throughout the country.

Both major railways provide train and train-related services (switching, signalling and communications, and maintenance-of-way and stations) in accordance with routes and schedules negotiated with VIA Rail. At this time, the railways are also responsible for equipment maintenance (the largest single component of railway charges). All direct costs of labour, materials, fuel and administration incurred by the railways are passed on to VIA on a full recovery basis. As owners of the rights-of-way and track used by passenger trains, the operating agreements also include certain ownership costs that are allocated to the provision of passenger service.

The Canadian Transport Commission plays its regulatory role by establishing the basis upon which the railways are permitted to charge VIA for services performed. The CTC also audits the final annual statements of the railways to ensure that these charges are in accordance with approved costing principles. In considering a service modification or expansion, VIA obtains cost estimates from the relevant railway, prepares its own revenue forecasts, and includes the projected loss in its annual request for funding from Transport Canada. If the service change is approved, charges rendered by the railway in accordance with the CTC Costing Order result in the final determination of

actual costs (which may greatly exceed the estimated costs upon which the service change was approved). Ultimately, the actual loss (after allowing for revenues) is determined only after a lengthy audit by the CTC as to the fairness of the railway charges.

Thus, although VIA is responsible for the provision of passenger service, its ability to do so is constrained by "income" from the Government of Canada on the one hand, and railway charges with their associated uncertainty, on the other. VIA, of course, does have limited flexibility to increase passenger revenues and reduce corporate costs through its own pricing, marketing, administration and service policies.

FINANCIAL PERFORMANCE

Since the 1967 NTA, and particularly after the creation of VIA, rail passenger services have represented a significant financial burden to the federal government. In 1972, when the railways were being compensated for 80% of their losses, the federal government's share was approximately $100 million (or $270 million in 1983 dollars). In 1983, the federal government contributed $451 million to cover VIA's operating deficit. The operating ratio (i.e., passenger revenues to operating expenses) for the entire rail passenger system declined from 37% in 1972 to 27% in 1983.

Although one of the principal reasons in creating VIA was to reduce the financial burden on the federal government, deficits continued to increase. As shown in Table 1, operating deficit almost doubled between 1979 and 1983.[3] Although average revenue per passenger increased by about 62% (or 5% in real terms), operating costs were escalating much more rapidly.

In one year alone, between 1980 and 1981, operating costs increased by 32%, compared with a 12% increase in the Consumer's Price Index. In response, the government announced major service cutbacks, whereby train-kilometres and car-kilometres operated by VIA declined by 16% and 21%, respectively (between 1981 and 1982). As a result, total costs were brought under control, but unit costs continued to increase (in constant dollars, 11% per train-km and 18% per car-km).

By 1983, there were some positive signs in VIA's financial performance. Total costs, as well as train-kilometre costs, increased at par with consumer prices. Due to declining ridership, however, costs and subsidies per passenger still increased at rates 6%-7% above the rate of inflation in consumer prices.

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3 The Consumer Price Index increased by a factor of 1.47 over the same period. Thus, this represents an increase of 32% in constant dollars.

Table 1

Financial Profile of VIA Rail

	1983	1982	1981	1980	1979
Operating Expenses (000,000s)	642	603	591	459	349
Passenger Revenues (000,000s)	173	162	165	140	107
Operating Deficit (000,000s)	469	441	426	319	242
Passengers (000,000s)	6734	7223	8009	7586	N/A
Passenger-kms (000,000s)	2490	2523	3098	3086	2954
Train-kms (000,000s)	19.5	19.8	23.6	24.3	24.6
Car-kms (000,000s)	114.8	126.0	160.4	163.2	169.4
		(constant 1983 dollars)			
Subsidy per passenger	69.6	65.8	63.0	56.1	N/A
Cost per passenger	95.3	89.9	87.4	80.7	N/A
Cost per passenger-km	0.26	0.26	0.23	0.20	0.17
Cost per train-km	32.9	32.8	29.7	25.2	20.8
Cost per car-km	5.6	5.2	4.4	3.7	3.0

Source: VIA Rail Canada, Annual Report, 1983.

In financial terms, performance of rail passenger services presents a rather bleak picture, and a source of growing concern for the federal government from a budgetary standpoint. Nevertheless, rail passenger services are still pervasive. In part, the continuance of these services is the result of a strong lobby which includes environmentalists, energy conservationists, and experienced travellers who have been exposed to modern passenger services in Western Europe and Japan. There is also a strong labour lobby that fears the employment disruption that would result from large-scale abandonment of passenger services. In addition, in some communities, rail transportation is seen as the only viable means of public transportation to the larger urban centres.

Moreover, there is a widely held belief that, while railway passenger services may be uneconomic in terms of direct revenues and costs, there are a variety of external benefits related to manufacturing activity, energy conservation, accidents and safety, and reduced government expenditures for highways and airports that

all contribute to the general public good.[4] In addition, the railways recognize that discontinuance of passenger service would represent a significant loss in net revenue and contribution to general overhead.

Rail passenger services experience financial difficulties for several reasons. First, their traditional markets have been eroded by competitive modes that offer higher quality service in terms of speed, frequency, reliability, comfort, flexibility and customer orientation. For certain trips, of course, existing rail service is advantageous for some segments of the travel market, generally where there is sufficient traffic density to justify reasonable schedule frequency.[5] Without direct control over operations,

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4 In other words, these benefits do not appear in the income statements of VIA Rail because they are experienced elsewhere in the services to compensate for these real or imagined external benefits. For a fuller description, see Adil Cubukgil and Richard M. Soberman, External Impacts of Rail Passenger Development Options In the Quebec-Windsor Corridor, (Toronto: University of Toronto-York University, Joint Program in Transportation, 1983).

5 According to one study, however, even in the high density Montreal-Toronto corridor, rail service accounted for 12.5% of all passenger trips compared to 9% for bus, 18.5% for air, and 60% for private automobile. See Ata M. Khan, VIA Rail Canada, An Analysis of VIA's Potential in Fulfilling Rail Passenger Objectives (Ottawa: Science Council of Canada, 1980), p. 12.

however, VIA has little or no ability to improve reliability (in terms of schedule adherence and on-time performance) and limited flexibility to adjust schedules.

More importantly, under the existing contractual arrangements, VIA has little control over its costs. The existing organizational structure imposes a further overhead burden on the system. Finally, the federal government's current role provides neither any incentive to improve financial performance, nor any effective control over costs and service frequency in quick response to market conditions.[6]

KEY PROBLEMS

As noted earlier, under contract to VIA, the railways are still responsible for the maintenance and operation of passenger trains on track that they own, operate and maintain themselves. The costs associated with these services account for approximately two-thirds of VIA's annual operating budget (see Table 2). These charges are made in accordance with CTC regulations which permit the railways to pass on to VIA:

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6 Probably the most significant element of rail service's "attractiveness", however, relates to the low fares offered under marketing programs designed to increase ridership. Recognizing the serious constraints on improving financial performance, VIA's management is not immune to the importance of demonstrating increased ridership, at whatever cost, as a strong political argument against further cutbacks in service.

Table 2

OPERATING EXPENSES OF VIA RAIL

(million $)

	1980			1981		
	Railway	VIA	Total	Railway	VIA	Total
Train Operations	116.5	8.9	137.9	163.5	11.7	175.2
Maintenance of Equipment	122.6	0.3	122.9	152.9	0.3	153.2
Maintenance of Way	42.1	-	29.6	29.3	-	29.3
On-board Services	-	50.2	50.2	-	54.5	54.5
Station Services	24.6	20.4	45.0	25.6	22.4	48.0
Marketing & Reservations	-	15.0	15.0	-	18.3	18.3
Taxes & Insurance	-	1.2	1.2	-	5.2	5.2
Depreciation & Amortization		-	8.1	8.1	-	13.9
General & Administrative	-	42.5	42.5	-	62.6	62.6
TOTAL	305.8	146.6	452.4	371.3	189.6	560.9

Source: Canadian Transport Commission, A Comparison of Amtrak and VIA Costing Approaches, March, 1983.

- Costs directly identified with passenger train services (e.g., station expenses, train crew wages)
- Transportation and maintenance costs shared in common with freight services (e.g., track. maintenance costs shared in common with freight services (e.g., track maintenance, signalling)
- Indirect but still avoidable costs associated with passenger services (e.g., pension, UIC, general administration)
- Avoidable capital costs associated with passenger services

Capital costs represent a very small share of annual railway charges (less than 5%). Common and indirect costs, on the other hand, are quite significant, each representing roughly one-third of total charges.

There are several problems associated with this costing arrangement. First, and clearly most important of all, is the lack of any incentive for improved efficiency. VIA buys service from railway companies that pass on all costs to the passenger authority in accordance with government-prescribed pricing regulations. Basically, the railways operate on a "cost plus" basis for the provision of a specified level of service and, as a result, derive no particular benefit from improvements in efficiency.

Although this problem affects every aspect of the system, the antiquated work rules under which train crews continue to operate constitute probably the strongest evidence that the railways do not have any incentive to improve productivity. Train crew costs account for roughly 55% of "train operations" costs shown in Table 2, translating to unit costs of approximately $0.40 and $0.60 per car-km in 1980 and 1981, respectively. Railway operating labour is paid by distance (a 100 mi. day for locomotive engineers, and 150 mi. day for others) with the result that fast passenger trains allow a crew to work off its "day" quickly. Under the existing work rules, it would not be unusual for a locomotive engineer to earn $45,000 a year for 900 hours of work (or 150 6-hour work days).

Within the existing framework, however, it is unlikely that the railways would attempt to improve labour productivity. In fact, the railways can use the existing rules to their advantage at VIA's expense. Under the current arrangement, senior crew bid for the faster passenger trains, giving the railways an opportunity to pass on the highest wages in their system to VIA. Moreover, the railways can use these rather attractive work conditions on passenger trains to negotiate concessions that primarily benefit their freight operations.

If train crew were paid on an hourly basis (e.g., $20 per hour), at an average operating speed of 75 km per hour and with a 50% allowance for deadheading, pensions, UIC, etc., costs of a 3-man crew operating a 6-car-consist would translate to $0.20 per car-km (in current dollars, one-half of 1980 or one-third of 1981 costs).

Second, neither the federal government nor VIA can exercise much control over railway costs. The only available mechanism is a CTC audit that the Minister of Transport can request. These, however, have little functional value other than ensuring that the railways adhere to the accounting practices permitted by the CTC. VIA cannot enforce any guidelines, specifications, or standards on the railways. VIA cannot even effectively monitor the functions that the railways perform on its behalf.

Problems arising from this apparent lack of control are most evident in maintenance of equipment, which accounts for nearly 30% of annual operating costs. Complaints about inadequate maintenance standards and overcharging by the railways have led to VIA's recent plans to build its own maintenance facilities. In 1980, maintenance of equipment costs averaged $0.75 per car-km, increasing to almost $1.00 per car-km in 1981. In comparison, Amtrak's equipment maintenance costs outside

the Northeast Corridor were $0.95 and $0.90 per car-km in 1980 and 1981, respectively, but declined to approximately $0.70 per car-km by 1983.[7] This was the result of Amtrak's efforts over the years to consolidate maintenance operations in 15 upgraded facilities across the country, of which 11 are now owned by Amtrak and 4 are still contract facilities operated under Amtrak's strict control.

Third, VIA has no effective means for negotiating the price of the services they buy from the owners of the railway facilities. In some cases, this price includes what may be unreasonable charges for sunk investment in right-of-way, facilities, and buildings that have no alternative use. Where common services are involved (joint use of track and facilities by both freight and passenger trains), VIA has no say in precisely how costs common to a number of different services are allocated to passenger trains. From the standpoint of VIA, railway pricing is simply a case of "take it or leave it."

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7 Since Northeast Corridor Services are electrified (between Washington-New York-New Haven) only maintenance costs outside the corridor are representative. All costs are converted to Canadian dollars.

In 1980, for example, the railways charged VIA some $29 million, or $0.18 per car-km, for maintenance-of-way costs (including track maintenance, signals, communications, and related indirect costs). In the U.S., where Amtrak negotiates much more effectively with the railways on the basis of avoidable costs, maintenance-of-way charges in 1980 were only $0.09 per car-km (excluding the Northeast Corridor where Amtrak owns, maintains and operates the entire infrastructure).

Fourth, the existing organizational structure imposes a heavy overhead burden on the system. As noted earlier, indirect costs (e.g., superintendence, administration, pension, UIC, taxes, etc.) constitute roughly one-third of railway charges. When combined with VIA's own general administration costs, these overhead items account for approximately one-third of annual operating costs (in 1981, $186 million or $23 per passenger). Prior to VIA's establishment, these costs accounted for about one-quarter of total costs. In general, it can be observed after the creation of VIA, the railways' overhead charges continued at about the same rate, but the system started to carry the additional overhead burden of VIA's organization.

OPTIONS FOR THE FUTURE

In contrast to the 1967 National Transportation Act, the creation of VIA Rail reduced the degree to which government exercises direct control over the provision of rail passenger services. Requirements for public dialogue and opportunities for public scrutiny were also eliminated. Under the 1967 Act, however, the role of the federal government was largely passive, one in which the government responded to railway initiatives that were almost always directed towards contraction of the rail passenger system. In this respect, the creation of VIA could be viewed as a positive attempt to assume a more active role that would include expansion of certain services and more aggressive marketing.

Unfortunately, the net effects of this reorganization have not been particularly impressive. It is probably fair to say that the public perception of rail passenger service has improved in some regions, largely due to the introduction of new rolling stock. On balance, however, cutbacks in service have been extensive, ridership has declined, financial performance has deteriorated, and the overall burden on public finance has increased.

Ultimately, therefore, one must question the government's basic intent with respect to rail passenger policy. If the intent was to gradually phase out most

of the rail passenger system, then the establishment of an agency, publicly perceived as having been designed to promote service, but which, in fact, has been designed to fail, must be viewed as an irresponsible step. The 1967 Act gave the federal government sufficient flexibility to gradually eliminate all uneconomic services without unnecessarily raising public expectations and creating an additional financial burden on the taxpayer. If the intent was to assume a more aggressive role in pursuing the untapped potential of this mode of transportation, then the government might have armed VIA to deal with some of the more important problems and issues with a more effective set of tools and policy instruments.

Under these circumstances, it may be useful to consider the range of options for the future of rail passenger service in Canada. One option (now being promoted by VIA) is to provide VIA with a broader mandate, including access to tremendous risk capital that would be used to build its own dedicated facilities where service could be provided independently of the railways and railway labour. Clearly, for such new facilities as might be constructed, it would be unthinkable to operate high-speed trains on the basis of nineteenth century work rules.

Given the realities of Canada's demographic patterns and the competitiveness of other modes, a reversal in VIA's financial performance, sufficient to offset the required capital expenditure, seems highly unlikely. In fact, for conditions in which dedicated facilities might be made available, major studies by the CTC in 1970 and by the Canadian Institute for Guided Ground Transportation in 1982, have both suggested that high-speed rail systems would not even be the preferred technology.

A second option is to return to the conditions that existed prior to the establishment of VIA. This would involve provision of passenger services under relevant sections of the 1967 National Transportation Act, suitably modified to engender some incentives on the part of the railways for improvements in service quality and efficiency. If a major infusion of capital is really required for both facilities and equipment, the railways could undoubtedly argue more effectively than VIA for such an investment, by demonstrating potential benefits to both the passenger and freight system. There is, however, no reason to believe that the railways would perceive any advantage in being more responsive to passenger needs now, than before.

A third option is to take a lesson from recent airline experience by simply closing down VIA and starting over again with a clean slate. Consider the effects.

If VIA were to be abolished, railway labour would lose large numbers of jobs, the railways would lose net revenue, and some segments of the travelling public would lose service. The Government of Canada would save hundreds of millions of dollars.

After a reasonable waiting period for the full effects to be felt, new companies could emerge to provide service on appropriate routes through strictly commercial negotiations with the railways, as shippers now do. In order to realize reasonable returns, the railways would have greater incentive to negotiate more effectively with their own labour. As under the National Transportation Act, the government could still "buy" services deemed to be in the public interest, but with one significant difference. Instead of examining the present system, now subsidized in its entirety, to determine where public need no longer exists (a massive and clearly unsuccessful exercise), it could assess need from the ground up.

CONCLUSIONS

The background research for this paper was hindered by the cloud of secrecy that seems to surround any detailed analysis of rail passenger services in Canada. Although the public foots the bill for rail passenger subsidies, the "right to know" is suppressed on grounds

of the proprietary rights of the railways and the confidentiality restrictions imposed by the CTC.

The railways understandably tolerate no outside interference in matters which they consider to be entirely within their own jurisdiction. However, confidentiality is a two-edged sword. If there were complete disclosure of the real costs of some rail passenger services, then opposition to proposed service abandonments would be based on more informed opinion, and in many cases, would probably disappear. If there were full disclosure of the contractual and work rule conditions that result in unexplainably high cost even where rail service makes a great deal of sense, there would be a public outcry over some of these abuses and a stronger and more widespread base of support for change. If such abuses are more imagined than real, then, of course, full disclosure would not be embarrassing.

The limited information available in the public domain, however, strongly supports the basic premise of this paper. Although many market and technological factors impede improvements in efficiency, the most significant reason for the high costs of railway passenger services is simply that the operating authority has no control over its cost exposure. In fact, as an organization, VIA suffers from the most important of all organizational weaknesses: it has responsibility without

authority. It does not even make its own equipment selection decisions.

The only way in which rail passenger service can be placed on a more competitive basis with other modes is to create an entirely new institutional framework, one in which more equitable operating agreements can be negotiated, and which will allow major improvements in labour productivity as well as realistic assessments of initiatives with respect to technological innovation. At the very least, dealing with some of these institutional problems is likely to produce far greater benefits in terms of reducing losses on the existing system, than the current preoccupation with achieving high speed.

USING MICROCOMPUTERS FOR COMPLEX SPECIALTY SOFTWARE: A CASE STUDY OF THE SERVICE PLANNING MODEL

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INTRODUCTION

Two problems plague the developers of specialty software: high costs and difficult to demonstrate benefits. The costs of developing any software product are high. They can be raised even further by the costs of transfering and adapting a program for a particular user's computer. To offset these difficulties and costs one must be able to show matching benefits, which is often difficult to do.

This combination of high costs and benefits which are difficult to demonstrate results in a barrier to the development and sharing of specialty software. As a result of this barrier many potentially useful software solutions are not being developed. Those that are developed are often used by only a few companies because of the high costs of sharing or transfering the software. Since it is difficult to share software organizations often engage in redundant development efforts. This barrier also discourages commercial developers because the chances for recovering the development costs and/or making multiple sales are small.

There are several traditional approaches to overcoming this barrier. One is for a government or trade association to sponsor the development of software. Sponsored development can reduce what the users have to pay to the cost of installing the software. A second approach is for a sponsor to conduct case studies to demonstrate the software's benefits and encourage its use. The sponsored case studies are often not trusted because potential users feel that differences between their situations and the case study examples are too great. Approaches comming from the private sector have included the use of centrally located "dial-up" computer systems and the "bundling" of minicomputer systems with the software. Unfortunately none of these approaches are able to lower the costs enough to make the use of the specialty software a low risk proposition.

This paper will propose an alternate way of attacking the development barrier. This alternate approach is to develop specialty software for use on a microcomputer. While the microcomputer will not reduce the total development costs, it will increase the potential for sharing these costs among a group of users. In addition, the installation costs can be reduced to the cost of the computer alone. If the cost of using the software is reduced sufficiently users will risk testing the software in the abscence of proven benefits. This testing will in turn help to document the program's benefits and promote its further use.

As an example of how the use of a microcomputer can benefit both a software sponsor and its target industry a microcomputer based railroad simulation model will be examined. This model, called the Service Planning Model (SPM), is a set of microcomputer programs that predict service levels and operating costs given a network, operating plan, traffic flows, and cost parameters. Measurable benefits from using the SPM can include reduced operating and investment costs, improved origin-destination trip times, and potentially increased business through improved customer relations. With over four man-years invested in the creation and refinement of the microcomputer version alone the SPM represents one of the most sophisticated planning tools available to the rail industry.

Before describing the development and marketing of the SPM this paper will describe in detail the software development costs discussed above and how the microcomputer can reduce these costs.

THE SOFTWARE DEVELOPMENT PROBLEM

This paper focuses on ways to reduce the costs of specialty software. To understand the costs and ways to reduce them it is necessary to understand the software development process. There are five basic stages or phases to the creation and use of a computer program:

- o Development
- o Testing
- o Installation
- o Maintenance

o Enhancement

First the software is developed. This includes the initial creation of the methodologies, algorithms, and software to address a particular problem. Second, the software is tested. This consists of testing for and eliminating errors in the program as well as demonstrating the software's usefulness. Third, the software is installed on each user's computer system. Fourth, the developer provides on going maintenance. This maintenance effort is needed to correct any errors and design flaws that are discovered through program use as well as to keep the software useable as the computational environment changes. Last, the program can be enhanced. New features or capabilities can be added over time to keep the software up to date and consistent with the user's needs.

There are two types of software costs: 1) overhead and 2) user specific. Overhead costs are those costs common to all users of a program such that they can be shared. These costs include the development and testing costs. The installation costs are generally considered user specific. The maintenance and enhancement costs can be either overhead costs or user specific. If every user has the same computer or an identical version of the software then only a single maintenance and enhancement effort is needed: the maintenance and enhancement costs could be overhead costs. If, on the other hand, the users each have different versions of the software, then the maintenance and enhancement costs will be more user specific.

To minimize the cost of a program for the user one must keep most costs sharable between users and minimize those costs that are user specific. One must also try to maximize the number of users. This can be done by forcing all users to use the same version of the software. By standardizing in this way only the installation costs remain user specific. This can be difficult or impossible to do without requiring the use of a specific computer. However, even in the case of two users having the same mainframe computer there may be sufficient differences to prevent standardization. In addition the installation costs for a mainframe computer program can be very high and still represent a major barrier to using a computer program.

The costs of developing and installing software are high. Table 1 shows typical costs for developing a program of 20,000 lines in length for a mainframe computer and for "bundled" minicomputer and microcomputer systems. A bundled system is when software and hardware are sold together as a single product. A program of this length would be typical of a transportation operations planning and scheduling system or a sophisticated inventory or accounting system. This table lists three basic cost categories. First, the development costs. The development costs will be same for any software effort regardless of the computer used. Second, the installation costs. The installation costs for a mainframe computer system are due to the programming required to adapt the software to

the user's computer. The minicomputer and microcomputer systems require that a particular computer be used. This eliminates the need for installation programming but introduces the need to purchase a computer to use the software. Third, the data base integration costs. This is an optional activity that allows the new software to tap existing software and data resources owned by the user. This is largely independent of the computer used. Not shown in this table are the on going costs of program maintenance and enhancement. These costs can range from $5,000 to $60,000 per year depending on the level program use and size of the enhancement effort.

The savings from shared development can be large as well. Table 2 shows the effect of shared development on the user's costs for software for each type of computer system. Due to the nature of each type of system different numbers of users can be expected to share in the development efforts. If all costs are paid for by the users the resulting costs per user is shown in the "All Costs" column. In this case the dominate effect is the increased sharing of the development costs. If, on the other hand, the development effort is paid for by a sponsor the user's costs will be restricted to installation and optional data base integration costs. The resulting costs for the user excluding the optional data base integration costs are shown in the "Installation Costs Only" column. It is here that the microcomputer shows its advantage most clearly. Not shown in this table are the on going maintenance and enhancement costs. These costs can be shared for the

Table 1

Typical Development and Installation Costs
for a
20,000 Line Program

Cost Category	Mainframe System	Minicomputer System	Microcomputer System
Development	$250,000	$250,000	$250,000
Installatiom: Equipment	0	50,000	10,000
Installation: Programming	50,000	0	0
Data Base Integration	50,000	50,000	50,000
Total Costs (Single User)	350,000	350,000	310,000

microcomputer and minicomputer systems, but not for the mainframe system.

This section has shown that software development can be a very expensive undertaking[1]. It has also shown that the costs for an individual user can be reduced dramatically by sharing the development effort. This sharing is only possible through standardization of the software. Standardization is easiest when all users have the same computational environment. This can be achieved through the use of a "bundled" minicomputer system. However, the high cost of minicomputer systems prohibits this approach in most situations. Microcomputer systems, however, are much less expensive and can solve the problem in the same way as the minicomputer. The next section will

Table 2

Effect of Shared Development Effort
for a
20,000 Line Program

System Type	Probable Number of Users	All Costs: Development, Installation, and Data Base Integration	Installation Costs Only
Mainframe	2	$225,000	$ 50,000
Minicomputer	4	$163,000	50,000
Microcomputer	8	$ 91,000	10,000

explore the possibility of using a microcomputer for developing specialty software.

THE MICROCOMPUTER SOLUTION

The development of software for a microcomputer reduces the cost of software for the user and thereby mitigates the barrier to software development and testing. The microcomputer is a relatively low cost way to enforce a standardized computer environment. This means that almost all of the costs can be shared except the installation costs. The installation costs are largely confined to the cost of the computer which is considerably lower than that of a minicomputer and often very small relative to the development costs of a specialty software product.

Standardization of the computer environment and the resulting standardization of the software has numerous advantages. Several of these were mentioned as part of

the discussion of Tables 1 and 2 in the previous section. One is the ability to share the development, maintenance, and enhancement costs. Also, the low cost of the microcomputer significantly reduces the installation costs particularily for sponsored software. The standardized software means that users can share the results of their experiences as well as any improvements that they make. It also becomes possible to have a user directed and centrally performed on going development and enhancement effort. Because the software is standardized all users will be able to share in the benefits of such an enhancement program. Furthermore, the cost to an individual user will be small because it will be shared by many users.

Using microcomputers can benefit commercial developers and software sponsors in addition to the users. Commercial developers can benefit by being able to reach a larger market because of the lower costs and easier transferablity. Similarily, government and trade association sponsors will be able to provide software to a larger portion of their constituency.

While the microcomputer makes sense from a cost perspective it is not a panacea for the problems of specialty software development. The basic development costs remain unchanged and the benefits still need to be documented. In addition, microcomputers are not suitable for some types of software, such as software requiring multiple data entry locations or large amounts of processing time. One must also remember that standardization and shared development are only possible if the users cooperate and

refrain from responding only to their personnal requirements. However, by using a microcomputer where appropriate, a greater number of the costs can be shared, and those that can not are significantly reduced. By lowering the costs more users will test the software and be able to demonstrate benefits helping justify its continued use and development. The next section will include a discussion of the effect of lowering the costs of a particular computer application, the Service Planning Model.

AN EXAMPLE: THE SERVICE PLANNING MODEL

The Service Planning Model (SPM) is one example of a trade association sponsored software development effort that has benefited from the use of microcomputers. As mentioned in the introduction the SPM is a microcomputer based freight railroad network simulation model that can be used to predict costs and performance of a rail system given a number of inputs detailing a method of operation.

The SPM was originally written in Fortran for an IBM 370 and DEC VAX 11/780. The program's development was jointly sponsored by the U.S. Federal Railroad Administration (FRA) and the Association of American Railroads (AAR). The SPM represents a major investment on the part of the sponsors in background research, programming, and testing. The total effort is estimated to have cost in excess of $1,000,000. Much of the SPM, however, was developed as part of broader research activities so that the "true" cost of development is hard to identify. If one

looks at railroad simulation models in general development costs are in the range of $250,000 to $1,000,000[2]. In addition installation and testing can be as high as $500,000.

In its role as a promoter of new methodologies the AAR funded an SPM distribution and enhancement program throughout 1982 and 1983. This program allowed any AAR member railroad to acquire the SPM for free, receive limited free training, and participate in a user's group. Thus the effective cost of the software was limited to the microcomputer and the staff time required to use it. The chief role of the user's group is to identify ways that the software can be improved. As part of this program the AAR announced at the outset that it would eventually phase out funding and expect the members of the user's group pay the costs of any continued software development and maintenance.

One of the stated goals of the AAR is to promote the use of computer techniques for service planning by the rail industry. It views this as a general good that can arise from any suitable software or planning method, not just the SPM. It also views itself as a change agent or catalyst to promote the adoption of new techniques. Its ultimate measure of success is based on the ability to promote a technique through sponsorship and then back away allowing the industry to take over continued development and promotion. In this context it views its responsibilities for the SPM as promoting its use and demonstrating its benefits by making it available at low cost

to the industry and then allowing the industry to decide where to go with it.

To promote and test the model the FRA and AAR sponsored case studies at the Boston and Maine[3] and the Santa Fe[4]. These case studies, sponsored by the FRA and AAR, were designed to show that the SPM had proven benefits for both large and small railroads. At the conclusion of the Santa Fe case study a decision was made to clean up the software and make it available to the industry. This posed a problem because the computational environments of each railroad varied widely and little concensus could be found on what form to use to make the software available. Even simple adaption efforts to make the SPM work on a railroad's mainframe computer were been estimated to cost in the neighborhood of $50,000. Clearly, conventional mainframe distribution of the SPM would represent a major barier to its use. To circumvent this issue the model was adapted for an Apple II microcomputer during 1980-1981.

The results of this distribution program have been very positive. By the end of 1983 fouteen AAR member railroads had acquired the software. Numerous refinements and improvements had been made at the user's group's request resulting in a much improved and more powerful SPM. In addition, the software was moved to an IBM PC at the user's request resulting in the addition of several new users. Several of the users have incorporated the software into their planning processes or made extensive tests of

its accuracy. One railroad has identified savings of over $3,000,000 from one study alone using the SPM. The Burlington Northern has judged the software useful enough to invest an estimated $60,000 in integrating the SPM with its mainframe data bases. Several railroads have indicated that they would not have acquired or used the software if the costs had been higher[5].

Starting in 1984 the AAR has reduced its funding and asked that railroads sponsor the continued maintenance and development of the software. To date six railroads have started to directly fund the users group, while several others have indicated they may commence funding in the near future. The SPM will probably survive without continued support from the AAR. The success of the model can be attributed to the ability of the microcomputer to lower the cost of the SPM and thereby achieve widespread distribution of the model.

CONCLUSIONS

A barrier exists to the development of specialty software. This barrier arises in part from the high costs of software development and the difficulty of transfering the software to many users. It also results from the difficulties associated with demonstrating the benefits of a program designed to address complex issues.

The effects of this barrier can be mitigated if the costs of using a program can be lowered through shared development and reduced acquisition and/or installation costs. This can be done to some extent through government

or trade association sponsorship of software development. However, the installation, maintenance, and enhancement costs can remain a significant barrier. One way to overcome this barrier and allow the full sharing of development costs as well as achieve low installation costs is through the use of microcomputers.

The microcomputer allows a standardized computational environment to be used for far less than the cost of adapting a complex software product for a larger computer. Through the resulting standardization of the computational environment a central entity can perform program development, maintenance, and enhancement which will benefit all users and allow the users to share the development costs. The bottom line is that microcomputers can reduce the costs of specialty software for the individual user allowing the adoption, testing, and widespread use of new and innovative computer planning and management tools.

FOOTNOTES

1. For an extensive discussion of program development issues see:
Frederick P. Brooks, Jr., The Mythical Man-Month, Reading MA: Addison-Wesley Publishing Co., 1975.

2. Joseph F. Folk, "Brief Review of Various Network Models," Studies in Railroad Operations and Economics, Vol. 7, Cambridge, MA: MIT, Department of Civil Engineering, Report No. R72-42, June 1972.

3. Carl D. Martland, Michael G. Messner, and Victor Nowicki, "Implementing an Operating/Service Plan: A Case Study of the Bostom and Maine," Studies in Railroad Operations and Economics, Vol. 29, Cambridge, MA: MIT Center for Transportation Studies, Report No. CTS 80-3, November 1980.

4. Carl D. Martland, Philip A. Clappison, Carl D. Van Dyke, and Robert J. Tykulsker, "Rail Service Planning: A Case Study of the Santa Fe," Studies in Railroad Operations and Economics, Vol. 35, Cambridge, MA: MIT Center for Transportation Studies, Report No. CTS-SROE-35, October 1981.

5. The following report contains a preliminary assesment of the Service Planning Model distribution program and the results of a user survey on the approach taken: Carl D. Martland and Carl D. Van Dyke, "Transferring the MIT Service Planning Model," Studies in Railroad Operations and Economics, Vol. 38, Cambridge, MA: MIT Center for Transportation Studies, Report No. CTS-SROE-38, December 1983.

FREIGHT TRANSPORTATION INFORMATION DISSEMINATION
STATE OF THE ART AND FUTURE DIRECTION

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This paper presents an overview of traditional methods employed by shippers in accessing freight transportation rate and service information and seeks to identify in practical terms the options which exist for employment of electronic technology to improve freight transportation information dissemination. It is based on research performed by the Goods Distribution Systems Office of the Ontario Ministry of Transportation and Communications and on consultant work performed by Currie, Coopers and Lybrand for the Ministry. However, the views and conclusions presented are those of the authors and do not necessarily reflect those of the Ministry.

***The views expressed are those of the authors and not necessarily those of the Ministry of Transportation and Communications, Ontario.**

TRADITIONAL METHODS

Almost without exception, Canadian shippers access freight transportation rate and service information by traditional methods which have been in place for decades. As transportation services and options have proliferated, systems for information dissemination have responded by simply increasing the number, frequency and size of publications. Large shippers generally subscribe to a broad range of tariff and service publications in order to have an adequate "in house" source of transportation information. Smaller shippers who lack resources and expertise in transportation matters tend to rely on verbal advice from carriers and/or freight forwarders/consultants for freight transportation information. Sources of information for both large and small shippers may be identified as follows:

Tariffs published by tariff bureaux (conferences).

Tariffs published independently by carriers.

Directories of carrier services/sailings.

Carrier advertising/sales contacts.

Freight forwarders/consultants.

Word of mouth/informal contacts.

Generally, large companies appear satisfied that they have adequate access to transportation information to support the efficient distribution of their products. However, there is rising concern about the costs associated with obtaining and analyzing data and the continuing ability to keep informed as options proliferate as a consequence of U.S. and Canadian regulatory reforms and market pressure for improved distribution efficiency.

Smaller companies report considerably greater difficulty in seeking out optimum options for freight transportation. Traditionally many small companies have avoided the problem of managing their freight transportation purchases by offering their products on an "F.O.B. plant" basis and transferring the responsibility for the selection and payment of transportation services to their customers. This is becoming an unattractive means of resolving the problem for two reasons. First, as transportation costs have escalated more rapidly than inflation in the past decade, purchasers have become more aware and concerned about the transportation component of any purchase. High transportation costs can influence supplier selection, with close suppliers or those offering a delivered price being

favoured. Second, as the Canadian manufacturing sector increases its dependence on export markets, there is a need to offset the natural tendency of prospective foreign customers to purchase from known domestic sources. Many Canadian producers competing in the U.S. marketplace have found the quotation of a delivered, duty paid price, an essential feature to support successful market penetration. However, many small Canadian companies have expressed concern about their inability to access reliable data to enable them to quote accurate, competitive, delivered prices to prospective U.S. customers. Similar problems arise for Canadian producers seeking to access offshore markets. These difficulties have been exacerbated by the proliferation of freight services and pricing initiatives which have developed in the U.S. since deregulation legislation of 1980. Frequently low cost service options available from U.S. border cities are overlooked due to inadequate or incomplete knowledge of their availability.

OPPORTUNITY PROVIDED BY TECHNICAL ADVANCES (Computers/Communications)

The difficulties encountered in accurate and timely dissemination of freight transportation information have their roots in several

characteristics of the data and the manner in which it is used.

1. The body of information is large.
2. The information is subject to constant change.
3. Maintenance costs by traditional methods are high.
4. Accessing data manually requires a relatively high skill level although many of the steps required are repetitive.
5. Those seeking information are numerous and usually require access to a very discrete portion of the total data available.
6. A high degree of integrity both in data accuracy and retrieval mechanisms is required.
7. Historical as well as current data is required.
8. Certain data may not be in the public domain and should be disclosed only to particular parties.

These characteristics are not unique to freight transportation price and service information. However, because of the large volume of transportation service suppliers and the complexity of pricing structures which has evolved through decades of regulation, the body of freight transportation related data in North America is immense.

In most areas of human endeavour where storage, retrieval and manipulation of complex data is required, the computer has been employed to useful advantage over traditional manual systems. While the computer has made considerable inroads into the manufacturing sector and the operations side of transportation service companies, it has yet to be employed broadly in the storage, maintenance, dissemination and retrieval of freight transportation rate and service information. The general lack of application of computer technology in this area would seem, however, to be the result of a lack of recognition by distribution and transportation professionals of computer capability rather than any deficiency in computer capability itself.

Indeed the advent of the personal microcomputer has made possible data manipulation directly by distribution managers and analysts who previously had to work through computer specialists in order to apply computer technology to distribution management. Combining the power of a personal microcomputer with access to a comprehensive databank of transportation price and service information provides the distribution professional with a powerful tool to support traditional traffic and transportation service

functions. If experience in other applications is a reasonable guide, applying this technology to distribution will result in a substantial modification of traditional methods of distribution management, particularly in activities relating to routing selection, carrier negotiation, freight payment and management reporting.

An exhaustive search in 1982 by the Goods Distribution Systems Office of the Ontario Ministry of Transportation and Communications failed to reveal any comprehensive application in Canada of computers to freight transportation data management. However several U.S. entrepreneurs were identified who had embarked on programs of developing electronic databases of freight transportation rate information. Generally, these consisted of a general body of data (e.g., U.S. domestic truck class rates) which was supplemented by the specific commodity rate requirements of subscribing clients. As new clients were obtained additional data was added. Clients accessed data to support routing and freight bill audit procedures over telephone lines either by a computer-to-computer communication or through a display on a remote terminal.

More recently, interest has been expressed by U.S. carriers in subscribing to such services for their own rate requirements. Service suppliers have also emerged who address the needs of shippers and carriers in offshore marine movements.

Because of the apparent opportunity for Canadian development and concern about the competitive effect on Ontario's industry if Canada did not parallel U.S. moves in this area, the Ontario Ministry of Transportation and Communications commissioned studies of the market for development of a centralized Canadian computerized transportation information system (CTIS) and the cost of such development.

THE CURRIE, COOPERS & LYBRAND REPORTS

The market and costing studies were performed by Currie, Coopers & Lybrand and completed in late summer 1983. The market survey included distribution of a questionnaire to 500 shippers of varying sizes. The response rate was high - exceeding 20%. A separate survey of a similar sample of domestic surface carriers was conducted in the Fall of 1983. This had a lower rate of response (10%). In both cases, the results of the mailed questionnaire were supplemented by personal and telephone interviews. The results

of both surveys have been published elsewhere and the complete reports are available from the Ministry.

Generally, the consultant studies concluded that Canadian shippers are prepared to accept the computerization of freight transportation rate and service information. However, several major companies have embarked upon "in house" computerization of their specific rate requirements. Many others are on the threshold of making decisions relative to applying computers to transportation rates. The consultant's costing study indicated that the concept of a centralized, comprehensive database of information is commercially viable but will require some government support at the outset.

However there were several cautionary observations by the consultants. Particularly it was noted that the Canadian market is insufficient to support more than a single service; that the service (database) would need to be comprehensive; and that if it is not available soon, then the Canadian market will fragment to "in house" systems and U.S. suppliers.

The question of whether to develop and maintain an "in house" database of transportation rate and service information or to access an

external database has been addressed by several major North American shippers. Many more, including several in Canada, are currently on the threshold of wrestling with this decision. Unfortunately, with the industry of external database services still in its infancy and without any long-term experience by those who have opted for "in house" development, it is difficult to make informed decisions or even to establish definitively the criteria to be evaluated. Some of the key points to be considered are:

- the size and complexity of the data required
- the frequency with which it changes
- the extent to which data requirements are repetitive
- the incidence of new products, new origins, new destinations, etc.
- the ease/difficulty with which an external service can support existing "in house" systems and procedures
- the cost of "in house" development and maintenance vs cost of purchased service.

Generally speaking, "in house" development will be favoured where data size is small, subject to infrequent change and where the incidence of new products, origins and destinations is low.

External service becomes a more practical option as the size, complexity and variety of changes increases. The matter of cost evaluation presents difficulty. "In house" development costs can often be under-estimated while the long term costs of purchasing from a new developing industry providing access to central databases may similarly be subject to uncertainty.

One of the chief observations of the consultants, which has been confirmed by Ministry contacts with industry sources, is the pervasive lack of understanding of computer capability within the distribution/transportation profession. The concept of CTIS is one which many have been slow to accept. This appears to be due not to any inability to grasp the concept intellectually, but rather a reluctance to accept the computer's ability to handle the task.

Naturally, acceptance is greatest among those who have been exposed to computer applications in other areas. Skepticism is greatest in those organizations and institutions with no experience in computerization. Generally, small and many medium-sized highway carriers fall into the latter category. While the Ministry has sought to promote better understanding by demonstrating the capability of U.S. systems to interested

individuals in Toronto, we believe there is a need for more intensive general exposure of distribution and transportation professionals to computer systems, their capabilities and applications.

OPPORTUNITY FOR FUTURE DEVELOPMENT

While we believe in the potential for CTIS development and implementation in Canada, this should be viewed as only the initial phase of employing computer technology to promote more effective goods distribution. Clearly this first step will do nothing more than apply the efficiency of the computer to existing freight transportation price and service mechanisms. However, computer and communications technology have considerably more to offer the transportation marketplace than mechanization of storage and dissemination of price and service information in its traditional form.

If a significant portion of the carrier and shipper community becomes plugged into the same electronic network, there would appear to be the opportunity for more fruitful marketplace interaction. Current technology can do much more than facilitate the exchange of information produced to meet the requirements of a pre-electronic communications age. The technical

capability exists for a working electronic marketplace in which shippers and carriers offer current and future transportation requirements and capacity. Carriers would be able to solicit traffic to balance lanes. Shippers would be able to offer traffic and receive confidential bids for movement. Deals could be made and consumated and freight moved without recourse to traditional methods of negotiation and communication.

However, it is much easier to grasp the concept in the abstract than to imagine its ready acceptance by those who are accustomed to highly-complex traditional methods of marketplace interaction. A comprehensive interactive electronic marketplace would obviate traditional tariffs, filing requirements and much of the costly clerical activity associated with assessment, audit and payment of freight charges.

The opportunity for flexibility and efficiency improvement in such an evironment is considerable. The speed of realization will depend largely on the ability of shippers and carriers to embrace a much more challenging environment but one offering perhaps less personal certainty and security than our present jungle of paper tariffs and government regulation.

CONCLUSIONS

Based on research done so far it is our conclusion that a CTIS will develop in Canada provided it has appropriate public sector support. While initial funding may be important, the concept will also require promotion by government and an appropriate regulatory environment in which to develop.

Development of an electronic marketplace will depend largely on the initiative of industry leaders in accepting the concept. If achieved it will likely be due to an evolutionary process. Governments may support and hasten such a development by removing any legal or regulatory barriers and providing opportunities for industry to become more aware of the ability of computer systems and networks to supplant traditional methods.

Certainly there is opportunity for a system to support both shipper and carrier activity. In the U.S., the concept of a centralized database was embraced first by users of the transportation system. However carriers are now gradually becoming more interested in the concept and system suppliers are starting to focus attention on the potential carrier market. Certainly a centralized database can support both carrier

billing and sales department activity. In Canada we have the opportunity to structure our approach in a way which may provide for development of a service which can address the needs of both shippers and carriers.

It would seem that the size of the Canadian market and the significance of transportation in the Canadian economy provide a unique opportunity for development of both the CTIS and electronic marketplace concepts. We would appear to have the opportunity to exploit our relatively small size, compared to the U.S., to advantage by developing a comprehensive electronic system whose ability to support efficient distribution should provide Canadian goods with a competitive edge in the North American and select offshore markets. Realistically, our choice is limited to whether we lead or follow our U.S. trading partners in developing appropriate computer systems to support more efficient distribution of Canadian products.

Indeed, a Canadian system might itself have the potential to become a model for world-wide distribution of an operating system.

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MULTIMODAL OWNERSHIP AND INTERMODALITY

John Gratwick & Michael Kirby.

The terms 'multimodal' and 'intermodal' have come into common use over the last twenty years or so. Unfortunately, as neither of them has yet appeared in a dictionary, their meanings, and the differences between them, if any, are rather vague and contradictory. Multimodal has the greater and and more general currency due mainly to the UNCTAD Convention on Multimodal Transport; this convention relates to international movements using more than one mode of transport under a single contract with a 'Multimodal Transport Operator' (MTO)

While the MTO is not a carrier, in Canada we use the term 'multimodal owner' (or operator) to refer to a carrier that owns, or has some measure of control over, two or more modes of transport. While we also speak loosely of multimodal shipments, intermodal traffic has come to mean more precisely, shipments that move from origin to destination by means of two or more different modes of transport, using a single transport containment throughout.

Examples are easier than abstractions. The current shipping container, whether twenty or forty foot, moving successively on truck or rail, ship, and rail and/or truck is clearly an intermodal movement. A highway trailer, loaded at origin, travelling over the highway, moving on a flat car by rail, then completing its journey to final destination by road, is also an intermodal movement. A rail car loaded at origin, moving to a port and then being transferred to a barge or ferry for a water leg, and finally being delivered over rail trackage to the consignee is also intermodal. One hundred cartons of canned food moved by truck to a railhead, loaded into a rail car for a line haul, and transferred to a delivery truck at the destination city for movement to a warehouse, is not an intermodal movement.

A multimodal operator is a carrier who owns or controls, wholly or in part, two or more transportation modes. It is possible that he can provide a complete intermodal movement within his own organisation, as CP can for some North Atlantic container traffic; he may provide some of the components of an intermodal movement as CN can; he may provide only one component, like Newfoundland Holdings Ltd.; he may not

participate in intermodal shipments at all, like a trucking company with no equipment capable of carrying containers.

Ownership by one enterprise of two or more modes of transport is sometimes being referred to as 'vertical integration'. This label implies that the different modes that are included in the structure are in some way combined to produce an integrated service. There may not be much chance that unambiguous definitions and usage of these various terms will emerge. It would make life easier if, however, we could confine the term 'multimodal' to ownership and control and 'intermodal' to integrated transportation movements.

This clarification is necessary in order to explore the issue that has been bouncing around for some years. Intermodal transportation services in general, and international container movements in particular, are seen as desirable by the shippers, and therefore as essential by the carriers. Faster, more reliable and economic transportation is now easily available compared to the break bulk operations of former years. With its clear advantages, intermodality

has been encouraged and supported by governments, particularly through the provision of new port facilities. On the other hand, perceived expansion or extension of multimodal ownership, as one of the adjustments carriers have been making to meet the challenge of providing intermodal services, has been extensively criticised, and formally challenged before the CTC under Section 27 of the National Transportation Act.

This section of the Act requires that any transport undertaking intending to acquire an equity interest in another transportation company, whether that company is of the same mode or a different one from the company doing the acquiring, must first obtain the approval of the CTC. This approval can be withheld should the CTC determine that the acquisition was prejudicial to the public interest or that it would unduly restrict competition. Well pre-dating this National Transportation Act requirement, both the Aeronautics Act and the Railway Act have more specific provisions covering acquisitions. In the case of the Aeronautics Act, it applies to anyone wishing to acquire an air carrier company, and the main intent seems to be to ensure that there will be adequate

financial and managerial resources available. The main intent of the Railway Act provisions is to provide for an orderly extension of the long-established practice of the two major railways, CP and CN, of entering into joint venture arrangements. Over the years these have encompassed rail freight and passenger activities, terminals, hotels and telecommunications.

Consumer and Corporate Affairs (CCA) is another player in the game. While their legislation has no specific reference to transportation companies per se, Section 27 of the NTA requires that CCA be informed of any application received by the CTC. The intent of this is presumably to further ensure that competition is not unduly limited by a proposed acquisition.

There are some useful inferences that can be drawn, both from the content of the existing legislation and from its application over the years. First, and rather surprisingly, if the intent is to provide a brake on the extension of multimodal ownership, then it is only existing transportation companies that are to be so constrained. A non-transport company can apparently acquire transport undertakings in different

modes without any limitation. The most recent example is the Royal Bank's acquisition of CAST(1983) Ltd., and its absorption of Sofati. The CTC ruled, on challenge, that it had no jurisdiction as the acquisition was outside the scope of Section 27.

Secondly, the definition of transportation that emerges from the legislation and its application raises some questions. Section 27 lists transportation as comprising railways, commodity pipelines, water carriage, motor vehicles, and air. Companies in these activities are the ones that have to obtain approval for an acquisition. Presumably, an oil or gas pipeline company does not. In the recent CTC ruling on the CN/CAST case, the acquisition by CN of Task Terminal Co. was found to be acceptable. Thus terminal companies are now deemed to be transportation companies, at least in the role of acquiree, if not as acquirors.

Since the formation of the CTC following the passage of the National Transportation Act in 1967, there appear to have been well over 500 applications under Section 27. While the majority of these were almost certainly modal companies acquiring another company in the same mode, all the multimodal applic-

ations are contained in this figure. Up to the present, no studies of these applications and their outcomes have been made. We hope to remedy this deficiency in the coming months, both to obtain some sense of the growth of multimodal undertakings, but also to identify the underlying policy basis of the decisions. Nobody can recall offhand any cases that were formally disallowed under Section 27 (although there have been cases under the Aeronautics Act provisions) but it is possible that a strong enough message may have been given in some instances to cause an application to be withdrawn. The information from these applications in particular would clearly be useful in defining the boundaries of the policy.

Multimodal ownership has been a fact of life in Canada since the formation of Canadian Pacific over one hundred years ago. Shipping was a part of Canadian National from its inception, and all Canadian Railway companies have been directly in trucking for many years. Canada's two major airlines both started as subsidiaries of railways; Clarke Steamships started life as an airline subsidiary, and after years as an independent multimodal company, is now back under common ownership with another airline. The Fednav/CSL

linkage joins ocean and lake shipping, trucking and passenger buses. Clearly, common ownership of a shipping line and a bus company offers no intermodal capability for passengers or freight; neither does common ownership of trucking and pipeline. Most multimodal companies are able to provide more than one segment of an intermodal movement. Most of the ownership linkages have come about in response to the needs and opportunities of the transportation market, and companies' adaptation to developments in transportation technology.

More recent acquisitions and restructurings continue to be part of the process of adaptation and survival. One of the key adaptations is to the challenge and demands of intermodal services. Linking together a number of transportation components to produce a truly intermodal service is in large part dependent on shared technology. A practical way of resolving the questions of compatibility and responsibility for capital investment is through joint ownership. Costs and benefits of the equipment and facilities needed for an intermodal service do not often equate within each component of the service; effective

transfer pricing may be difficult, if not impossible. Joint ownership relieves the requirement for such pricing precision, and management attention can be better directed to the performance of the total operation.

For international intermodal traffic in particular, the issue of allocating liability for a through freight movement has yet to be satisfactorily resolved. Discussion at the UN on the Multimodal Convention has been going on for many years and no resolution appears to be in sight. The problem of determining responsibility and liability for the loss or damage of goods moving through several modes of transport within and between several countries is clearly an intractible one. The number of separate entities that have to be dealt with is too large for a series of successive bilateral negotiations to be very practicable, apart from the fact that the process itself is very time-consuming and costly. Any means of reducing the number of distinct organisations in the chain is an advantage; joint or shared ownership achieves this.

Closely linked to the issue of liability is

the more general one of the operational organisation and control of intermodal shipments. Simplification of paperwork and compatible, timely communications between the various components are essential if the service advantages are to be retained and offered to the customer. Again, the smaller the number of independent components involved in the total movement, the easier this facilitation becomes.

A multimodal operator has a clear advantage in terms of marketing the intermodal service. By having direct control over all or the major part of an intermodal move, it is possible to make more specific service and price commitments to the customer and to meet those commitments.

The growth and extension of multimodal ownership, particularly where it is providing integrated intermodal transportation, has, however, given rise to some serious concern. To some extent, the NTA itself has generated that concern by the mere presence of Section 27. Its requirement for prior approval and the provision for the hearing of objections encourages objectors. Much of our experience with Section 27 in this context has come from the CP-DART consortium and

the CN-CAST acquisition. Both of these applications were objected to on the grounds that some aspect of the public interest would suffer if the se acquisitions were to be allowed. In the event, the main objections in both cases came from port promoters and from Consumer and Corporate Affairs. The representations on behalf of the port were to the effect that, as a potential component of an intermodal service, it would be excluded from the particular services that would result from the acquisitions.

Consumer and Corporate Affairs' objections were less clear. They appeared to be defending an abstract principle of competition, rather than identifying any adverse effects that might arise from the acquisitions. It is significant that no customers of the services appeared to lodge objections; it is to be presumed that their interests were not threatened.

The final outcome in both cases was the same; the mergers were allowed. In the CP instance, the CTC ruled that it was not prejudicial to the public interest; in the CN case, events overtook the hearing timetable. CAST went under, and CN's acquisition of the remaining remnant, TASK terminal,

was allowed. Unease remains, however, and the CTC has decided to hold a fact finding inquiry under Section 22 of the NTA to allow for a more objective examination of the more basic issues underlying multimodal ownership. This inquiry is expected to get under way in the summer.

In recent years, U.S. transportation policy has leapfrogged ahead of Canadian policy. With the passage of the NTA in 1967, Canada was clearly well in advance of U.S. thinking, certainly in terms of deregulation and competition. With their successive moves in rail, air and trucking, the U.S. is now well ahead of us. The results have been rather brutal for some established carriers, but the rationalisation is putting new health into the whole industry. A variety of new multimodal configurations are appearing, as well as mergers within the modes.

In determining its own policy towards various forms of multimodalism, Canada has now to consider the impact of this deregulation process that is taking place to the south. Based on past experience it is not inimical to our interests when Canadian regulation is less oppressive than that in the U.S.; adverse con-

sequences seem to arise when the situation is reversed.

To find a basis for a future policy, it is necessary to return to the NTA, review its terms and look at the experience over the 17 years that it has been with us. In 1967, the NTA reflected a major shift in Canadian transport policy. For the first time, competition was to be the primary guidance mechanism for the operation and pricing of transportation. Longer term development, growth and decline was to be allowed to occur according to the same principle. Transportation companies were to be recompensed if they were required, for national policy purposes, to deviate from this principle. Support, at public expense, of transportation was to be equitable across the modes.

The Act was fairly silent on intramodal competition. The legal accommodations that were in existence, and to a considerable extent are still with us, allow railways, truckers and shipping conferences to collude in the setting of rates. The NTA's emphasis on competition did not extend intramodally; it concentrated on competition between the modes. Bearing

in mind the origins of the legislation, the MacPherson Royal Commission had been preoccupied in adjusting to the realities of trucking without appearing to either favour or destroy the railways. Competition between the modes seemed to be, and at the time was, the best answer. Certainly, the trucking industry grew mightily, the railways pulled their socks up, and the customer received better service and lower rates.

Changes to the Maritimes Freight Rate Act in 1969 were another consequence of the new policy. By extending the MFRA subsidies to all modes of transport, all modes were being treated equitably, rather than favoring one mode, rail, as had been the case theretofore.

The very rapid growth in intermodal movements, both international and national, was well under way by 1967, but had not been foreseen by the architects of the legislation. The Royal Commission had finished its work several years earlier, before the containerisation revolution hit. It is now becoming obvious that the rather tidy concept of competition between the modes is now in some disarray. The customer's choice is no longer between alternative modes, but is

between alternative intermodal packages. Not only is one mode no longer the key component of the total movement, it is no longer the determinant of the total price. Competition, as far as the customer is concerned, is between packages, not between modes. These intermodal service packages are available in an increasing variety of mode and route combinations. What we are now looking for, therefore, is a policy basis which will enable these various service offerings to compete equitably; this must decrease the emphasis on modal integrity and competition between the modes.

Monopoly of a single element in a given intermodal package is also unlikely to have any harmful effect on the customer. While this situation may be perceived to exist for a port or a rail route, it has to be remembered that the field for competition between intermodal services is not confined to a single route or even to a single country. Alternatives will always exist, and the term monopoly in this context can be quietly dropped.

Another consideration for the policy makers is that, to an increasing extent, Canadian transportation

companies are selling their services internationally, not merely to Canadian shippers or receivers. The opportunities in this market are virtually limitless, and it would be shortsighted indeed if, in an attempt to protect some segment of the Canadian economy, we destroyed our collective capability to compete, and therefore participate, in this much larger international transportation market.

Intermodalism is a fact of transportation life that is here to stay for some while. If multimodal ownership, operating under new policy guidelines, can help to ensure that we take full advantage of the opportunities offered, so be it.

Pages 413-429 WITHDRAWN

CONSEQUENCES OF PROVINCIAL OWNERSHIP

of

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I. INTRODUCTION

The Canadian financial community is accustomed to dealing with various aspects of the regulatory and legislative process, and the transportation industry as well has had to deal with government regulation since its inception. Transportation in Canada is as much a political issue as it is an economic fact and, therefore, changes in ownership and control of transport companies can be expected to come under public scrutiny. Thus, it should come as no surprise that the announced intention of one provincial government to use its pension fund to increase its holding of the country's largest transportation company would lead to much intense Parliamentary debate and public outcry.

"An act to limit shareholding in certain corporations", better known as Bill S-31, was introduced into the Senate on November 2, 1982, to "ensure that the interprovincial transportation sector will operate for the general benefit of all Canada". [1]

The bill was designed to prevent provincial governments or their agents from acquiring more than 10 percent of the voting shares in a transportation company operating across provincial or national boundaries. [2] It is widely regarded that the implicit aim of the legislation was to prevent Quebec's $18 billion pension fund, la Caisse de depot et placement, from increasing its ownership of CP Ltd. beyond its current holdings of 9.6 percent. The federal government appeared to be acting in the

belief that the policies of a government committed to a separatism may not be consistent with the national interest, and that those policies may take precedence over purely economic considerations. That doctrine forms the basis of the first of two issues to be discussed in this paper; that is, would the fund's return on investment be sacrificed in favour of its use as an instrument of economic development and political gain? The second issue to be dealt with is the question of the public interest. Specifically, what are the effects on the public interest of a controlling share in a national transportation being held by an agent of a provincial government?

The paper begins with a review of the growth of the Caisse, and a discussion of the shift in its policies since its creation. Against this background, the issue of political versus economic priorities of the Caisse will be discussed. Finally, an assessment of the impact of government control of transport firms on the national public interest is made and legislative solutions are proposed.

II. THE CAISSE DE DEPOT ET PLACEMENT DU QUEBEC

The Caisse was created in 1965 to manage the funds in the Quebec pension plan, which was no longer part of the Canada pension plan. Its establishment was largely the work of Jacques Parizeau, currently Quebec's Finance Minister. It has since grown to a fund with assets in excess of $18 billion, the largest pool of investment capital in the country, public or private. [3] The Caisse is currently the largest single shareholder in most of Canada's major banks, and it also has controlling or potential control blocks of stock in several of the country's largest corporations. Following is a list of some of these companies, with the Caisse's share shown in parenthesis: [4]

Domtar	(42%.0)
Noranda	(12.6%)
Alcan	(5.3%)
Bell Canada Enterprises	(3.0%)
Dominion Textile	(12.0%)

In addition, the Caisse also has holdings in excess of one million shares of each of the following companies: Gulf Canada, Imperial Oil, Inco, John Labatt Ltd., Norcen Energy Resources, Nova Corp., Seagram's, Shell Canada, Thomson Newspapers, Trans Canada Pipelines, Hiram Walker Resources, and each of Canada's five major chartered banks. [5] It should be noted that while the Caisse's stock holdings are over $3 billion, that sum is only 17 percent of its total portfolio. [6] Most of the rest is invested in Government of Quebec and Hydro Quebec bonds and debentures.

The preceeding figures provide ample evidence that the Caisse de depot et placement is a formidable member of the Canadian investment community. The question that needs to be addressed is whether it should be regarded as just another investor, albeit a large one, or as a tool of government economic and social policy. To answer this question, we must look at the philosophy of the people involved in the creation and management of the Caisse. It was under the regime of Premier Jean Lesage that the Caisse was established in 1965. The premier stated then that the first aim of the Caisse should be the protection of pensioners' assets, but that it must not be solely an investment fund. He said it "also must be an instrument of growth - a more powerful lever than any now available in the province". [7] One of Lesages' ministers at the time, Rene Levesque, wrote in 1968, "By nationalizing electric power and creating the Caisse, we have taken the first steps toward the kind of collective control of certain essential services without which we cannot feel secure. But none of this has been brought to completion. What has been done is only a beginning." [8] Ten years later, after the Levesque government had been elected to power, the first signs of political pressure on the Caisse began to show. The Chief Executive Officer of the Caisse cautioned in his 1978 annual report, "under no circumstances was the capital to be used to finance social or economic projects, essential as they might be". [9] A year later, he took early retirement and was replaced by a former deputy minister to Jacques Parizeau.

In 1980, another sign was given that the Caisse had undergone a shift in policy. It began to lend money to the government and Hydro Quebec at below market interest rates, after Mr. Parizeau had complained that the provincial government should be able to borrow money at the same rate from the Caisse as it paid on money borrowed from the Alberta Heritage Fund. This action was widely regarded as an indication that the investment policies of the Caisse had shifted away from the maximization of return on pension funds and toward the subsidization of the economic development of Quebec. The finance minister's comparison of the Caisse with the Alberta Heritage Fund was at best a tenous one, for the latter is not a pension fund and any loans it makes are the result of cabinet decisions. These two characteristics alone distinguish the Heritage Fund from Quebec's pension fund.

This unacknowledged shift in policy resulted in public criticism of the Caisse by two prominent Quebec politicians. One vocal critic was none other than Jean Lesage, the founder of the fund, who accused the PQ Government of "stealing the people's money". [10] The other was Eric Kierans, who resigned from the board of the Caisse over the policy of lending money at less than market rates to the government, and the government's refusal to publicly acknowledge this new policy.

Any discussion of the activities and policies of the Caisse would be incomplete without mention of the takeover of Domtar Ltd. in 1981. This acquisition was carried out in

conjunction with the Societe Generale de Financement du Quebec (SGF), a Quebec government industrial financing agency. The government's ownership of the Domtar now stands at 46% which, because of legislation limiting the Caisse's holding to 30% of any company, is shared with SGF. [11] Shortly after the acquisition took place, the company's shares dropped in value on the stock market by 16%. [12] This event was a clear indication that the financial community was somewhat reluctant to accept the Quebec government as a bona fide member.

Some of the apprehension about the government's intentions as a major shareholder came about as a result of certain statements made about the firm by the Levesque government. Early in 1981, when the Caisse's holdings in Domtar were still only 23%, Finance Minister Parizeau indicated his displeasure with Domtar's decision to move the headquarters of its Sifto Salt division out of the province, as well as the firm's refusal to help fund a government subsidized salt mining operation. He stated in the National Assembly that, with the government being such a large shareholder, this lack of cooperation from Domtar could not be tolerated. And, finally, the president of the company was criticized by the new Caisse chairman for statements made in Domtar's annual report that Quebec would be better off staying in Confederation.

Through its two agencies, SGF and the Caisse, the government now owns 46% of Domtar's shares and has six directors out of twenty on the board. [13] The fact that ownership has not translated directly into representation may explain the ability

of the company to continue operating as a private enterprise. The fears that investors expressed that company decisions would be influenced by political objectives rather than profit maximization have not been borne out. Evidence of this is provided by the company's strategy for surviving the severe recession that hit the forest products industry in 1982.

In its efforts to trim marginal operations, the company closed or sold off seven plants, three of which were in Quebec. Two of the plant closings put over 200 people out of work, but there was no evidence that the Quebec government attempted to block the shut-downs. Perhaps it recognized the limitations of thirty percent board representation. Stock market analysts seem to have overcome their fears and have stated in reports that "Domtar is at least as well managed today as it ever was. Government ownership has not done the company any harm". [14]

Not enough is known about the Domtar situation to state conclusively whether or not the government was thwarted in its attempts to exert stronger control over the company's policies. What is clear is that the government has expressed its intention to work towards attaining a stronger voice in the management of the companies it has significant holdings in. This philosophy is clearly stated in the following excerpt from the Caisse's 1982 annual report:

> "...The Caisse wishes to be acknowledged as any other shareholder of equal importance, it particularly expects to be consulted on the appointment of certain directors or to be invited to propose nominees. In such instance, it surveys the milieu...for the candidate best suited to favour the development of the company. It may occasionally, for reasons inherent to a corporation or to the nature of investment, propose members of its staff." [15]

The last comment is an explicit statement of the intention of the Caisse to seek an active role in the companies it invests in, beyond the normal directors' role of policy and long range planning issues.

In the preceeding pages, we have examined the growth and development of the Caisse, which controls the largest pool of investment capital in the country. We have also outlined the gradually increasing influence exerted on the fund by the PQ government. And it has been shown that significant ownership does not necessarily translate into control of day to day operations. Nevertheless, there is concern that the public expression of the Caisse's intentions, combined with the record of the provincial government's involvement in the economy, will ultimately result in a form of covert socialism. Against this background, let us now proceed to examine the effect on the public interest of provincial ownership of national transportation companies.

III. POLITICS AND THE PUBLIC INTEREST

Anyone familiar with transport regulation in Canada has probably come across the statement of Canadian transportation policy as expressed in the National Transportation Act of 1967. Section 3 of the Act states that "an economic, efficient and adequate transportation system making the best use of all modes at the lowest total cost is essential to protect the users of transportation and to maintain the economic well-being and growth of Canada." [16] The issue in question is whether the terms of the national transportation policy could be carried out if a major company in the industry has a provincial government as its largest shareholder. The authors believe that this is unlikely. The statements in support of this argument are made under the hypothesis that, without federal legislation limiting provincial ownership in national transportation companies, it would indeed be possible for the Quebec government, through such agencies as the Caisse and SGF, to acquire an equity position in CP Ltd. that would enable the government to influence company policy. Unless Bill S-31 is reintroduced to Parliament, such a scenario may move out of the realm of the hypothetical.

Governments, through the nature of the political process, have objectives which do not always coincide with those of private enterprise. While they are generally interested in the long-term growth and development of the area under their jurisdiction, sometimes short-term policies appear to take

precedence. That is because the primary objective of any government is to maintain power. A party out of office can do little to implement its strategies, even if they are likely to contribute to overall growth and prosperity. There is no doubt however that the Quebec government has the long-term interests of the province at heart in its attempt to exert some influence over the manner in which its development is carried out. But the long-term objectives of a provincial government may not be consistent with those of a national transportation company which, by definition, has interests beyond the borders of a single province.

A federally chartered transportation company is required to conduct its affairs in a manner consistent with the public interest. That implies that it must be able to provide transportation services to the public in an economically efficient and equitable manner, over the long run. The latter phrase cannot be over emphasized, because short-term policies aimed at satisfying certain special interests may jeopardize the long-term viability of the corporation.

Examples of governments using crown corporations as a means of obtaining political objectives are not difficult to find. Three will provide sufficient illustration of the point. The first is the purchase, in 1975, of Pacific Western Airlines by the Alberta Government. One of the first acts of the new owner was to move the headquarters of the airline from Vancouver to Calgary. Shortly thereafter, Parliament amended the

Aeronautics Act to prohibit any provincial government from taking over an airline without the federal government's approval. A second example of government influence is the policy of Petro-Canada to lease Canadian-built supply vessels, which cost 40 percent more to build than foreign built ones, and to pay rates up to three times higher for those ships than for foreign ships. [17] Rather than concentrating solely on oil exploration at the lowest cost, Petro-Canada is willing to subsidize the Canadian shipbuilding industry at the same time.

The third example of government influence in the management of a crown corporation was the pressure put on CN Rail in late 1982 to advance the date and increase the size of its order of rails from another crown corporation, the Sydney Steel Corporation, which was in desperate need of new orders to stay in business. These examples provide a clear illustration of how political objectives, even those aimed at improving the level of economic development of particular regions or industries, can cause a firm to deviate from the doctrine of profit maximization. Using one corporation to subsidize another may contribute to overall economic well-being in the short run but, if this policy is implemented without discretion, the long-term viability of the stronger firm may be shaken.

The point of these examples is that governments generally find it difficult to let corporations, over which they have some degree of control, operate on a completely autonomous basis. And frequently, the objectives of the government are not

consistent with the private interests of the firm. A point to keep in mind here is that corporations generally have longer lifespans than political administrations and the planning horizons of the two types of organizations differ. The implementation of political policies based on a government's planning horizon may result in the lifespan of the corporation approaching that of the government's.

It is not difficult to imagine a conflict of objectives between a provincial government and a national transportation company. If that government has a policy of independence from the rest of the country, the scenario becomes even further complicated. Such would be the situation if the Quebec government, through the administration of the Caisse, acquired a significant share of CP Ltd. of Montreal. The expressed wish of the Caisse to be involved in staff appointments of corporations in which it has ownership combined with the suggestion by its Chairman that there is a need for changes in CP's senior management ranks, provides cause for concern about the degree of influence the new owners would expect to have on the operations of the company.

The effect of such an arrangement on the public interest is simple to speculate on but difficult to quantify. It all comes down to the definition of the public interest. If terms such as "equitable", "accessible", and "economically efficient" are used, then there would likely be a negative effect on the national public interest. However, if one regards the long term

economic development of the province of Quebec, as in the public interest, and the beneficial effect on the federal system as a whole, then the Caisse's ownership could be construed as having a positive effect. The danger is that, while these two definitions of the public interest are not necessarily mutually exclusive, if the former must be sacrificed for the latter, then the overall effect would be a shift in policy away from the objectives of economy and efficiency towards the objective of political stability. Such a policy shift would likely be regarded by investors negatively, thereby depressing the price of the company's stock and hampering its ability to raise funds in the capital market.

Some hypothetical examples may help to illustrate the potential problems. A transportation company the size of CP Ltd. has operations all across the country. Some of these enterprises may compete directly with other firms owned partially or wholly by the Quebec government. If the provincial government were to be in a position to influence corporate policy, it might attempt to use this influence to reduce competition between the operations. For example, it could prevent the company's trucking subsidiary from applying for a license to serve a route currently being served by a trucking firm in which the government is a large shareholder. It may use its power to implement a similar strategy for the company's airline. It is even conceivable that, with sufficient board representation, the government would aim to reduce capital

spending on intermodal facilities, if such facilities would give the company's railway operation a competitive advantage over provincial trucking companies. Or, approval for capital projects could be weighted in favour of those that take place within provincial boundaries, and increase employment of the province's labour force. Rail line abandonment applications may only be made if the line in question does not serve a government subsidized manufacturing operation. And finally, the merger and acquisition activities of the firm could be subject to political influence.

These examples may be hypothetical, but they serve to illustrate the point that there are many ways in which a provincial government's objectives may differ from those of a private company. Substituting political objectives for corporate ones can result in sub-optional decision making by the firm. Any outside influence that causes management to lose the focus of its corporate strategy, by attempting to meet incompatible objectives, could be harmful to the long-term viability of the firm. The consequences of such a conflict of interests would be truly frightening, if the result was a redirection of the private enterprises's operations within one province. The effect on the national public interest would almost certainly be detrimental under these circumstances.

IV. LEGISLATIVE SOLUTIONS

The federal government introduced the Corporate Shareholding Limitation Act, Bill S-31, into the Senate on November 2, 1982 where it was approved in principle on December 21, 1982. It was then referred to the Standing Senate Committee on Banking, Trade and Commerce. When Parliament ended its last session on November 30, 1983, the Bill died on the Senate's order paper. Finally, in a press release on January 19, 1984, the government announced that there were no plans to revive the legislation. The statement said that the Bill "isn't among government priorities nor is there any plan to include its provisions in the long promised competition bill." 18

It appears that the federal government succumbed to pressure from its Quebec wing, which felt that the legislation was specifically aimed at that province. The government was accused of introducing a bill that could have the effect of limiting the return on investment achieved by the pension fund. Other critics claimed that the federal government has no right to legislate against provincial investment in the private sector, due to its own record of intervention in the economy. It was also argued that legislation of this nature would limit the free flow of capital within Canada, and that the result could be that investment capital is driven outside the country. This would have a negative effect on Canada's foreign exchange position. The bill was also criticized by some economic nationalists who believe that provincial ownership of

corporations is preferable to control by a foreign-owned multinational company, who may not have the interests of either the province or the country at heart.

All these arguments do have some validity, but they become largely academic when one considers the precedents for the proposed Corporate Shareholding Limitation Act. Federal legislation has been in place for some time limiting the degree of ownership by provincial governments of certain national enterprises, the existence of which is essential to the public interest. For example, provincial governments are prohibited from owning more than 2.5 percent of the publicly held shares of Telesat Canada, the satellite telecommunications company established in 1969, and jointly owned by the federal government and the country's telephone companies. The Bank Act permits provinces to own up to 10 percent of a Canadian chartered bank, but denies them voting rights. And the Broadcasting Act prohibits licenses from being granted to any company controlled by a provincial government, unless such license is for educational purposes.

The underlying rational for this type of legislation is that certain enterprises provide services and facilities that form an essential part of Canada's economic and social infrastructure. These insitutions are considered too critical to the country's development to let them fall under the control of a provincial government, which may not be acting in the national interest.

The same argument applies to the country's transportation

system. An efficient transportation network is as essential to a nation's economic development as an efficient banking or telecommunications network. No provincial government investment fund should be in a position to influence the strategy and direction of any of these corporations. These national institutions form the pillars of the Canadian economy, and the government should not let any of them fall into the hands of any special interest groups. To allow such an occurrence would be to risk the long-term national interest for short-term political expediency. The dangers of such a trade-off are clear.

The political process is governed by compromise. Few bills pass without some changes to the initial drafting. Such was the case with Bill S-31, which passed second reading in the Senate, only to be referred to the Senate Commerce Committee, where it died on the order paper. Unless the government can find a way to amend the bill without alienating the province of Quebec even further, then it is unlikely that the legislation will be reintroduced. It is essential to the future of the country's transportation system that a compromise be found. Such a compromise may be found if the government follows the precedent set by the Bank Act. As mentioned previously, provincial governments are permitted to hold up to 10 percent of the shares of a Canadian chartered bank, but they are denied voting rights.

The restriction allows large institutional investors to achieve a significant equity position in an enterprise which has an attractive yield, thus enabling the institution to maximize the return on its investment. By denying the provinces voting

rights, the law forces provincial governments to accept the management of the corporation as it stands, which presumably must be competent in its decisions, for otherwise the company would not have attracted the investment fund's capital in the first place.

If a clause of this type were to be included in Bill S-31, then the national public interest could be protected without the federal government being open to criticism that it is denying the people of Quebec the opportunity to seek the highest return on their invested pension funds. Any suggestion by the Caisse, or any other provincial investment fund, that it requires board representation to match its shareholding, should be taken as a clear indication that it is less interested in the return on its investment than it is in being in a position to steer the direction of the company towards its own political goals.

V. CONCLUSION

The legislation limiting provincial ownership and voting rights in essential sectors, such as banking and inter-provincial telecommunications, has not been challenged by the provinces, so it can be assumed they are satisfied with this arrangement. Similar legislation protecting the national transportation system from provincial interference should be re-introduced as soon as possible. The provinces should be permitted to increase their investments in transportation companies beyond the ten percent level, but they should not have matching voting rights. This restriction would ensure that the management of this essential industry remains independent of provincial influence, while at the same time, permitting those administering large provincial investment funds to seek the highest yield on their invested capital.

Failure to pass legislation placing some restrictions on the ownership of transportation companies could result in a provincial government with avowedly separatist intentions having a significant degree of influence over the corporate strategy of Canada's largest transportation company. This form of "socialism by the back door" cannot be tolerated in an economy where governments are already the dominant force in many industries. The Quebec government's record of nationalization (Hydro-Quebec, Asbestos Co., and Quebecair, to name a few) is not one that would put the corporate sector at ease. Any attempt at further

intervention in the economy should be regarded as an implementation of the government's policy of achieving economic independence. The future of a critical part of Canada's economic infrastructure should not be jeopardized in order to allow a separatist government to fulfill its mandate. Nor should any other provincial goverment, whose interests may not be consistent with the long-term objectives of a firm in the private sector, be permitted to attain a position of significant influence on the direction of these companies. The Canadian economy already is a mixture of public and private enterprise and covert takeovers by provincial governments should be closely scrutinized. Politicians do not always make good businessmen.

FOOTNOTES

1. Sen. H. A. Olson, quoted in Editorial, Globe, Mail 16 January 1984.
2. Editorial, Globe and Mail, 16 January 1984.
3. A threat to private business; Nicholas J. Patterson, Globe and Mail, December 27, 1983.
4. Caisse Unpopulaire; David Olive, Canadian Business, May 1982.
5. Ibid.
6. Patterson, op. cit.
7. Olive, op. cit.
8. ibid.
9. ibid.
10. Government and Business: The Caisse de Depot et Placement du Quebec; Heward Grafftey
11. Forest Giant on the Way Back; Julia Maskoulis, The Gazette, November 26, 1983.
12. Olive, op. cit.
13. ibid.
14. Maskoulis, op. cit.
15. Caisse de Depot et Placement du Quebec, Annual Report 1981.
16. Revised Statutes of Canada, 1970, Ch. N-17.
17. Maclean's, February 20, 1984
18. Canadian Press, January 19, 1984.

NORTHERN TRANSPORTATION: KEY TO DEVELOPMENT

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ABSTRACT

This paper explores the role government can play to ensure the development of adequate transportation infrastructure in support of northern non-renewable resource development. It is written from the perspective of two senior executives within the Department of Indian Affairs and Northern Development who have been active in the promotion of non-renewable resources and transportation development in the North.

The geography of that 40% of Canada north of 60° makes it inevitable that non-renewable resources will present the greatest opportunities for future economic growth and that transportation will be the major constraint to realizing those opportunities. In that sense, then, northern transportation is the key to development.

Northern mines and northern oil and gas will make an increasing contribution to the national economy. Northern mining, which currently accounts for only 3% of national mineral production, offers the greatest potential for Canada to maintain its role as a major supplier on world mineral markets. Northern Canada sedimentary areas may contain as much as 40% of Canada's potential hydrocarbon resources which, if developed, will ensure the country's energy self-sufficiency,

particularly in the supply of crude oil. Therefore, northern non-renewable resource development is in the national interest.

Northern aspirations and northern political institutions are evolving very rapidly. The move towards responsible government in the North should be accompanied by increasing economic self-reliance. Mining as the industry which opened the northern frontiers and oil and gas with its tremendous potential offer the best, perhaps the only, hope for economic self-sufficiency. Therefore, non-renewable resource development is in the interest of northerners.

The dynamic of decentralized decision making which provides free individuals with an opportunity to make a profit is central to our system.

The private sector is, and must remain, the engine of economic growth. Industry must mobilize the large amounts of project capital and sophisticated and demanding labour, which are required to develop frontier resources in an uncertain and volatile international market. Managers and firms are best equipped to respond to market signals and to risk investors' capital. The entrepreneur's task is complicated, but the objective is clear. There is a bottom line.

Government is different. There is no single bottom line. Given the large amounts of money involved, the long lead times, the need for environmental integrity, broad political and social development objectives in the North, the requirement for a clear and stable fiscal and

regulatory policy environment, the up-front need for publicly financed transportation infrastructure, government's progress cannot be measured by any one number. Its central development objective remains, however, the pursuit of balanced public policies which allow entrepreneurs to successfully compete and create wealth.

It has been noted that transportation is the key to development. A central issue, as always, is who pays for it. On the one hand, fiscal restraint and the ideology of laissez-faire may be seen to argue against massive public investments in advance of development. A reactive transportation policy based upon such a laissez-faire approach and employing traditional concepts to evaluate economic development opportunities may satisfy the economic purists but in most cases would not further the national and northern objectives described above. On the other hand, a pro-active approach in which very large public expenditures are made in the hope that opportunities may materialize some day, would undoubtedly encourage development, but at a prohibitive cost.

Government can no more sustain unlimited financial exposure than industry can operate in an environment of uncertainty. Industry regards the up-front expenditures for the development of transportation infrastructure as highly risky. It is therefore understandable why corporate decision makers would wish to transfer this risk to the public sector. In short, they regard this as a corporate risk, but expect government to view it as an

investment. It should therefore be understandable why guardians of the public purse would similarly like the private sector to commit to an investment before the taxpayer is asked to provide support.

This chicken-and-egg dilemma can only be broken if all parties realize that they have a common interest in reducing uncertainty and sharing irreducible risks. Such an objective will not be attained through motherhood statements about partnership or the sophisticated use of economic and financial techniques only. It can only be brought about if all major stakeholders, business, labour and governments are prepared to systematically exchange information and coordinate their long range plans.

The recent experience of the Department of Indian Affairs and Northern Development working closely with northern mineral industry on both a wide range of policy issues and in specific problem areas has been encouraging. Similarly, the introduction of the so-called "single window" approach through the Canada Oil and Gas Lands Administration (COGLA) under the Departments of Indian Affairs and Northern Development, and Energy, Mines and Resources, has also suggested avenues for nurturing future cooperative relationships. The real test, however, will come in the future when mineral markets rebound and northern oil moves to market.

Our capacity to plan and deliver transportation systems for mineral and hydrocarbon development will be the acid test of our capacity to manage northern resources in the northern and national economic interest.

THE INFLUENCE OF THE CLOSURE OF THE URANIUM CITY MINE ON LAKE ATHABASCA REGIONAL TRANSPORTATION

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INTRODUCTION

The purpose of this paper is to examine the process of making major alterations to a regional transportation system. In so doing the paper provides some insights into the responsibility of the various groups and agencies, including the federal and provincial governments, private industry, and the public, and examines the nature of federal obligations to transportation whether based upon legislation or arising out of historic involvement.

A further purpose is to examine the regulatory role of the federal government, and the degree to which such regulation, in itself, constitutes a commitment to ensure that transportation services are provided to meet the needs of the public.

As part of these considerations, the paper also highlights a number of complex economic and policy issues. These include the question of the degree to which isolated communities should be expected to bear the full cost of the transportation services that support them, and the degree to which federal or provincial governments should support such services through funding or other means. In addition, the paper touches upon the role of Crown Corporations in the fulfilment of federal obligations and objectives.

The regional transportation system discussed in this paper is a remote one, straddling the Alberta/Saskatchewan border near its northern end at 60°N latitude (Fig. 1). It includes a number of small communities and also, most importantly in the context of this paper, the town of Uranium City. It was the closure, in 1982, of the last and largest mine there that precipitated the transportation problem discussed in this paper.

BACKGROUND

Historical Review

In order to have a full appreciation of the nature of the transportation problem and the federal government's obligations for its resolution, it is necessary to have an appreciation of how transportation services to the region have evolved.



Figure 1

MACKENZIE - ATHABASCA WATERWAY

The Athabasca waterway has played a major role in freight transport to northern Canada at least since 1884. In that year the Steamer "Grahame" began to operate from Fort McMurray to Fort Fitzgerald[1] on the Slave River north of Lake Athabasca (Fig. 2). At Fort Fitzgerald, northward bound freight was unloaded and from there hauled around the rapids on the Slave River into the Mackenzie River system.

The extension of the Northern Alberta Railway to its Waterways terminus at Fort McMurray and the growth of mining and other activity through the 1930's on Great Bear Lake, Great Slave Lake, and Lake Athabasca encouraged a growth in river traffic. The Northern Transportation Company Limited (NTCL), began serving the region in 1931 as a private company under the name Northern Waterways Limited.

The major federal involvement began following World War II. It grew out of a Canada-U.S.A. agreement for development of the oil field at Norman Wells, Northwest Territories, as a source of petroleum products for use in the defence of Alaska. Marine equipment brought in by the U.S. military for transport of materiel to Norman Wells in 1942 proved to be too deep draft for efficient use on the Athabasca River and the next year, selective dredging began. In 1946, the first Public Works Canada dredge was put into service on the river.

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1. Current maps refer to this locality simply as Fitzgerald

Figure 2

STUDY AREA-REGIONAL SETTING



LEGEND

Road

Rail

Scale

0 50 100 200 Miles

Also during World War II, NTCL became a federal Crown Corporation when its parent, Eldorado Nuclear, was expropriated by the federal government under the War Measures Act. Eldorado subsequently developed the mine at Uranium City. NTCL, meanwhile, developed largely independently to become the dominant freight carrier on the Athabasca-Mackenzie waterway.

Post-war inflation and the consequent increases in rates for water-borne freight on the Athabasca-Mackenzie system led to the entire waterway being placed under federal economic regulation with the extension of the Transport Act to the region. This was done by Order-in-Council in 1946. Entry and rates have since been regulated by the Water Transport Committee of the Canadian Transport Commission (CTC).

Until the late 1940's the Athabasca-Mackenzie waterway was the sole surface freight route into the north for provision of supplies and support of mining activity. This began to change in 1948 with the completion of the Mackenzie Highway from Grimshaw, Alberta, to Hay River, Northwest Territories. It culminated in 1962 with the effective separation of the two waterway systems following construction of the Great Slave Lake Railway and the consequent establishment of a marine terminal at Hay River. The new terminal obviated the need to circumvent the long rapids on the Slave River and the Athabasca became essentially an independent operation with no further through traffic to the Mackenzie system.

Freight Transportation in 1982

In addition to air transport which has carried about 1,500 tons annually in recent years, surface freight transportation to the Athabasca Region has been provided via three main routes -- the Athabasca waterway and two winter roads. On the northwest side of Lake Athabasca, Parks Canada and the Alberta Government cost-share a winter road to Fort Chipewyan. The 35-mile winter road extends from the southern extremity of a road which loops through the northeast corner of Wood Buffalo National Park. About 1,000 to 1,500 tons of freight, mostly petroleum products, move over the road during the two-month period when ice bridges over the major rivers can support heavy trucks. In total, the road is open from mid-December to late March for passenger cars and sees substantial use by such vehicles. The road is of a high standard and the 105-mile distance between Fort Chipewyan and Fort Smith, at the northern extremity of the loop road, can be driven in about 2½ hours.

In Saskatchewan, the provincial government has, since 1977, provided a 120-mile winter road from the north end of Highway 155, at Cluff Lake, to Uranium City. The purposes of the road were to make winter transportation available and to provide an opportunity for Saskatchewan businesses to supply goods to Uranium City. Traffic peaked in 1979 at 5,000 tons but declined to 1,800 tons in 1981. Driving time from Cluff Lake to Uranium City is about five hours.

Over 85 percent of the freight moving into the region has been carried by NTCL's tug and barge service out of Fort McMurray. In the five years prior to the closing of the Eldorado mine, traffic averaged 70,000 tons per year, about 60 percent being petroleum products in bulk. During this period, the Uranium City area and the Eldorado mine accounted for about 73 percent of the freight cargoes moved by NTCL. This indicates how clearly, since the establishment of Lake Athabasca as a transportation system separate from the Mackenzie River, the key factor providing for its economic viability has been the mining industry activity at Uranium City.

From time to time small marine operations have also served the region. In recent years these have been Pine Creek Construction Ltd., out of Fort Chipewyan, Alberta, and Norsask Marine Ltd. out of Uranium City. Each has operated one tug and one barge. In 1983 a new carrier, A. Frame Construction Ltd. operated in partnership with Norsask, primarily to carry salvage from Uranium City.

In support of the NTCL operation and of the other small carriers, the federal government has provided dredging services on the river and an extensive system of navigation aids. This in addition to its normal country-wide provision of dock facilities. The dredging and navigation aids programs have, as an operational objective, the marking of four feet of water depth.

Federal Policy Perspective

An important feature of the historical development of the waterway transportation system has been gradual evolution of federal participation, to the point where the federal role and influence have become extensive. This gradual evolution appears to have occurred without any conscious examination of the appropriateness of such an involvement.

Federal participation has prevailed in three areas:

(a) The major carrier is a federal Crown Corporation.

(b) The support services, specifically dredging and navigation aids, have not only been provided by the federal government, but such provision has been at no charge to the users.

(c) The federal government has chosen to regulate transportation activity through application of the Transport Act.

(a) Northern Transportation Company Limited.

NTCL, as indicated earlier, was formed in 1931 to operate between Fort McMurray, Alberta, and Aklavik, Northwest Territories. The reopening of the Port Radium mine and the initiation of the Canol project during World War II led to a considerable expansion in NTCL's activity. On completion of these projects the Company continued carrying commercial freight on an ever expanding scale.

Although establishment of alternative rail and road routes to Hay River, negated the need for the Slave River route to the Mackenzie Valley, continued expansion in mining and other activity in the Athabasca and Mackenzie

regions led to parallel expansion in NTCL facilities and equipment, all duly licensed by the Canadian Transport Commission in response to the clear need for transportation services.

It is important to appreciate that such responses to transportation demand made by NTCL were essentially commercial decisions based on the economic circumstances prevailing at the time. However, part of its activities involved carrying freight for people resident in the numerous small communities. This led to a general acceptance, both by the company and by the federal government, that NTCL did indeed have obligations with respect to provision of freight services to such users.

In spite of this general acceptance, however, there is no record of any directives issued by the federal government to NTCL in respect of community resupply objectives nor imposed on it by the Canadian Transport Commission. Similarly, although the company saw community resupply as its corporate responsibility, at no time did it articulate this definitively and formally.

The closing of the mine at Uranium City precipitated a number of issues relating to NTCL. First, the Company concluded that the level of service that it had provided could not be maintained without payment of a subsidy. While the issue of subsidy payment served initially to focus attention on the apparent need for increased federal expenditures, it quickly led to an examination of the whole question of the federal government's responsibility to

ensure transportation services in the region. As noted above, although NTCL had chosen to provide services to communities, there was in fact nothing in any legislative mandate or stated obligation which compelled it to do so. This is particularly relevant when one recognizes that, unlike the Mackenzie River, which is located in the federally administered Northwest Territories, the Athabasca system is totally within provincial domains.

(b) Provision of Marine Services

The question of support services to marine transportation is no less obscure. As indicated, dredging of the Athabasca River was first undertaken during World War II in support of the war effort. It has continued ever since, under the direction of Public Works Canada, in support of the considerably expanded transportation traffic. While under the Public Works Act, that Department is authorized to undertake federal projects in support of navigation, nothing in the Act indicates under what circumstances there exists an obligation to do so. Dredging funds for the Athabasca Region, and hence operations, continued to be provided largely on the basis of historical precedent. The longer that this practice continued the more justifiable it appeared that it should continue. It was only in 1982, when the federal dredging program responsibility was transferred to Transport Canada, that a fresh examination of the justification for dredging of the Athabasca River was undertaken. It was coincidental, but perhaps propitious, that it occurred at the time of the mine closure. For the

federal government to expend in excess of $1.0 million in indirect support of the movement of some 70,000 tons of cargo constituted a substantial indirect subsidy. For the federal government to continue to do so in support of a projected movement of only some 10,000 tons raised even more serious questions as to its justification.

This has not, of course, been the only federal expenditure. Once dredged, the river has had to be marked with navigation aids. These have been provided and maintained each year by the Coast Guard. In a similar fashion to the Public Works Act, Transport Canada is authorized, under the Canada Shipping Act, to provide navigation aids. However, like dredging, there is nothing in the legislation giving guidance as to the circumstances under which these aids should or should not be provided. It has reasonably been concluded that if there is a need to dredge a channel, there exists a similar need to mark it, particularly in light of the transportation activity that such dredging allowed. In this respect the provision of navigation aids has leant upon the dredging activity for its justification. Annual expenditures for navigational aids have amounted to about $400,000, which again constitutes a very considerable indirect subsidy in support of the comparatively limited tonnage movement.

(c) Federal Regulatory Involvement

Another aspect which served to focus attention on the role and obligation of the federal government is its regulatory involvement, carried out by the Canadian

Transport Commission under the provisions of the Transport Act. As indicated earlier, the Act was proclaimed to apply to the Athabasca-Mackenzie waterway in 1946. At that time the primary purpose of the Athabasca system was to provide access to Great Slave Lake and the Mackenzie River. Because the Athabasca system was part of the access route, its inclusion in the regulated area was necessary. There is little evidence to suggest that any activity on Lake Athabasca at that time prompted consideration for regulation in its own right.

This being so, it would have seemed appropriate that, when alternative road and rail services negated the need for continued water-borne access to the Mackenzie River via the Athabasca system, the need for continued application of the Transport Act to that section would have been reviewed. However, there is little evidence that this in fact occurred, and carriers have continued to be licensed by the CTC to serve the Athabasca region. This is not to infer that such regulation may not be desirable or necessary, but only to indicate that apparently no conscious decision was ever taken in that regard.

A feature of the regulatory process that is worthy of note is that it concerns itself only with control of entry and conditions of service of interested carriers. This, of course, assumes that, as long as there is a transportation requirement there will be several such carriers willing to meet it. On the other hand, the Transport Act has, quite properly, no power to oblige carriers to offer services when none are interested. However, this results in a

regulatory "void", of special significance to remote regions where carrier interest may be limited. In this respect it may be regarded as irrational for the federal government to assume a regulatory role in the provision of transport services when carriers are prepared to offer them, but to abandon all interest if no carrier comes forward. If "public convenience and necessity" require that constraints be placed upon a particular carrier or carriers, then presumably "public convenience and necessity" requires at least one carrier in the first place.

In summary, therefore, the historical record of involvement of the federal government in marine transportation services to the area can be described as haphazard. It has nonetheless been ongoing and extensive. Under these circumstances it was concluded that, even if federal involvement had not been justified, it was not acceptable at this point to abandon the region to cope on its own. Instead, it was clear that the federal government had an obligation to lead in resolving the problem albeit attempting in the process to realign its involvement in a way that more appropriately reflected its obligations.

ANALYSIS OF THE TRANSPORTATION SYSTEM

The foregoing indicates that federal responsibilities, viewed in a narrow legal sense, are very limited. On the other hand, moral and historic responsibilities made it incumbent on the federal government to conduct an analysis of the situation in order to realise an appropriate resolution. What follows are the main elements of that process.

Users and Demand Forecast

Traffic into the region can be divided into two types, "Dry" and "Bulk". Dry cargo refers to items carried as deck cargo on barges. "Bulk" refers to petroleum products carried in tanks below deck.

The consignees constitute two groups: the communities in the region (Fig. 3), and the mining and tar sands activities. Exclusive of Uranium City the population of the region is primarily resident in the five communities tabled below.

TABLE 1

POPULATION OF THE ATHABASCA REGION

Community	1981 Population
Black Lake (Indian Reserve)	585
Stony Rapids	240
Fond-du-Lac (Indian Reserve)	510
Camsell Portage	60
Fort Chipewyan and Vicinity	1200
Athabasca River - Rural	225
	2820

Sources: Regional Socio Economic Assessment, Alsands Project Group; Athabasca Regional Service Study, UMA Group for the Governments of Canada and Saskatchewan.

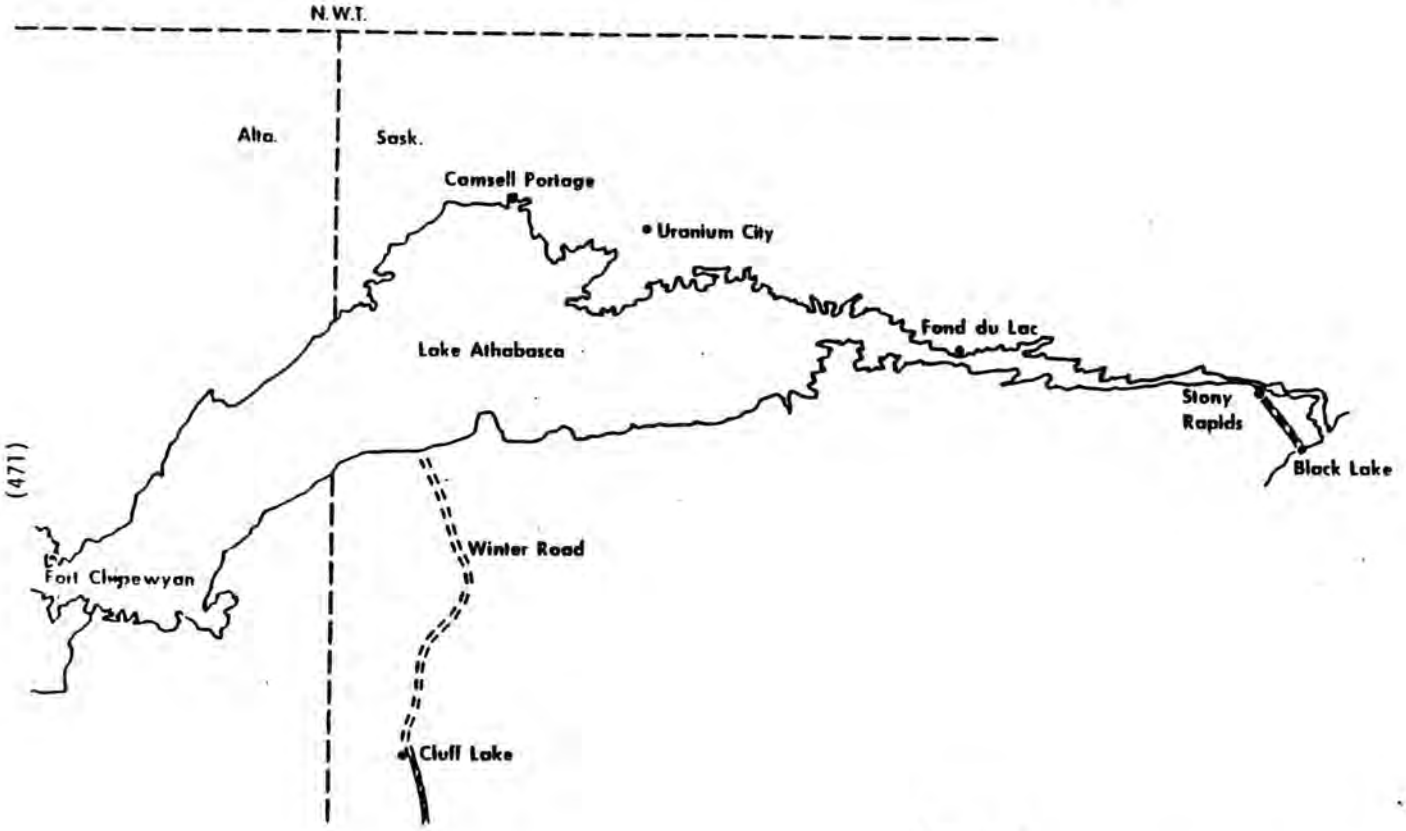


Figure 3

LAKE ATHABASCA COMMUNITIES

Prior to the closing of the mine, the population of Uranium city was 2,750 people. It was not possible to estimate with any certainty what the future population would be once mine salvage and clean-up operations were completed in 1984. It had, however, been estimated that, in the absence of government action (either compelling people to move or giving the community a regional government service centre role), the population would stabilize at about 165 people[1].

In early 1983, the Saskatchewan Government did announce that Uranium city would indeed be a government service centre. However, to date there has been no indication as to what services would be available there. It had been estimated that, as a regional service centre with the required range of hospital and educational services, Uranium City would have a permanent population of about 400 people[1]. It would also have above-average freight requirements because of the concentration of institutions (hospitals, schools) and the transient population that would be using them. Nevertheless, it was clear that it would still constitute a dramatic reduction in freight demand from the situation that existed prior to the mine closure.

Historical and community data suggested that over the next five year period, the demand for freight by the communities was likely to be in the order of 10,500 tons

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1. 1983, Athabasca Regional Services Study, the UMA Group, for the Governments of Canada and Saskatchewan.

annually, plus the demand in Uranium City. The demand, by community, was forecast to be as follows:

TABLE 2

Forecast Freight Demand(1)

(Tons)

	Bulk	Dry
Fort Chipewyan	2,800	3,000
Camsell Portage	100	50
Fond-du-Lac	200	500
Stony Rapids/Black Lake(2)	2,200	1,700
TOTAL	5,300	5,250
Uranium City (service centre)	1,000	1,200
Uranium City (local centre)	200	150

(1) Rural residents along the Athabasca tend to use contract (air) or private (boat) carriage for their freight needs.
(2) Transportation facilities are at Stony Rapids with a year-round road to Black Lake.

In addition to community resupply requirements, there was, in the past, a freight demand generated by mining exploration and tar sands development. With completion of a bridge across the Athabasca near Fort MacKay, all the area with tar sands development potential is now accessible overland. Mining exploration has declined sharply with the decline in demand for the region's main mineral, uranium, and now generates little freight demand.

Finally, it was noted that a proposed major dam project on the Slave River was currently under study. Its timing was speculative but if it did proceed it would generate a freight demand of 520,000 tons over a ten-year

period dwarfing community demands and requiring a re-evaluation of current infrastructure.

Possible Additional Transportation Elements

In addition to the transportation facilities and services currently available to the region, a number of additional routes and systems were identified that could be put into place within a short time frame as alternatives to the NTCL service out of Fort McMurray. All- weather roads were not considered since such additions would take in the order of seven years to plan and construct.

(a) Rabbit Lake-Black Lake Winter Road. The Saskatchewan Government had done preliminary planning for a winter road extending from Rabbit Lake, near the terminus of Highway 105, to Black Lake, at the east end of Lake Athabasca. A system of ice roads to connect the Saskatchewan communities on the northeast shore of Lake Athabasca was also concluded to be feasible.

The Rabbit Lake-Black Lake winter road would require a capital investment of $3.6 million and carry an annual operating cost of $320,000. An ice road system to connect to the other Saskatchewan communities on Lake Athabasca would require a further $300,000 in capital and $550,000 in annual operating costs.

(b) Marine Terminals - Peace and Slave Rivers. Two potential terminal sites were identified in Alberta north of Lake Athabasca. Carlson's Landing on the Peace River and Fitzgerald on the Slave River had served as marine terminals in the past and, at least technically, could do

so again, in a significant way, with minimal expenditures for dock facilities.

Carlson's Landing is at the southern end of the loop road through Wood Buffalo National Park. The use of the loop road by substantial volumes of commercial truck traffic and indeed the use of Carlson's Landing would be contrary to Parks Canada policies and objectives for the park.

Fitzgerald is located 13 road miles south of Fort Smith. When NTCL served the Mackenzie Valley from Fort McMurray, prior to the establishment of a marine terminal at Hay River, Fitzgerald served as the terminal at the southern end of the portage around the rapids on the Slave River. With the cessation of barge traffic, the community has virtually disappeared. However, a good dock and terminal area remain. These are owned by the federal government.

Even though loaded barges would have to move upstream on the Slave River to reach Lake Athabasca, Fitzgerald is the better site. As well as being outside the park, it has better water depths, (loadings at Carlson's Landing would be constrained during the low water period in late summer and fall) and is closer to Fort Smith with its pool of labour, equipment and services.

(c) Marine Terminals - Athabasca River. Terminal potential north of Fort McMurray on the Athabasca River was also examined. The all-weather road system in northeastern Alberta extends about 70 kilometers north of Fort McMurray

on both the east and west sides of the Athabasca River. A number of small terminal sites are available, but, because the river banks are steep, access to them is difficult. Additionally, the sites are subject to large water level fluctuations.

From a marine operations standpoint, dredging and navigation aids would be required north of any Athabasca River terminal if the river were to be used for commercial shipping.

(d) Marine Terminals - Lake Athabasca. Such terminals would be connected to the southern supply sources by winter roads. Goods would be brought in over the winter road and stored for about three months until the navigation season opened.

(e) Air. As a result of an early freeze-up in 1981 terminating marine operations, substantial quantities of bulk petroleum had been flown into Fort Chipewyan. Moreover, most perishable food currently enters the region by air. Rate considerations aside, use of the air mode could be expanded.

It was noted that both Fort Chipewyan and Uranium City have 5,000 foot long paved air strips capable of handling large cargo aircraft. On the other hand, the air strips at Camsell Portage, Fond-du-Lac, and Stony Rapids are gravel and 2,300 feet, 3,000 feet, and 4,400 feet long respectively. These strips would have to be upgraded or landing strips on the lake ice would have to be constructed if large freighter aircraft, such as Hercules, were to be used. No

estimate of the cost of upgrading the landing strips is available but ice strips could be constructed annually at a cost of about $10,000 each.

An indication of costs to Alberta consignees is available from the 1981/82 experience when large volumes of bulk fuel were airlifted into Fort Chipewyan using Hercules aircraft. According to Gulf Canada Limited, the cost was 21 cents per litre. This compares with the 1983 rate of 3 cents per litre by barge. Similarly, air freight on a non-priority basis is 21 cents per pound as opposed to 2.6 cents per pound by barge. These differences in transportation costs would not be offset by savings in inventory costs, especially if two season transportation service to Fort Chipewyan (winter road, summer barge) continued to be available.

(f) Non-Transportation Alternatives. Over one half of the marine cargo to Lake Athabasca communities in Saskatchewan is bulk petroleum. Most of this is diesel fuel used for heating and for generating electric power.

It was determined that consideration is being given to construction of a power line from the 29 megawatt hydro generating station near Uranium City to the Rabbit Lake mine, about 100 miles south of the east end of Lake Athabasca. The line could be routed to provide hydro power to Camsell Portage, Fond-du- Lac, Stony Rapids and Black Lake, thereby reducing the need for bulk petroleum by approximately 1,000 tons. The cost of this project is estimated to be in the order of $10-20 million.

FINANCIAL ANALYSIS

Government Costs

A summary of government costs attributable to the current system is tabled below. Additions or modifications to the system would, of course, result in different costs. Some of these were described in the previous section.

TABLE 3

SUMMARY OF GOVERNMENT COSTS

Federal	
Athabasca River Dredging	$1,000,000
Athabasca Navigation Aids	400,000
Fort Chipewyan Winter Road	32,000
Provincial	
Fort Chipewyan Winter Road (Alta)	$ 6,500
Uranium City Winter Road (Sask.)	350,000

Source: Public Works Canada, Parks Canada, Government of Saskatchewan.

System User Costs

The ultimate users of a seasonal transportation system incur two major types of costs: inventory costs and transportation charges.

Inventory costs consist of three components:

1. Cost of money
2. Insurance
3. Warehousing, (including facilities, operations and maintenance, and utilities).

Calculation of the first two components is straightforward. Calculation of warehousing costs is more complex and the calculated cost varies greatly from community to community.

Warehouse depreciation cost, for example, is simply a function of the character and age of the building while operating costs are, in many instances, an allocation between the warehousing and retailing side of an operation.

Annual warehousing costs for dry cargo were calculated at $60 per ton while insurance and the cost of money was calculated to be $49.20 per ton per month in Alberta and $37.25 per ton per month in Saskatchewan. This reflects different values of goods.

The second type of cost is the transportation cost. For this study these were calculated based on 1982 rates from a major distribution centre. Edmonton was selected for goods originating in Alberta and Saskatoon for goods originating in Saskatchewan.

NTCL's 1982 rates were as tabled below:

TABLE 4

NTCL RATES FOR 1982

Community	Bulk	Dry[1]
	($/ton)	
Fort Chipewyan	32.80	51.40
Camsell	50.60	77.40
Uranium city	50.60	77.40
Fond-du-Lac	62.60	92.00
Stony Rapids	66.20	96.80

1. The dry cargo rate was taken to be the general cargo rate with NTCL's $5.00 per ton terminal charges added.

Source: NTCL Tariffs.

For dry cargo, trucking from Edmonton to Fort Chipewyan over the winter road, and to Fort McMurray to interface with NTCL, was assumed to be at filed rates for truckload lots. These were $10.10 and $2.42 per 100 lbs. respectively. In reality, some traffic moves at contract rates and some at LTL rates; the truckload rate represents a compromise.

For bulk petroleum, the trucking rate from Hay River over the winter road to Fort Chipewyan was $0.043 per litre for diesel and $0.040 per litre for gasoline which is lighter.

For purposes of this analysis, 1982 trucking rates over hypothetical routes in Saskatchewan had to be established. These are tabled below.

Typical Saskatchewan Trucking Rates

	GVW (lbs.)	Dry (ton mile)	Petroleum (Litre/ 100 miles)
Normal highway	44,000	12.7¢	1.1¢
Northern all-weather	42,000	21.4¢	1.7¢
Overland winter road	42,000	28.6¢	2.3¢
Ice Road	42,000	40.0¢	3.3¢

Source: Government of Saskatchewan

It was recognized that bulk petroleum has to be transported from the refinery to the bulk dealer or wholesaler. However, in establishing the price at a particular bulk location, the oil company takes a number of factors into account and the wholesale price at a location could be more or less than the refinery gate price plus

transportation. In order to avoid speculating as to what bulk dealer prices resulting from market strategy decisions would be, rail rates were taken from Edmonton and Regina although it was recognized that in reality the price to consignees might have an element of cross-subsidization.

The rail rate used from Edmonton to Fort McMurray was $0.016 per litre, and from Edmonton to Hay River was $0.037 per litre. On the Saskatchewan side, the Regina to Prince Albert rail rate used was $0.016/litre.

Alternative Transportation Systems

Besides the established system involving marine transport out of Fort McMurray and winter roads to Fort Chipewyan and Uranium City, there are, as indicated earlier, a large number of other possible combinations of winter and ice road routes. As well, marine transport from alternative terminals could be developed in the short term. A summary of costs of those alternative systems originally considered to be most feasible technically and economically is given in Table 5.

From a federal perspective, the combination of a marine system operated from a terminal at Fitzgerald coupled with a new winter road to the east side of Lake Athabasca was considered the most attractive option because of the very considerable cost savings and the fact that it would serve to readjust the federal involvement to a level more appropriate to its formal obligations. An additional consideration was that residents at the east end of the

TABLE 5

TOTAL COSTS OF ALTERNATIVE TRANSPORTATION OPTIONS
1982 RATES AND COSTS, POST 1983 TRAFFIC
($'000 per year)

	Current System	Winter Roads [1]	Fitzgerald Based Marine Sytem[3]	Fitzgerald Marine and Black Lake Winter Road [5]
Government Costs				
Federal	1,432	32	132	132
Alberta	7	7	7	7
Saskatchewan	350	1,230[2]		680[5]
	$1,789	$1,269	$ 139	$ 819
Consignee Costs				
Fort Chipewyan	557	1,316	1,094	1,140
Cansell Portage	15	27	27	30
Fond-du-Lac	116	146	213	236
Stony Rapids/ Black Lake	480	553	904	553
SUBTOTAL	$1,188	$2,032	$2,238	$1,959
Uranium City Service Centre	305	527	631[4]	686[6]
NTCL Revenue Shortfall	885	-	-	-
GRAND TOTAL	$4,167	$3,836	$3,008	$3,464

1. Includes winter road to Fort Chipewyan and winter road to Black Lake with a connecting ice road to Fond-du-Lac, Uranium city and Cansell Portage.
2. This comprises $870,000 in winter road maintenance costs and $360,000 interest on $3.6 million in capital for the Rabbit Lake/Black Lake winter road.
3. Includes the winter road to Fort Chipewyan.
4. If there is no Uranium City traffic, other consignees would have to absorb $100,000 in additional marine transportation costs resulting from fixed costs being distributed over a small volume of traffic.
5. This comprises $320,000 for road maintenance and $360,000 interest on capital invested for the Black Lake winter road.
6. Without Uranium City traffic, an extra $165,000 in fixed marine transportation costs would have to be absorbed by other consignees.

lake had expressed a strong desire for a road connection, at least on a seasonal basis, to further their social and economic development. This option responded to their wishes.

Of course, it was recognized that the large and sudden passing of costs to Alberta residents and the Saskatchewan Government would not be welcome. Accordingly, it was proposed that the federal savings, amounting to some $1.0 million annually, resulting from termination of dredging on the Athabasca River be divided between the two provinces for a six-year period, to be used for transportation projects in the region. In the case of Saskatchewan, it was anticipated that funds would be used for the winter road to the east end of the Lake. It was also noted that continuing to provide the Cluff Lake-Uranium City road, at an annual cost of $350,000, did not seem to make economic sense and that, potentially, these funds could also be used to cover part of the costs associated with a Rabbit Lake-Black Lake winter road.

At this point, having reached conclusions about the appropriate transportation system and the financial implications, the federal government advanced the resolution of the problem from the analysis stage to the negotiation stage.

POLITICAL/ECONOMIC TRADE-OFFS

Positions of Interested Parties

There were essentially six groups with major interests in any adjustment to the region's transportation system. These comprised the Alberta and Saskatchewan residents served by the system, the federal, Alberta and Saskatchewan governments, and the City of Fort McMurray.

The interest of Fort McMurray needs some explanation. The town's concern was not, as one would expect, a possible loss of commercial activity, but rather the possible removal of dredging equipment. Many years ago, a causeway had been built for flood control purposes from an island at the confluence of the Clearwater and Athabasca Rivers to the mainland. This created a bay now referred to as "the Snye". The causeway eliminated a natural flushing action with waters flowing from the Athabasca, around the island into the Clearwater. The result was the development of a sand bar at the mouth of "The Snye". A culvert which had been put into the causeway to retain the flushing action failed to work properly.

In order to assist the town in preserving "The Snye" as a sheltered water area, the federal government, some 25 years ago, began clearing the sand bar as a "shakedown exercise" each spring prior to proceeding with the dredging required in support of commercial navigation. "The Snye" has, over time, been developed into the town's seaplane base and major boating and recreational area. While

municipal officials long had realized that the free dredging was not the long term solution, (indeed the whole of "The Snye" is slowly filling up), it had never quite got around to dealing with the problem.

"The Snye" situation is perhaps another micro example of how governments acquire historic and moral obligations. In any case, it became clear that the problem of "The Snye" was a sensitive issue. It had to be taken into account in resolving the problems associated with reduced resupply requirements in the region.

As far as most of the Saskatchewan residents were concerned, any proposal which would further development of a road to the east end of the Lake was satisfactory. On the other hand, Alberta (Fort Chipewyan) residents considered that any proposal that resulted in increased rates or reduced service was unsatisfactory.

As far as governments were concerned, Saskatchewan did express interest in entering into negotiations with respect to a winter road but these proved unfruitful. The province was unwilling to fund a share of the winter road's cost.

The Alberta Government took the position that the region's main transportation system should continue to operate from Fort McMurray. It also proposed that, to minimize rate increases, a private operator should

be provided with 10 to 15 acres of NTCL's waterfront land at Fort McMurray at nominal cost, and that NTCL equipment should be made available to such an operator at the lesser of market or book value. In Alberta's view, this proposal would result "in potentially the least added cost".

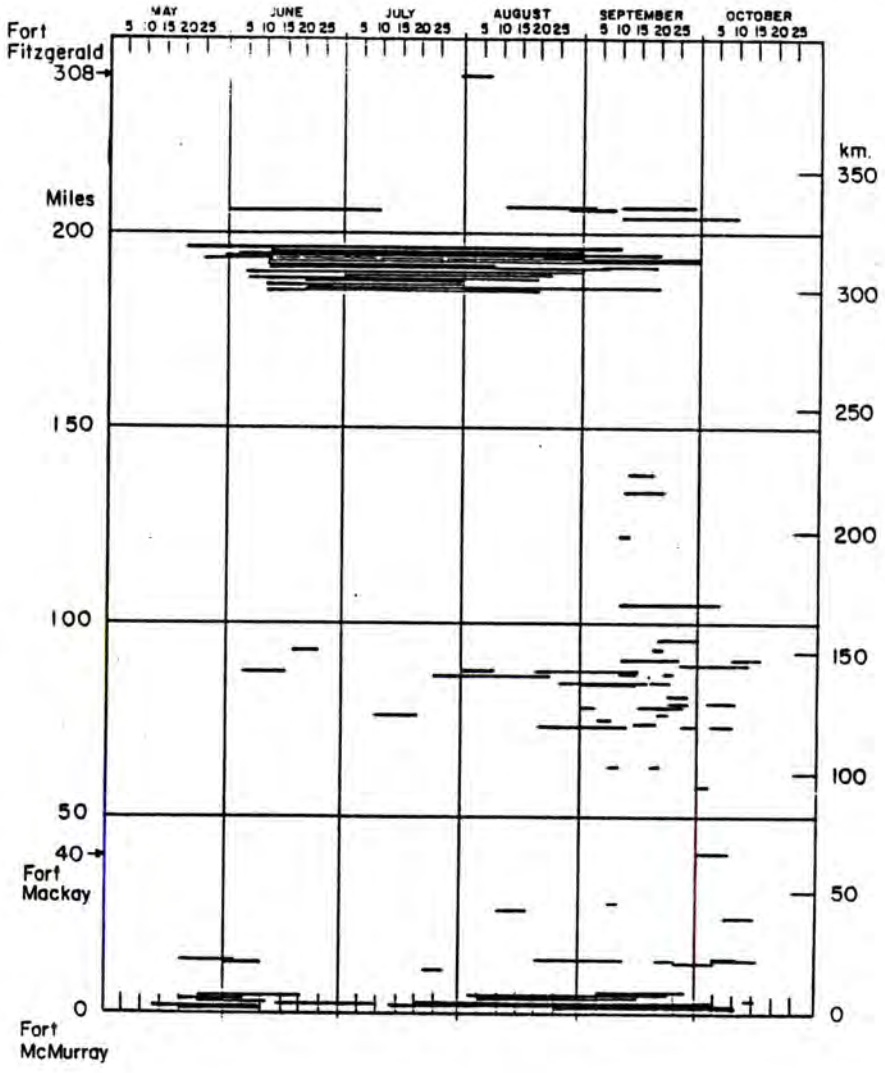
Resolution of Views

The elements of the acceptable solution ultimately developed out of proposals made by small carriers operating in the region. They suggested use of a landing site across the river from Fort MacKay about 40 miles north of Fort McMurray. This suggestion offered a number of appealing features. These included the fact that rate increases could be minimized and government costs for dredging and navigation aids could at least be reduced. As Figure 4 indicates, the bulk of the dredging requirement is in the Athabasca River delta, and between mile 0 (at Fort McMurray) and mile 30.

With no apparent likelihood of an agreement with the Saskatchewan Government on a solution which would see the area's wishes for a road to the east end of the Lake satisfied, the option preferred by the federal government was no longer tenable. On the other hand, the Fort MacKay option had the potential of satisfying the residents of Fort Chipewyan and at the same time, permitting continued use of Fort McMurray as a base for the dredging equipment. Thus the equipment would still be available to clean out the mouth of "The Snye" as part of the spring "shakedown".

Figure 4

ATHABASCA RIVER DREDGING ACTIVITY 1973-83



Each horizontal line indicates the time spent by a dredge at a particular location and includes any travel time associated with getting to the site. Some lines portraying activity near Mile 3 and Mile 188 are displaced for illustrative purposes.

Economic analysis indicated that, of all the alternatives, the use of the site near Fort MacKay could generate the smallest cost increases to consignees. (See Table 5, p. 28 and Table 6, p. 34). An analysis of the dredging operations also indicated that obviating the need to dredge south of Fort MacKay, coupled with reductions in standards for channel width in the rest of the River, would permit discontinuing the use of one of the two dredges in the system.

Ultimately, an agreement was struck between the Alberta and federal governments under which the Province would guarantee a road connection down the steep river bank between the nearest provincial highway and the terminal (roads normally being a provincial responsibility); and the federal government would guarantee a dock area. (Such facilities are normally provided by the federal government.) The Alberta Government also agreed to ensure that the proposal was acceptable to its residents and that the site was unencumbered by Native land claims. The Province of Saskatchewan also indicated that it would support the proposal. In light of the above, the federal government confirmed its acceptance of the site near Fort MacKay as the best compromise between social and economic considerations.

As with its previous proposal, the federal government expressed a willingness to direct its savings during the six-year period to improving transportation facilities in the region.

TABLE 6

TOTAL COSTS FORT MACKAY BASED MARINE SYSTEM

($'000 per year)

Government Costs	
Federal	$1,050[1]
Alberta	20[2]
Saskatchewan	-
	$1,070

Consignee Costs	(High)[3]	(Low)[3]
Fort Chipewyan	899	706
Camsell Portage	24	18
Fond-du-Lac	213	152
Stony Rapids/Black Lake	814	611
SUBTOTAL	$1,950	$1,487
Uranium City Service Ctre	553	404
GRAND TOTAL	$3,573	$2,961

1. Includes $30,000 interest on $300,000 capital investment in a dock.
2. Includes $12,500 interest on $125,000 capital for road to Fort MacKay terminal and $7,500 maintenance cost for Fort MacKay terminal road and Fort Chipewyan winter road.
3. Depending on cost of available marine equipment and the requirement for fixed facilities such as warehousing.

IMPLEMENTATION

Although the consultation and negotiation processs resulted in a solution which was economically and politically acceptable, there were still a number of steps required in order to make it work. In this respect, there were two main aspects: government services and regulatory matters.

Government Services

From the federal perspective, an acceptable proposal had to go some way toward bringing federal costs in line with federal responsibilities. The negotiated solution had the potential for reducing dredging costs immediately, and also served notice that there would be another review in six years.

The annual costs associated with the dredging operation have been approximately as follows:

$325,000 for each of two dredges;

$200,000 for a boat, the Atha, used principally for snag clearing but also providing general support services;

$150,000 shore and general expenses.

It will be appreciated that, broadly speaking, costs can only be reduced by one vessel increments.

Operating plans for 1984 call for laying up one of the two dredges. This is made possible by the elimination of dredging south of Fort MacKay and the reductions in service north of that point. While with two dredges a 200-foot wide channel could be maintained, with one dredge, only a

100-foot wide channel will be provided and channel closures caused by silting, after a major storm for example, will take longer to reopen. It will also require a shortening of the navigation season since one dredge cannot keep the river open through the low water period in October.

The elimination of dredging south of Fort MacKay will also create a difficulty with respect to the navigation aids maintenance vessel Miskanaw. Because it has equipment and facilities, Fort McMurray is the optimum place to over-winter the vessel. On the other hand, the vessel requires the same channel depth as a barge tug and, as things stand, will not be able to traverse the undredged section of the river south of Fort MacKay during periods of low water. This is the second reason why the 1984 navigation season will close at the end of September, rather than in late October as it has in the past.

Further savings will be generated by discontinuing use of the Atha and reassignment of snag clearing to the navigation aids support vessel. The scope of snag clearing operations will also be reduced, and the practice of cutting down on shore trees which could potentially fall into the river will be discontinued.

Regulatory Matters

By mid-1983, federal government analyses had begun to indicate that viable alternatives to a marine system requiring a terminal at Fort McMurray and high cost government services did exist. However, as noted previously, the federal government had no regulatory power

to ensure that a marine operator would come forward to provide an alternative service. In recognition of this, and accepting the shortcomings of the Transport Act, the Minister of Transport had asked the CTC to canvas current and potential operators to determine the level of interest which might exist for replacing the current services out of Fort McMurray with similar services, beginning in 1984, using the original federal choice of Fitzgerald on the Slave River as the terminal.

Only the carriers operating in the Athabasca region expressed interest. Northern Transportation Company Limited indicated it was interested only if a subsidy were available. Subsequently, it informed Transport Canada that, to provide service out of Fitzgerald, the company would require about one-half of the reduction in federal expenditures that would result from a termination of dredging and navigation aids programs. In other words about $700,000.

By late summer of 1983, the possibility of timing difficulties with regard to carrier licensing was becoming evident. On the one hand, negotiations among governments and residents were still going on with respect to a revised regional transportation system. On the other hand, marine equipment, other than that owned by NTCL, was limited and NTCL had already indicated that it foresaw using its Athabasca equipment in the Mackenzie system. Thus, it was probable that a new carrier would have to bring equipment in from elsewhere, likely from the Mackenzie River system, and this would have to be done before freeze-up.

In the light of these difficulties, the Committee requested applications to serve the region from an unspecified terminal. Even so, it soon became clear that the process of analyzing and verifying licence applications would not result in an award before winter. However, the problem of a potential equipment shortage was averted when NTCL was able to agree to a suggestion by the federal Minister of Transport that it over-winter its equipment in the Athabasca system until 1984 as a contingency measure.

In January, 1984, after a one-day hearing at Fort McMurray, the Water Transport Committee issued licences to three applicants. The carrier selected to provide scheduled service, that is to replace NTCL who did not apply, was A. Frame Construction Ltd. The Committee also licensed A. Frame, Pine Creek Construction Ltd., and Norsask Marine Ltd. to provide unscheduled service. An application from a fourth carrier, Western Shipping Calgary Ltd. was denied.

In coming to its decision, the Committee had to deal with two difficult matters: shipping capacity and the question of competition.

Demand for barge transportation in the Athabasca region tends to be bimodal with peaks in the spring and fall. The Committee's analysis indicated that while A. Frame Construction Ltd. did have sufficient equipment available to provide essential services at the opening of the navigation season, it might not be able to respond fully to total early season demand. However, as the season progressed, and equipment it had available in the Mackenzie

system was brought into the Athabasca, A. Frame would have sufficient capacity, over the shipping season, to handle all forecast 1984 traffic. Nevertheless, the NTCL equipment that had been left to over-winter in the region provided welcome insurance, especially when, in late February, the Alberta government made it known for the first time, that it wished to ship over 4,000 tons of freight for infrastructure projects to Fort Chipewyan as soon as the navigation season opened. A subsequent lease agreement between NTCL and A. Frame Construction Ltd. obviated the problem.

In denying the Western Shipping application, the Committee expressed its views on competition. The Province of Alberta, in its intervention, proposed that as many carriers as sought to do so, be licensed and permitted to compete. The Committee rejected this view and took the position that under foreseeable commercial circumstances, competition in the normal sense was unworkable in the Athabasca region and that community resupply transportation service should be provided by one general carrier.

In its decision, the Committee stated that, in its view, competition could only apply readily in cases where:

(a) a high volume or a variety of commodities were moved;
(b) carriers had adequate, if not equivalent, strength;
(c) a range of modes or combination of modes was "available as required more or less any day in the year".

The Committee concluded that such an environment did not exist on the Athabasca waterway.

CONCLUSION

This paper reports on the nature of a transportation problem that arose and the various actions that were taken to resolve it. The timing of the paper's presentation has, of course, precluded any report on success or failure. Nevertheless, in reviewing the events that occurred and the actions that were taken in response to those events, a number of conclusions can be drawn.

(a) The solution is not a panacea. The first important point to appreciate is that the resolution to the problem is not seen as a panacea for all the transportation and other problems created by the closure of the Uranium City mine. For a transportation system there is a normally a direct relationship between the quantity of tonnage moved and the level of service that can economically be offered to users of the system. There is no exception here. With a 70 percent reduction in demand, the cost per ton for the remaining tonnage must rise dramatically or levels of service must fall. At issue is the degree to which each of the interested parties - governments, shippers, or consignees should absorb the additional cost or accept a lowering of levels of service. Whatever the resolution, there is bound to be some economic hardship and dissatisfaction with a less efficient and comprehensive service. It is hoped that the proposed resolution provides a satisfactory compromise which balances the needs of users and the obligations of the providers of the service.

(b) Resource-based northern transportation systems are sensitive to change. The impact of the closure of the mine at Uranium City on the transportation services to the area serves to highlight how sensitive certain northern transportation routes are to changes in economic circumstances. Northern supply routes are frequently characterized by a single mode with a single major carrier whose commercial success is built upon the full spectrum of types of freight transportation demand. Where community resupply activity makes up the major part of such demand, then it tends to be relatively stable. However, in those circumstances where a major proportion of it stems from resource related activity, demand may be much more volatile, and the transportation system much more vulnerable. This was, of course, the situation in the Lake Athabasca region.

(c) Historic involvement as much as legal responsibility dictates obligations. The federal involvement in Athabasca Region transportation has been continuous and extensive despite the lack of any clear legal obligation. Such an involvement has generated its own historic obligations to an extent that it is no longer an option for the federal government to revert, immediately, to the limited scale of involvement required by law. Thus, failure to recognize past changes in circumstance and to implement appropriate responses to those changes is now resulting in what could be argued as legally unjustified federal expenditures. This circumstance highlights the need to ensure that

government involvement in transportation activities is continuously monitored to ensure that it is both necessary and appropriate.

(d) Government-provided support services create demand distortions. Government provision of free services to a particular transportation system results in that particular system becoming more attractive than other non-supported alternatives. This can be carried to the point where such alternatives may well be discarded. Government support thus becomes an essential element, if not the dominant factor, in the establishment and continuation of the major route into a remote area.

(e) The economically most attractive solution may not be the most attractive politically. Arising out of (d) above, it is clear that federal involvement in the form of support of the transportation system created expectations in the beneficiaries of that support. Any attempt to realign the nature and scope of federal involvement that has the effect of reducing support, (whether or not such reduction is perfectly defensible from legal and economic considerations) is bound to be strongly and vocally resisted by such beneficiaries. In this respect, the optimum solution is clearly a balance between economic considerations and political expediency. This conclusion has, of course, more universal application!

CANADIAN EXPORT OF LNG

T.J. ANDERSON

MELVILLE SHIPPING LTD.

CALGARY, ALBERTA

This paper will discuss the feasibility of export of liquified natural gas (LNG) from Canada. Particular emphasis will be placed upon the transportation issues involved, but all aspects of the business will be discussed in limited detail.

CANADA'S RESERVES

The fundamental issue which must be discussed prior to getting into the natural gas export issue is the availability of gas in excess to Canada's domestic needs. A comprehensive accumulation of data regarding reserves, production and Canada's demand was performed during the 1982 National Energy Board Omnibus Hearings. At these hearings the Federal government was reviewing 16 applications to export gas from Canada and in addition it was to re-evaluate its policy with regard to determining surplus quantities. As a result of these hearings the Board adopted a more flexible attitude with regard to what amounts represented surplus quantities and granted licences to export 325 billion m^3 (12.2 exajoules) of western Canadian gas. By far the most significant event at these hearings was the granting of a licence to Dome Petroleum Limited to ship 64.2 billion m^3 (2.4 exajoules)

to Japan. This was the first time the Board had given approval to export gas to a country other than the United States as well it was the first time the transportation of the gas was to be by ship.

Figure 1 presents the supply and demand for Canadian gas as determined by the NEB Hearings and it was on this basis which the Board evaluated the merits of each proposal to determine who were issued licences to export and the maximum quantities which they could sell.

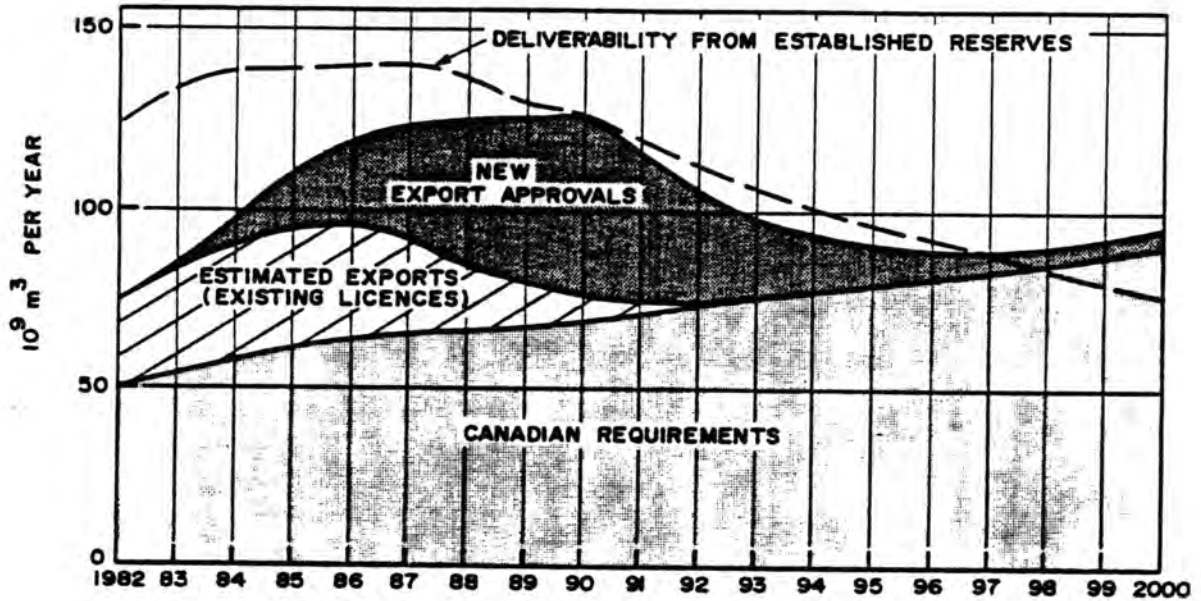
WORLD ENERGY DEMAND

It would be outside the scope of this discussion to fully develop the many different scenarios which would need to be developed for each buyer of Canadian gas in order to determine the quantities which we could export. Although Canada's major market will quite obviously always remain the United States, other potential buyers have identified themselves as being interested in purchasing Canadian gas. Japan, Korea, United Kingdom, France, Germany as well as the U.S. and others are interested in our gas for their own specific reasons. In general they all have the following in common:

- They see Canada as a secure supply.
- All are either currently in a net import position or will be heavily reliant upon imported gas within the next 5-10 years.
- Canada's political environment is much more stable than some other countries which have excess supplies of gas.

FIGURE 1

DELIVERABILITY APPRAISAL



(500)

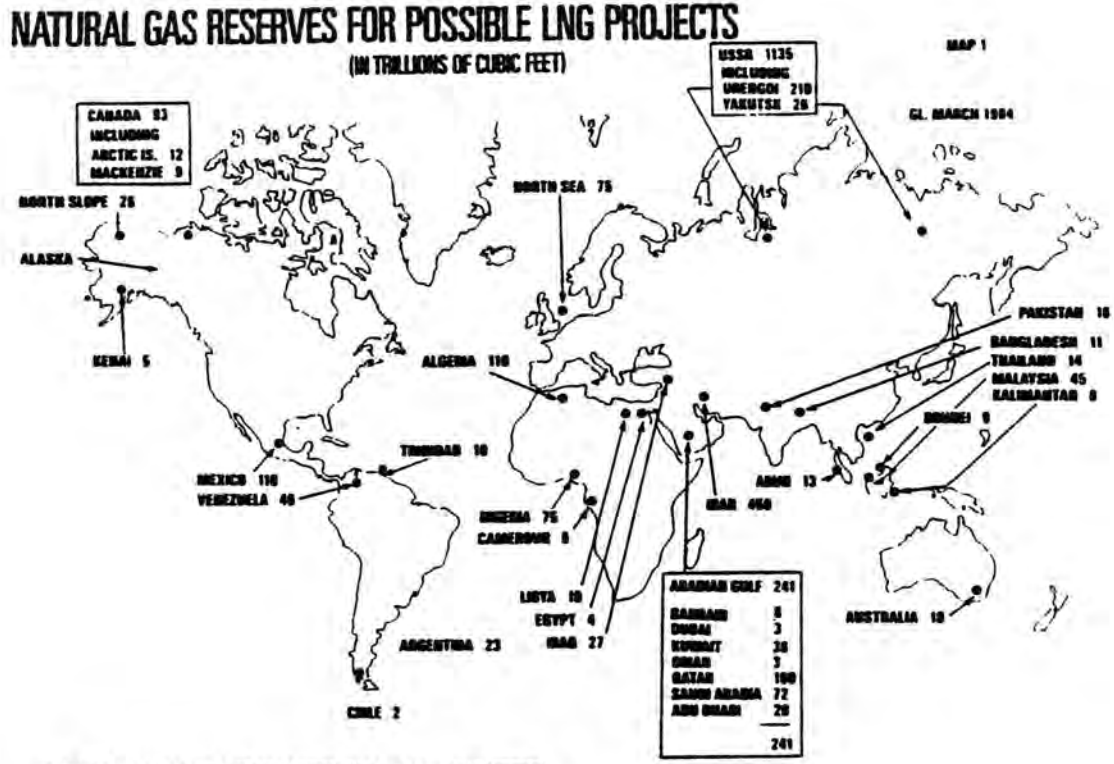
World demand becomes very difficult to ascertain as there are so many variables which must be considered. Some of these are:

- Politics
- Natural Gas vs Oil Mix
- Pricing Policies
- Perceived Supply
- Alternate Energy Sources
  - Electrical
  - Coal
  - Nuclear Power

These factors are difficult to analyse on their own, but become unmanagable to accurately predict how each will effect the others and ultimately natural gas demand in the future. The present world gas supplies are presented in Figure 2, this shows the amount of gas which is available from each of the major gas producing nations. In light of past events in the energy market buyers are attempting to diversify supply to ensure more consistant deliveries during time of political unrest and the irregular supply which seems to be most prevelant in the major energy producing nations.

The two buyers which are currently most interested in Canadian gas are the United States and Japan. These countries are both currently importing gas and are looking to secure supplies to satisfy their future requirements. Both have had continuing discussions with Canadian suppliers and in the case of Japan hope to add Canada to their current sources of LNG.

FIGURE 2



SOURCE: GOTAAS LARSEN 1984 SHIPPING REVIEW

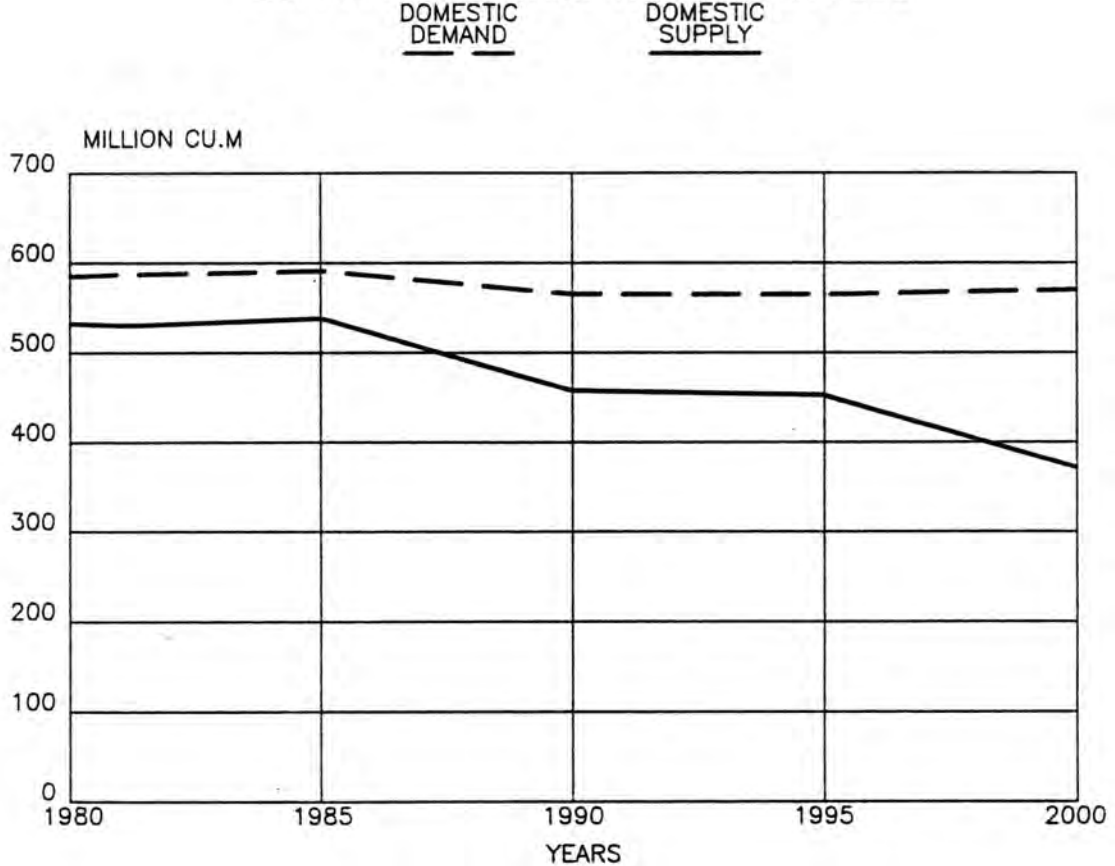
The United States' demand is most important to Canada as they have to be our geographically preferred customer. Pipeline and gas gathering systems have been developed over the years which facilitate easy delivery to U.S. destinations. To contemplate sales off the North American continent obviously requires a more sophisticated transportation system and must present immediate benefits to Canada which counter the enormous capital investment required to facilitate the offshore exports.

Figure 3 present the internal production in the United States as well as a prediction of demand. The supplimental supply required is presented on a conservative basis in that it accumulates several sources of data and averages these into a best estimate.

In order to properly evaluate whether Canada should export to other countries a cost benefit analysis was performed by the NEB. This analysis showed that although we could currently provide the U.S. with additional gas it was in Canada's best interest to explore other markets which would be available when gas from Venture and Arctic fields is produced. To this end the NEB has approved export of Alberta and B.C. gas to Japan.

UNITED STATES NATURAL GAS

SUPPLY AND DEMAND TO THE YEAR 2000



The NEB heard and accepted Dome's assessment of the Japanese demand picture. They presented to the Board evidence of Japanese demand increasing from 24.2 billion m^3 (16.8 million tonnes) in 1980 to 56.46 billion m^3 (38.5 million tonnes) by 1990 and 67.21 billion m^3 (45 million tonnes) by 2000. This strong growth is predicated upon the following:

- The Japanese economy would continue to perform strongly and the demand for thermal electric generation capacity would continue to grow.
- Long-term Japanese energy policy would continue to suport the general shift away from imported crude oil to natural gas and other alternatives.
- Nuclear power would continue to be constrained by the long lead times for the approval and construction of nuclear plants.

LIQUIFIED NATURAL GAS

LNG is not a new concept in Canada as there are "peak shaving" plants which liquify and store surplus natural gas taken from pipelines during low consumer demand. When demand rises during the winter the LNG is regassified and returned to the pipeline system.

When natural gas is cooled to -162°C it becomes a liquid occupying approximately 1/600 th of its initial volume. This means that containment and handling systems for the LNG must be capable of maintaining their strength as the cryogenic liquid comes in contact with them. The systems designed to store and handle LNG must also be

heavily insulated or the LNG will boil off becoming a gas once again.

Transporting LNG presents relatively little risk to the marine environment as any spill resulting from a collision would rapidly vapourise. The cargo in itself is not combustable, and can only be ignited when it has boiled off into its natural state (natural gas) and then is mixed with between 85 to 95 parts air.

Most of the tankers designed to transport LNG are also equipped to utilize the natural boil off as fuel for its propulsion system, which burns cleaner that other fossil fuels such as coal or oil. While coal or oil combustion produces a wide range of pollutants the only significant contaminants that result from the use of natural gas are oxides of nitrogen and even these contaminants are emitted at comparatively low levels.

LNG SHIPPING

LNG gas been shipped commercially since 1964 when trade began between Algeria and the United Kingdom. This trade along with interest expressed by France for imported LNG led to rapid development of LNG containment technology and from this research three dominant containment systems evolved;

- The Technigaz Mark I Membrane System
- The Gaz Transport Membrane System
- The Moss Rosenberg Spherical System

As energy demand increased the shipment of LNG became more frequent and through the seventies and early eighties approximately 60 LNG carriers have been constructed ranging in size from 29,000 m^3 to 133,000 m^3. Table 1 presents a world wide review of current LNG tankers.

Through development of the various designs of tankers some problems were encountered which led to concerns over safety and reliability. The three designs highlighted above are fundamentally different from each other and all have proponents and adversaries. From the listing provided on Table 1 it is clear that ships of all three designs have been constructed and are currently in use successfully throughout the world. All three of these systems employ the following:

- primary barrier which can withstand the dramatic change in temperature as LNG is loaded and discharged from the tanks,
- an insulation barrier - which differs between all three but is generally a material which protects and insulates the primary containment system from the outside environment, and
- a secondary barrier which must be capable of containing any envisaged leak as well as protecting the ship's structure from the extreme low temperature.

The Moss Rosenberg and Technigaz systems have each been in successful service sufficiently long that they have now proven themselves very safe and highly reliable. There are some questions surrounding the Gaz Transport

TABLE 1

LNG CARRIER REVIEW AT 1 MARCH, 1984

VESSEL	DESIGN	DELIVERY	PROJECT/STATUS
20-35,000 m^3			
Methane Princess	Conch	1964	Laid-up
Methane Progress	Conch	1964	Laid-up
Jules Verne	Gaz Transport	1965	Algeria-France
Venator	Moss	1973	Libya-Spain
Century (Ex Lucian)	Moss	1974	Algeria-Spain
Isabella	Gaz Transport	1975	Algeria-Spain
NORMED 1402	Gaz Transport	1975	Laid-up with yard
40-50,000 m^3			
Laieta	Esso	1970	Libya-Spain
Esso Brega	Esso	1969	Laid-up
Esso Porto Venere	Esso	1969	Algeria-Boston
Esso Liguria	Esso	1970	Laid-up
Descartes	Technigaz	1971	Algeria-France
Hassi R'Mel	Gaz Transport	1971	Algeria-France
Tellier	Technigas	1974	Algeria-France
70-80,000 m^3			
Arctic Tokyo	Gaz Transport	1969	Alaska-Japan
Polar Alaska	Gaz Transport	1969	Alaska-Japan
Gadinia	Technigaz	1972	Brunei-Japan
Gadila	Technigaz	1973	Brunei-Japan
Gari	Technigaz	1973	Brunei-Japan
Gastrans	Technigaz	1974	Brunei-Japan
Geomitra	Gaz Transport	1975	Brunei-Japan
Gouldia	Technigaz	1975	Brunei-Japan
Genota	Gaz Transport	1975	Brunei-Japan
87,000 m^3			
Normal Lady	Moss	1973	Abu Dhabi-Japan
Pollenger	Moss	1974	Open spot
120-135,000 m^3			
Hilli	Moss	1975	Abu Dhabi-Japan
Gimi	Moss	1976	Abu Dhabi-Japan
Khannur	Moss	1977	Abu Dhabi-Japan
Golar Freeze	Moss	1977	Abu Dhabi-Japan
Golar Spirit	Moss	1981	Laid-up (1)
Mostefa Ben-Boulaid	Technigaz	1976	Algeria-U.S.
Larbi Ben M'Hidi	Gaz Transport	1977	Algeria-U.S. (2)
Bachir Chihadi	Gaz Transport	1979	Algeria-U.S. (2)
Mourad Didouche	Gaz Transport	1980	Algeria-U.S. (2)

(1) Laid-up pending start up of deliveries from Indonesia to S. Korea.
(2) Idle pending settlement between Sonatrach and Trunkline.

TABLE 1 (Continued)

LNG CARRIER REVIEW AT 1 MARCH, 1984

VESSEL	DESIGN	DELIVERY	PROJECT/STATUS
120-135,000 m^3 cont'd			
Ramdane Abane	Gaz Transport	1981	Algeria-France
Gastor	Gaz Transport	1977	Laid-up
Nestor	Gaz Transport	1977	Laid-up
El Paso Paul Kayser	Gaz Transport	1975	Laid-up (1)
El Paso Sonatrach	Gaz Trasnport	1976	Laid-up (2)
El Paso Consolidated	Gaz Transport	1977	Laid-up (1)
El Paso Southern	Technigaz	1978	Laid-up
El Paso Arzew	Technigaz	1978	Laid-up
El Paso Howard Boyd	Technigaz	1979	Laid-up
Benjamin Franklin	Technigaz	1975	Laid-up
Heogh Gandria	Moss	1978	Laid-up (3)
Edouard L.D.	Gaz Transport	1977	Algeria-France
LNG Aquarius	Moss	1977	Indonesia-Japan
LNG Aries	Moss	1977	Indonesia-Japan
LNG Capricorn	Moss	1978	Indonesia-Japan
LNG Gemini	Moss	1978	Indonesia-Japan
LNG Leo	Moss	1978	Indonesia-Japan
LNG Libra	Moss	1979	Indonesia-Japan
LNG Taurus	Moss	1979	Indonesia-Japan
LNG Virgo	Moss	1979	Indonesia-Japan
Methania	Gaz Transport	1978	Algeria-Belgium
Lake Charles	Moss	1980	Algeria-U.S. (4)
Louisiana	Moss	1980	Algeria-U.S. (4)
Tenaga Satu	Gaz Transport	1982	Malaysia-Japan
Tenaga Dua	Gaz Transport	1981	Malaysia-Japan
Tenaga Tige	Gaz Transport	1981	Malaysia-Japan
Tenage Empat	Gaz Transport	1981	Malaysia-Japan (5)
Tenaga Lima	Gaz Transport	1981	Malaysis-Japan (5)
Rhenania	Gaz Transport	1981	Laid-up with yard
Zenit Hull 564	Gaz Transport	1981	Laid-up with yard
Bishu Maru	Moss	1983	Indonesia-Japan
Kotowaka Maru	Moss	1983	Indonesia-Japan
Echigo Maru	Moss	1983	Indonesia-Japan
Banshu Maru	Moss	1983	Indonesia-Japan
On Order (125,000 m^3)			
Hull 1890(Dewa Maru)	Moss	6/84	Indonesia-Japan
Hull 1230(Senshsu Maru)	Moss	2/84	Indonesia-Japan
Hull 1250(Wakaba Maru)	Moss	11/84	Indonesia-Japan

(1) Sold to Mundo Maritime Financial Group, Hong Kong, 1983.
(2) Sold to KOTC (Kuwait) in 1983 for spot deliveries of LNG to Kuwait.
(3) Laid-up pending start up of deliveries from Indonesia to S. Korea.
(4) Laid-up pending settlement between Sonatrach and Trunkline.
(5) Laid-up pending employment on Malaysia-Japan trade.

system resulting from problems encountered for the most part as a result of the sloshing motion of the cargo causing failure of the membrane tank. The Gaz Transport system has now apparently solved the problems it once had in this regard.

There are currently several laid-up 125,000 m^3 tankers which would be available for LNG projects. The deregulation of United States gas sales in conjunction with apparent surplus of energy resources has led to several LNG projects going sour around the world in the last few years. LNG tankers are not like other ships in that they are not easily converted to other trades and so are generally purpose built for a specific project.

CURRENT CANADIAN LNG PROJECTS

Several Canadian energy resource companies have expressed interest in offshore exports of LNG. These sponsors have brought their projects before the NEB to receive export licences for the requested amount of gas.

Two major projects have progressed a reasonable distance through the regulatory jungle, but neither of which have reached fruition. These projects are the Arctic Pilot Project and the Western LNG Project which are both currently in different stages of hearings before the NEB.

The Arctic Pilot Project (APP) was an ambitious venture between three of Canada's larger oil companies along with three major Canadian shipping companies to bring 54 billion m^3 of gas out of the Arctic. As the name suggests this was to be a pilot project which would hopefully lead to other larger projects in the future. The APP initially involved shipment of the LNG from Melville Island, NWT to a terminal on the east coast of Canada. This was to be in effect traded for Alberta gas which would then be exported to the United States. As the regulatory approval dragged on it became apparent to the project sponsers that their United States buyer was getting less enthusiastic about its current need for expensive Canadian gas so they began looking at other potential buyers. It was at this point that the Hearings were indefinately suspended as the contract with the U.S. buyers had lapsed and has not been replaced. The project is still in a state of indefinate suspension and will likely remain in that status until world energy prices become more conducive to supporting these types of innovative mega projects.

The Western LNG Project developed by Dome Petroleum Limited and Nissho Iwai of Japan was one of three similar proposals which were presented to the British Columbia government. As a result of its analysis the B.C. government came out in support of the Dome proposal at

which time the other two groups withdrew their requests to export from the NEB.

The Dome Western LNG Project proposes to take B.C. and Alberta gas, liquify it at Grassy Point, B.C. and ship the LNG to Japan over a 20 year period. This project employs currently available technology which could be used as a stepping stone to bring the required expertise to Canada which would enable Arctic Pilot Project type venture to go ahead. This project proposes the use of 5 newly-built ships of the Moss Rosenberg design.

This particular project is setup such that the Japanese pay a fixed price for delivered gas and then all shipping, liquifaction, storage, gas gathering and other miscellaneous costs would be netted from the price paid to the producer. Dome and its Japanese partner have taken a great deal of time and effort to firm up these costs but have yet to fully satisfy producers they will be receiving an adequate return.

The project has passed through Phase One of the NEB Hearings on facilities approval and Phase Two will commence on project economics when Dome has satisfied several criteria which the Board has requested. The major hurdle is currently agreement of the producers to the pricing scheme and although B.C. producers have

agreed in principal, the Alberta government and producers have not been convinced of the project's viability. They are most concerned about jeopardizing their American market share by being seen to sell gas at much lower prices than the current Canada-U.S. border price of $4.40 (U.S.)/MCF (3.30 U.S./MCF at certain volumes).

Discussions between Dome and producers continue and hopefully will be settled prior to the Japanese gas buyers looking elsewhere for supplies.

BENEFITS TO CANADA'S MARINE INDUSTRY

The Canadian marine industry is currently suffering along with the world shipping industry as a result of the recession which has occurred over the past two-three years. Canada's shipbuilding industry has decreased from a peak work force of perhaps 14,000 to 6,000. This reduction has resulted from the lack of work which most yards have experienced. World wide shipbuilding is very competative, although Canadians have displayed specialized expertise with regard to some aspects of shipping for which we will always have a market.

- self-unloading bulk carriers,
- Arctic class tugs and barges,
- Arctic class bulk carriers,

The total construction cost (including special financing available elsewhere) for newbuildings in Canada compared to other countries is quite high. Other countries are much more reliant upon the shipbuilding industry in their

economy and so provide favourable financing or direct subsidies and incentives to the shipyards or operators because they see these expenditures helping their economy as a whole.

This is not to suggest that Canadian yards should not be active at this time, but it is difficult to compete in the world markets for expensive, highly complex vessels such as LNG carriers. The LNG vessels which have become most prevelant in the last few years are the 125,000 m^3 size carrier which no yard in Canada is currently large enough to construct using conventional methods. Through our recent discussions with shipyards and suppliers we are aware of Canadian companies willing to supply all of the ship components shown on Table 2. It makes a great deal of sense that the technology required and expertise involved in constructing these vessels should be brought to Canada and to this end we are aware of discussions between Canadian yards and foreign shipbuilders who have peviously had LNG ship construction experience.

This type of dialogue is helpful to Canadian industry and will hopefully one day lead to the construction of an entire LNG carrier in Canada.

Canada currently has ship owning and operating companies who would be considered large by world

TABLE 2

LIST OF SHIP COMPONENTS AVAILABLE FROM CANADIAN SUPPLIERS

Accommodation Block & Components	Aluminum Products
Boilers & Boiler Equipment	Bow Thrusters
Castings & Shafting (Ferrous)	Casting & Ingots (Non-Ferrous)
Communication Systems	Compressors
Condensers	Containment System Insulation
Cryogenic Pumps	Deck Machinery, Cranes
Electric Cables	Electricl Motors & Equipment
Fire Fighting Equipment	Galley Equipment Package
Gear Boxes & Components	Generator Sets
Heating, Air Conditioning & Ventilation	Hydraulic Power Systems
Inert Gas Systems	Instrumentation & Controls
Lifesaving Equipment	Mooring & Towing Lines
Navigation Equipment	Paints, Protective Coatings
Pipe & Pipe Fittings	Propellers
Propulsion Package or Components	Pumps, Purifiers, Filters (General Service)
Steam Turbines & Components	Steels, Special Alloys
Steel Manufacturing	Sewage Treatment Plant
Steering Gear	Switch Gear, Panels, Consoles

standards. These companies have expressed interest in owning and operating LNG vessels. In order to have a Canadian flag a vessel must be owned by an organization which is Canadian controlled; there are currently some exceptions to this, but newly proposed regulations will eliminate non-Canadian controlled companies from owning Canadian flag vessels.

Crews for these vessels should be largely Canadian from the outset of any project. These crews would require specialized training to operate these highly automated vessels with particular emphasis on safety and the specific problems which are unique to this cargo.

ECONOMIC BENEFITS

A project such as Dome's Western LNG Project will bring potentially enormous benefits to Canada aside from the actual sale of shut in gas. It allows us to acquire the technology to liquify and transport gas on a scale and to markets which we have not previously envisaged possible. This project can open doors to exports to the other net importing gas nations and can help to encourage development of the frontier areas in the Arctic as it will prove Canadian capability in this highly complex industry.

It is most important that the Western LNG Project be allowed to proceed, but at this time the specific

economics of this have left its future uncertain. The benefits to Canada for such a project should not be dissected and examined individually, but should be looked on as a whole and evaluated on that basis. To examine any one of the segments and justify or criticize the project based upon that lone sector's interest or returns is not a practical way for Canadians to evaluate this project.

Future Canadian endeavours such as an Arctic Pilot Project or shipments of Venture field gas can be developed based upon the experience gathered with the Western LNG Project for which technology and expertise are currently in place. If we do not prepare today by taking opportunities such as these as they arise more speculative or technically advanced Canadian projects will never be developed. If this project fails in its current form to reach a successful conclusion it will be several years before sponsors attempt to put together projects of this nature again.

THE DEVELOPMENT OF NEW MARINE NAVIGATIONAL TECHNIQUES IN ICE: IMPLICATIONS FOR EXPANSION OF THE CANADIAN ARCTIC TRADING SEASON

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ABSTRACT

The Canarctic Shipping Company Limited has undertaken an extensive research program to develop new techniques for navigating in ice. Canarctic operates the M.V. Arctic, an Arctic Class 2 icebreaking bulkcarrier. For the past 2 years Canarctic has made a conscious effort to expand the Arctic trading season to the maximum permitted for a Class 2 vessel under the present regulations. Experience has shown that navigation in total ice cover conditions requires a different approach to that traditionally used in the open water season. This paper describes techniques which have been developed and successfully applied by Canarctic, and comments on the implications these will have on ship operations in the Arctic marine environment.

INTRODUCTION

Marine transportation in the Canadian Arctic has traditionally followed the mid-summer open water season from mid-July to mid-October. A few dedicated research probes have been made outside these dates, but these went

only as far as was considered prudent for the ice conditions at the time. Vessels trading into the north during the open water season were content to skirt around local ice concentrations, or await local icebreaker escort if ice conditions could not be avoided or were considered too difficult. This traditional method of operation was also that followed by Canarctic Shipping during the first 2 years of commercial operation in the Eastern Arctic.

Canarctic operates the M.V. Arctic, a Canadian built Arctic Class 2 icebreaking bulkcarrier. The ship has been engaged since 1978 to lift lead-zine concentrates from the Nanisivik mine on northern Baffin Island, and since 1982 from the Polaris mine on Little Cornwallis Island. The length of the vessels trading season is controlled by the Arctic Shipping Pollution Prevention Regulations (ASPPR), which establishes for each navigation control zone seasonal limits of entry for various classes of ships (see Table 1).

TABLE 1

PRESENT ASPPR OPENING AND CLOSING DATES

ZONES 6 AND 13

CLASS	ZONE 6		ZONE 13	
	OPENING	CLOSING	OPENING	CLOSING
2	AUGUST 15	NOVEMBER 20	JUNE 25	NOVEMBER 22
3	AUGUST 1	NOVEMBER 30	JUNE 10	DECEMBER 31
4	JULY 20	DECEMBER 31	JUNE 1	FEBRUARY 15

Figure 1 depicts the northern minesite locations and the shipping control zones.

Since the 1980 season there has been a conscious effort to expand the vessel's trading season to the maximum permitted under the present regulations. The resulting five month season in the north has required the vessel to contend with ice regimes well outside the recognized open water period. The experience of the last four years has shown, perhaps no more dramatically then November 1982 when heavy ice conditions forced the cancellation of the last commercial voyage of the season, that a new approach is needed if one is to resolve unique problems presented by the very dynamic ice conditions being encounted.

DEVELOPMENT OF A SHIPBOARD ICE NAVIGATION SUPPORT SYSTEM

Initial research undertaken in 1982 concentrated upon filling some of the gaps in past ice observations and reports in order to gain a better understanding of the medium in which the vessel was working. One of the key elements to come out of the research was the notion of selectively routing a vessel through an ice field to avoid contact with as much ice, or at least the heaviest ice, as possible. Theoretical and case study results using airborne radar imagery showed that selective routing within an ice field of six-tenths old ice could reduce actual encounters with ice to less than 25 percent of the actual track length (Lapp, 1983a). It was noted

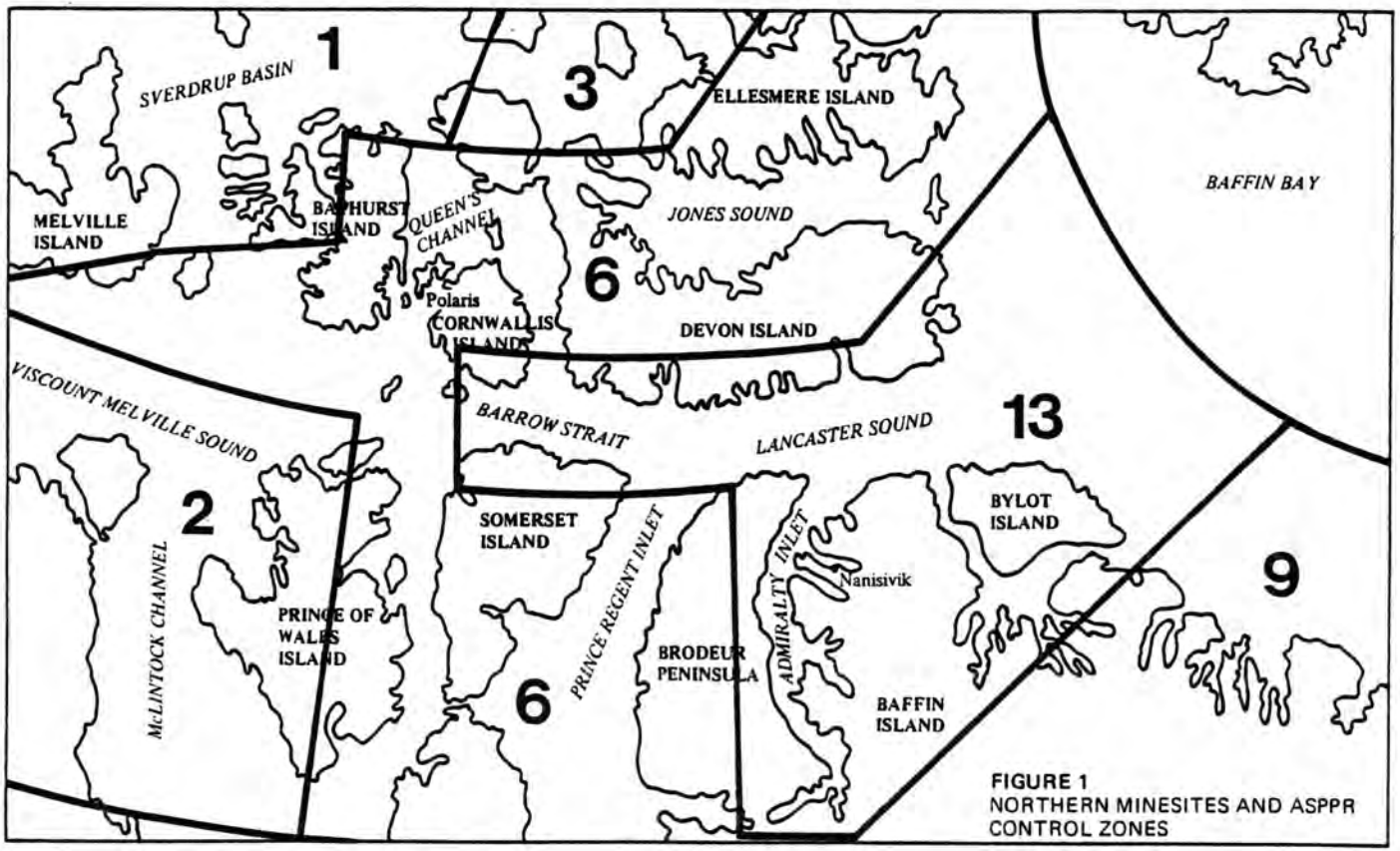


FIGURE 1
NORTHERN MINESITES AND ASPPR CONTROL ZONES

that the provision of real-time information products to the ship's Master would facilitate more detailed routing and accurate monitoring of the vessels position. The results of these studies provided the basis for the current research program which is to develop the conceptual requirements for an integrated Shipboard Ice Navigation Support System (SINSS) to assist with navigation outside the traditional open water season. The objective of SINSS is to develop on-board the vessel a level of ice information and intelligence which will result in optimal route selection together with the ability to monitor and refine the selected track as the vessel proceeds through an ice regime. To be totally effective SINSS must incorporate long-range strategic route planning, medium-range tactical support in the ice and close-range hazard detection and avoidance. Figure 2 depicts conceptually, the geometric structure of SINSS.

The further one departs from the open water season the more critical becomes the requirement for strategic route planning and selection. The traditional ice chart, prepared by the Atmospheric Environment Service, showing ice location and generalized concentrations becomes inadequate as a planning tool. What is needed is a succession of near to real-time "snap-shots" of the ice regime to identify the larger features and determine their relative movement in the period prior to the vessel entering an ice field. Such intelligence is available with satellite imagery. This when interpreted with an

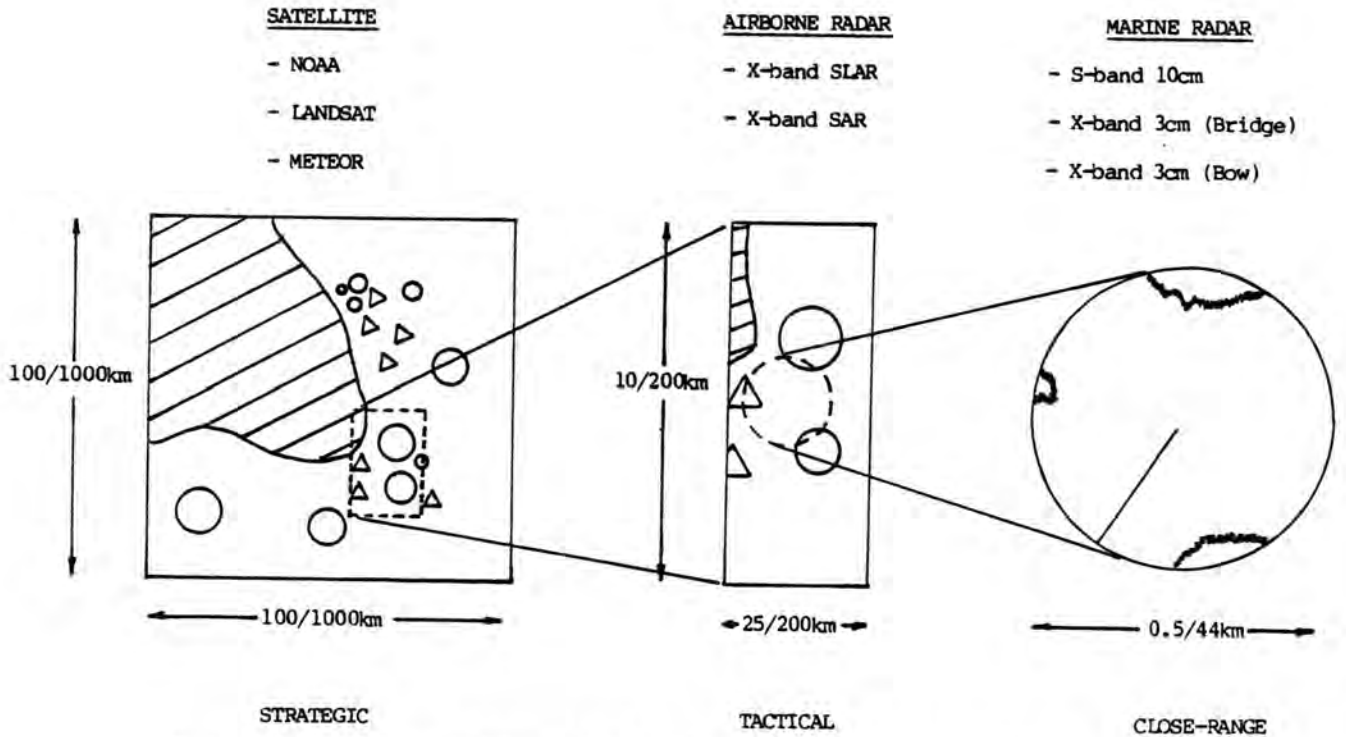


Figure 2 - The geometric structure of a Shipboard Ice Navigation Support System (SINSS)

historical appreciation of the behaviour of the ice regime in the past, plus a record of recent meteorological conditions and trends, allows logical decisions to be made on-board the vessel regarding general route selection and the need for tactical support.

As the vessel approaches an ice regime conditions along the general route selected are then surveyed by airborne imaging radars using a large swath width, and the resultant imagery is downlinked to the ship in real-time. This 100km to 200km wide overview of conditions along the ship's proposed route provides an opportunity to refine the route as a result of the more detailed radar imagery, particularly if satellite images have been poor or unobtainable.

With the final route determined further airborne radar imagery is obtained as the vessel enters the ice. This second level of SLAR (side-looking airborne radar) or SAR (synthetic aperture radar)imagery is of a narrower swath width, probably 50km or even 25km, so that the imagery can be used as an ice chart to plot and monitor the vessel's progress relative to the ice features. It is important that this imagery include the ship on it to facilitate inital position fixing. Ice features recorded on the SLAR/SAR imagery are then visually correlated with features recorded on the ship's radar displays and progress is monitored in this way. The ship's track would be refined to circumvent the heavier ice features as they are identified or to optimize open leads in close

pack ice conditions. Further imagery would be flown and transmitted to the ship as updates are needed.

While SLAR/SAR imagery can be used to identify most ice features, there is still a critical need to be able to detect ice hazards ahead of the ship at close range. In fog, the M.V. Arctic has repeatedly failed to detect large icebergs until they were sighted visually. With the high occurrence of restricted visibility in the spring and prolonged periods of darkness in the fall improving the probability of detection is paramount. Existing marine radar displays present a confused picture of backscattered returns and it is difficult at this time to differentiate icebergs from the surrounding ice clutter. One method of highlighting hazards such as icebergs or growlers is to look for shadow areas on the marine radar display. Berg shadows are more pronounced when the aspect angle of the scanner is reduced, thus allowing for some level of detectability in ice clutter.

The development of all three levels of SINSS were addressed by Canarctic during the 1982 and 1983 commercial shipping seasons, and the results are described below.

RESEARCH RESULTS

For the first and the last voyages in 1982 and 1983, Canarctic implemented several initiatives to begin preliminary testing of SINSS. Instrumentation was acquired to access satellite imagery and communication links were

upgraded to facilitate information transfer from supporting agencies such as Ice Forecast Central in Ottawa. A SLAR downlink receiver was installed on the M.V. Arctic to access real-time airborne radar imagery, and arrangements were made to acquire equipment to assist with display and interpretation of the imagery. A bow-mounted 3cm X-band marine radar was used to try and accentuate iceberg shadows by virtue of it's lower aspect and elevation. Results of each voyage are compiled in reports (Sneyd 1983a, 1983b, 1984) and several recommendations for refinements in data requirements and analysis and display techniques were made. The following discussion highlights the results to date.

The acquisition of satellite imagery for strategic planning was attempted using the INMARSAT telecommunications facility linked to an electrostatic printer. Images were fabricated at the satellite receiving stations in Sondre Stromfjord, Greenland, and the Prince Albert Satellite Station in Saskatchewan, and then passed through the communications satellite network to the vessel. After rectifying the printers reception capability, several images were received from the NOAA and LANDSAT satellites. In general, printer resolution was not sufficiently good to allow for discrimination or measurement of ice types. However, the imagery was useful for delimiting ice boundaries and thin ice areas, as well as land and open water. Figure 3 illustrates a typical NOAA satellite image of the Lancaster Sound region of the Eastern Canadian Arctic. The image clearly



Figure 3 - NOAA satellite image of ice conditions in Lancaster Sound and Eastern Baffin Bay, November 12, 1982.

shows the stream of old ice migrating south past Devon Island and the heavy concentratons of old ice north of the Bylot Island coast. Fragmentation of the ice and curvature of the leads indicates that the ice is under pressure north of the coastline. Also, by examining imagery from several successive days it is possible to note the relative drift rates of the ice field. From the information analyzed to this point, it is apparent that heavy concentrations of old ice moving south towards Lancaster Sound, and convergence and south-eastward drift of ice out of the entrance to Lancaster Sound, make entry to the Sound from the north the only practical route. In fact the general route into the Sound can be picked off the satellite image and thus forms the basis for developing the tactical support role. Receiving such imagery before reaching the entrance to Lancaster Sound, allows the Master of the vessel to choose both the approach and the general entry point, thereby saving time and wear and tear on the ship and crew.

Once the general routing plan has been established from satellite imagery, detailed information is gathered to help with the tactical support exercise. The SLAR flight lines are developed by the ship's crew and relayed to the supporting aircraft which then overfly's the areas requested and downlinks the imagery to the ship. Upon receipt of the imagery, an intensive interpretive effort begins. An example of the level of tactical support provided by SLAR is depicted in Figure 4. The ice conditions presented are typical of late June in Baffin Bay.

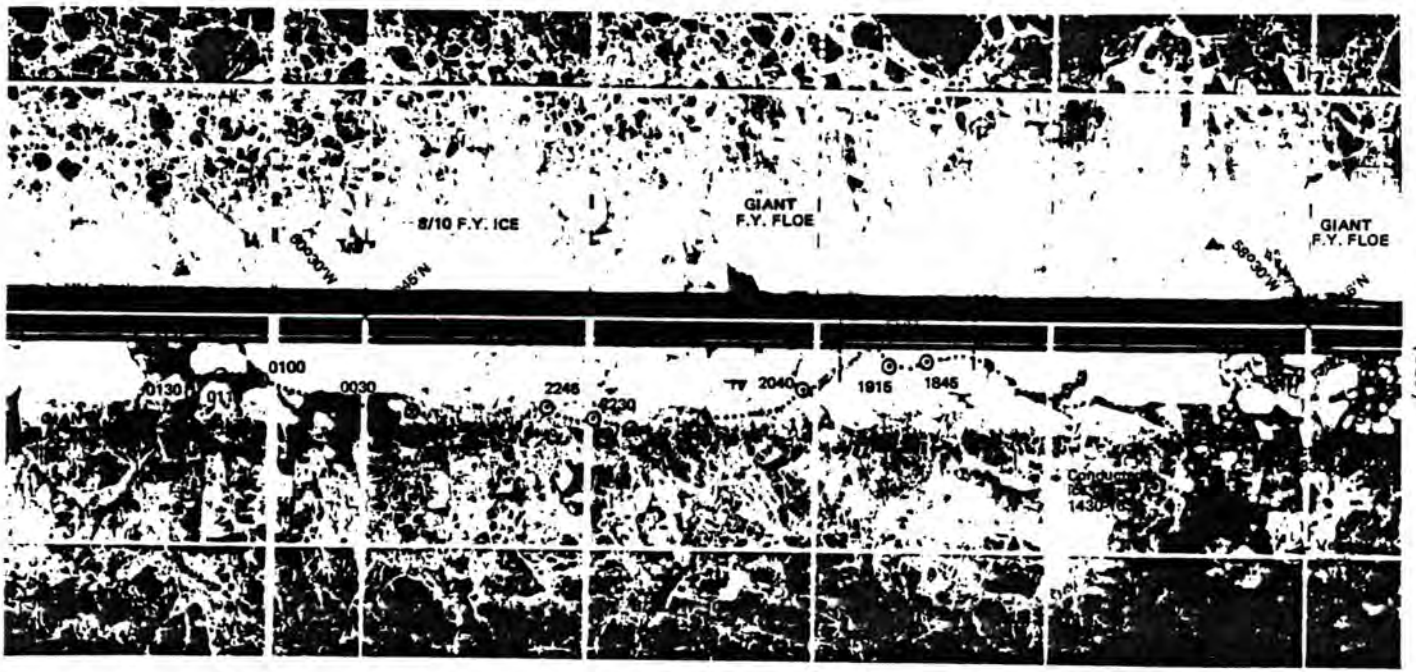


Figure 4 - Side-looking airborne radar (SLAR) image of ice conditions in Baffin Bay on June 21, 1983, and the M.V. Arctic routing during tactical support exercise. The centre strip is the blind spot under the aircraft. Black represents open water, dark grey is relatively smooth first-year ice, and icebergs are small bright dots.

As noted earlier, finding the ships position on the SLAR is paramount, and in this case the M.V. Arctic and its track through the ice appears as a bright return on the image. The route which the M.V. Arctic took was developed largely to take advantage of leads and open water areas. The ship's positions were all verified by marine radar displays at the times noted. One particularly interesting aspect of the tactical exercise was the use of SLAR to aid the ship in dense fog conditions. For a period of about one hour and twenty minutes the M.V. Arctic maintained an average rate of speed of 10.0 km/hour in fog conditions so thick that the bow of the vessel and the ice edges defining each side of the lead were not visible from the navigation bridge. This compares favourable with the average rate of speed of 10.8km/hour which the M.V. Arctic accomplished under good visibility conditions. Once the vessel reaches the end of an image strip, it moves onto another image that has been tape recorded for later playback, or additional imagery is flown by the aircraft. Experience has shown that, depending on the season, location, prevailing ice conditions and vessel progress, SLAR imagery can be reliable for 24 to 48 hours.

When used in heavy ice conditions such as those illustrated in Figure 4 the SLAR provides excellent tactical support. When used in conjunction with marine radar, vessel position relative to ice features can be carefully monitored to ensure that full advantage is

taken of leads and thin ice where possible. However, hazards such as icebergs are not always clearly defined on SLAR, because of geometric imaging properties of the radar, and the surface characteristics of icebergs. Also, the 30 meter height of a navigation bridge radar scanner is not optimal for detecting bergs that project a surface profile above the waterline of only a few meters. It was envisioned that lowering the radar scanner to a deck elevation of less than 10 meters would facilitate berg recognition in ice clutter.

Figure 5 shows the M.V. Arctic in typical heavy ice conditions for mid-November in Northern Baffin Bay. The overcast skies and low sun angle at this latitude make it difficult to see the small iceberg which is located about 375 metres off the starboard bow. On the bridgetop radar displays the berg is lost within the ice clutter. However, on the bow-radar display pictured in Figure 6, the berg shadow clearly stands out. The bowmounted scanner is about 9 metres above the level of the ice, and the iceberg profile was measured at 7 meters above waterline. Given that eight-ninths of an icebergs' mass is below the waterline it is apparent that this ice feature represents a formidible hazard. The lower relative difference in relief between ice and the bow radar scanner is one key to close-range detection of hazards in ice.

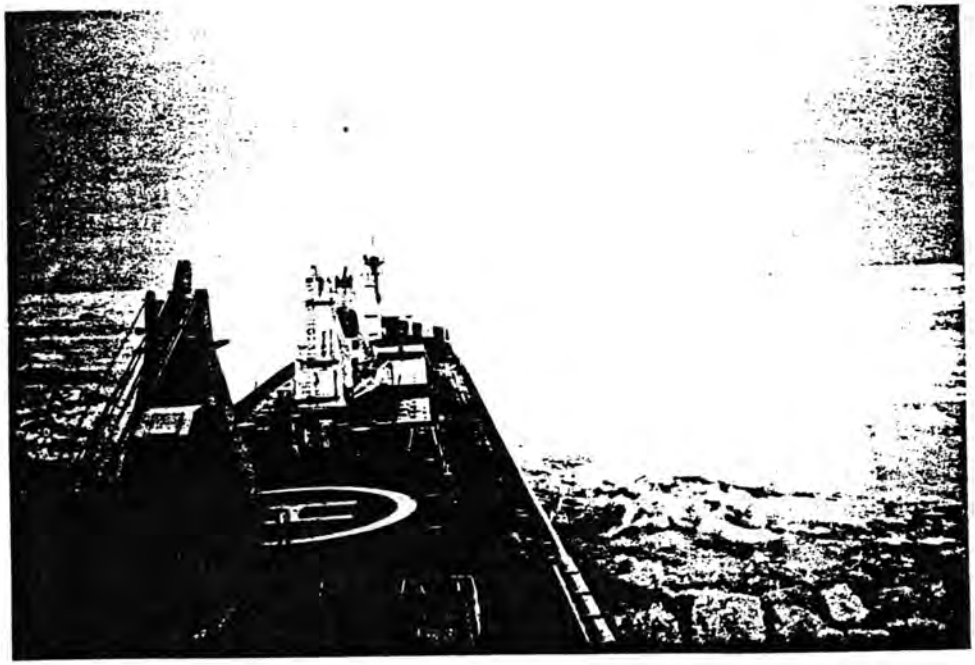


Figure 5 - M.V. Arctic stopped in thick first-year ice in Northern Baffin Bay, November 1982. A small iceberg, projecting approximately 7 metres above water line, lies 376 meters off the starboard bow. The surrounding ice and visibility conditions make this hazard difficult to detect visually and with conventional marine radar.

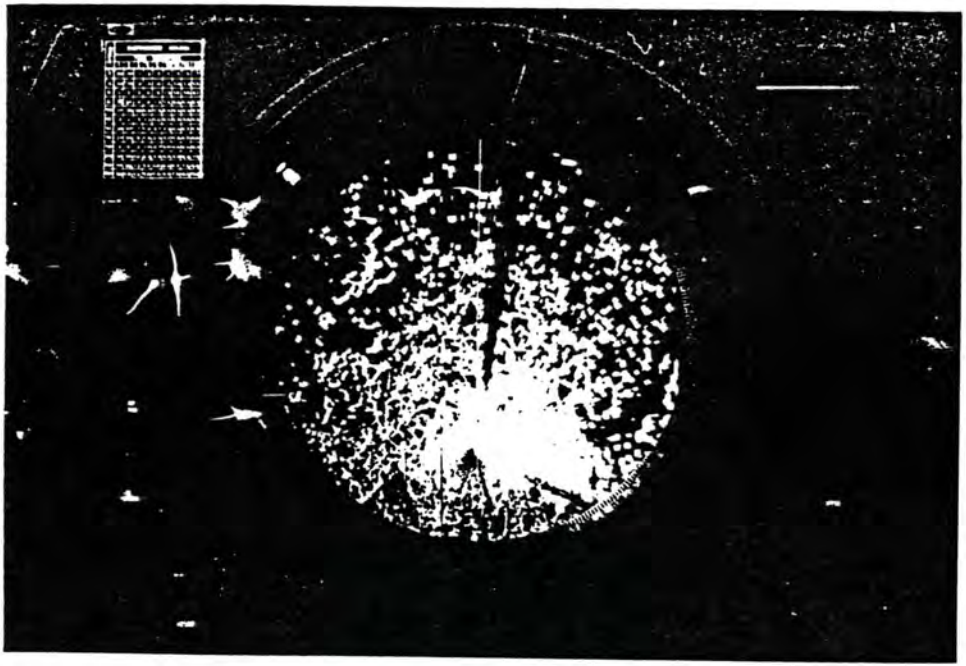


Figure 6 - Marine radar presentation from a bow-mounted 3cm x-band radar. The scene is identical to that displayed in Figure 5. The radar scanner is positioned about 9 metres above ice level and therefore the above-ice portion of the iceberg clearly casts a shadow that is delineated in the surrounding ice clutter.

SUGGESTIONS FOR IMPROVEMENT OF SINSS

The initial testing of SINSS has provided significant improvements concerning navigation techniques in ice. The strategic planning exercise has shown that satellite imagery can be received by a vessel and used for initial route planning. However, the current method of reception via telecommunications link, and the type of reproduction using an electrostatic printer, combine to produce imagery that is not always of a standard required for precise positioning of major features. Options, such as direct reception and on-board digital processing, are currently being looked at to help improve image reception and resolution.

The tactical planning exercise, has demonstrated the utility of airborne SLAR as a vital information source for daily route planning. The ability to selectively route the vessel through a hazardous ice environment often in conditions of restricted visibility, with the same level of performance as achieved in light ice conditions is a major improvement. Precise positioning of the vessel vis-ã-vis the surrounding ice allows for logical decisions to be made regarding hazard avoidance and this improves the operational safety of the vessel. Although the SLAR radar imagery received on the vessel to date has been of inestimable value, the lack of consistent quality and reliability of the imagery are still areas of concern. Techniques for on-board analysis and information extraction need improvement so that the

will be more readily available to the ship's navigating personnel. Improvements in the efficiency of the radar downlink and use of the newer SAR radar systems will help improve the imagery, while further work is needed to determine if optical or machine-processed enhancements will aid image interpretability.

The close-range hazard detection exercise utilized a conventional marine radar in an unconventional position to achieve an improvement in the detection of icebergs. The problem of discriminating low-level ice hazards in poor visibility conditions when surrounded by ice cover was solved by lowering the scanner to deck level to enhance the iceberg profile. Two other approaches for solving the problem of ice hazard detection have been raised and there appears to be merit in each. The first suggests that radar returns be differentiated based on level of intensity, the conventional wisdom being that icebergs, with their higher out-of-water profile, would backscatter more direct energy to the scanner. The second approach would be to take advantage of the large underwater mass of the iceberg by using sonar techniques. Research to address both options is currently being pursued.

As new and better methods for route planning, image processing and ice detection evolve, the need will arise for on-board integration of each data source. A systems approach to development will be required to ensure machine storage, processing and display compatibility for each level of planning information. At the present time

however, the structure of SINSS provides an effective means of safely moving a ship through hazardous ice covered waters outside the normal open-water season.

IMPLICATIONS FOR COMMERCIAL ARCTIC SHIPPING

The ASPPR Safety Control Zone limits and dates were established prior to the availability of satellite and airborne radar imagery. As such, the standard of ice intelligence and approach to navigation in ice in use at the time was that traditionally followed in the 1960's. Hazard avoidance was dependent upon helicopter reconnaissance for a limited distance ahead of the ship. This in no way provided the strategic overview or the level of detail for tactical support that is available with SINSS. Also, in restricted visibility and darkness, the limited range helicopter was unavailable. Navigating in the hazardous mixed ice conditions of the eastern Arctic under such conditions may be likened to the exploratory ventures across uncharted seas by the early mariners. SINSS has revolutionised this haphazard approach to navigation and greatly improves the safety of the vessel.

The intelligent approach to hazard avoidance provided by SINSS, once it has been developed to an acceptable standard of reliability, will provide a tool to navigate outside existing zone dates particularly into the time of total darkness of the Arctic winter. It is submitted that an intelligent approach to ice navigation utilizing SINSS will optimise vessel performance in ice

and will provide an added factor of safety sufficient to warrent extension of present zone seasons.

The regulations currently allow the Class 2 M.V. Arctic to enter the consolidated ice in Admiralty Inlet within zone 13 after June 25. The vessel must depart the zone by November 22. However, studies have shown that the vessel is structurally capable of handling the ice conditions in Admiralty Inlet several days earlier and later than presently allowed. Entry and exit dates into McDougall Sound in zone 6 are even more conservative. Research has shown (Lapp, 1983b) that the ice conditions along the access routes to the two minesites are fundamentally similar. Yet, while the M.V. Arctic can enter Admiralty Inlet 4 weeks before the mean fracture date of the ice, it is restricted to entering McDougall Sound, on average, 2 weeks after the date of initial fracture. With SINSS the vessel possesses the intelligence to safely transit the hazardous ice conditions in Baffin Bay and Lancaster Sound both earlier and later in the season, to allow for entry to zones 6 and 13 as given in Table 2.

TABLE 2

RECOMMEND ASPPR OPENING AND CLOSING DATES

FOR A CLASS 2 VESSEL POSSESSING SINSS

Zone 6	Opening: July 15	Closing: November 22
Zone 13	Opening: June 15	Closing: November 30

The most significant change occurs in Zone 6, although the extension of the zone dates in zone 13 would allow for at least one additional cargo to be lifted, bringing the vessel's total Arctic voyages during one season to six. The additional cargo lifted from the mines presents attractive commercial benefits to the carrier as well as the producer.

Since SINSS provides the intelligence to safely navigate through an ice regime and avoid most hazards, it stands to reason that the limiting factor will become a vessels capability to move through thick first-year ice. This suggests that a Class 6 vessel, utilizing SINSS for ice navigation, will be able to operate for a twelve month season in the Eastern Canadian Arctic. The opportunity for expanded commercial Arctic shipping with the development of SINSS, will thus have a significant impact on transportation development scenarios for Arctic resource projects.

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THE SEAWAY ECONOMIC PLANNING SYSTEM - COMPUTER MODEL PROGRAM (SEPS-CMP)

"An Essential Planning Tool"

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ABSTRACT

This paper describes the Seaway Economic Planning System - Computer Model Program (SEPS-CMP) which simulates most of the economic activities related to the Seaway Transportation System and allows Seaway economists to respond efficiently to the growing requirements of the St. Lawrence Seaway Authority on matters related to the present and future economic situation of the waterway. The SEPS-CMP was developed on a user-friendly and cost-effective, micro-computer system in order to be accessible, used and modified directly by in-house economists.

The paper will review the major factors which prompted the development of this system and will discuss the SEPS concept prior to describing its structure, major components, techniques, outputs and uses. Detailed analyses of each of the SEPS-CMP subcomponents will be the subject of other specialized papers.

INTRODUCTION

The Great-Lakes Seaway System is a major North American transportation artery and is part of a highly complex commercial framework with tremendous economic

importance to both Canada and the U.S.A. It is mainly used for domestic as well as international shipments of bulk commodities, such as grain, iron ore, coal, stone, etc., moving in and out of the continental heartland. The St. Lawrence Seaway proper which is a system of fifteen locks is an essential part of the Great-Lakes Tranportation System. It extends from Montreal to Lake Erie and includes two sections, the Montreal-Lake Ontario section, consisting of five Canadian and two U.S. locks and the eight locks, all Canadian Welland Canal section. The waterway is administered by the Canadian St. Lawrence Seaway Authority (SLSA) and its U.S. counterpart, the Saint Lawrence Seaway Development Corporation (SLSDC).

The Seaway is in competition with alternative routes and modes, therefore, services and transportation charges are maintained at a level which allow the system to be competitive, efficient and safe. The Economics Section of the SLSA is responsible for the preparation of short, medium and long range traffic forecasts. These projections are updated periodically and are used by the Authority in the preparation of its strategic planning programs. In particular, they are necessary for the estimation of toll revenues as well as the capacity of the Seaway facilities. Moreover, impact and sensitivity analyses are undertaken in order to determine the optimum toll levels that fulfill the Seaway's financial objectives without undermining the competitive position of the waterway. Economic analyses are also undertaken

to determine the economic impact of the Seaway system on its environment and vice versa.

In a rapidly changing economic environment, the requests by the Seaway Authority for quick and sophisticated answers to the Seaway economic behaviour, have increased significantly, whereas the modest resources of the Economics Section remained unchanged. In essence, this situation required the analysis and interpretation of large amounts of data of a highly complex system in a short period of time and with limited resources. Although, it was possible to meet routine requirements, it was difficult to provide fast and sophisticated response to the growing number of "What if" scenarios of sensitivity analyses of traffic forecasts and Seaway tolls.

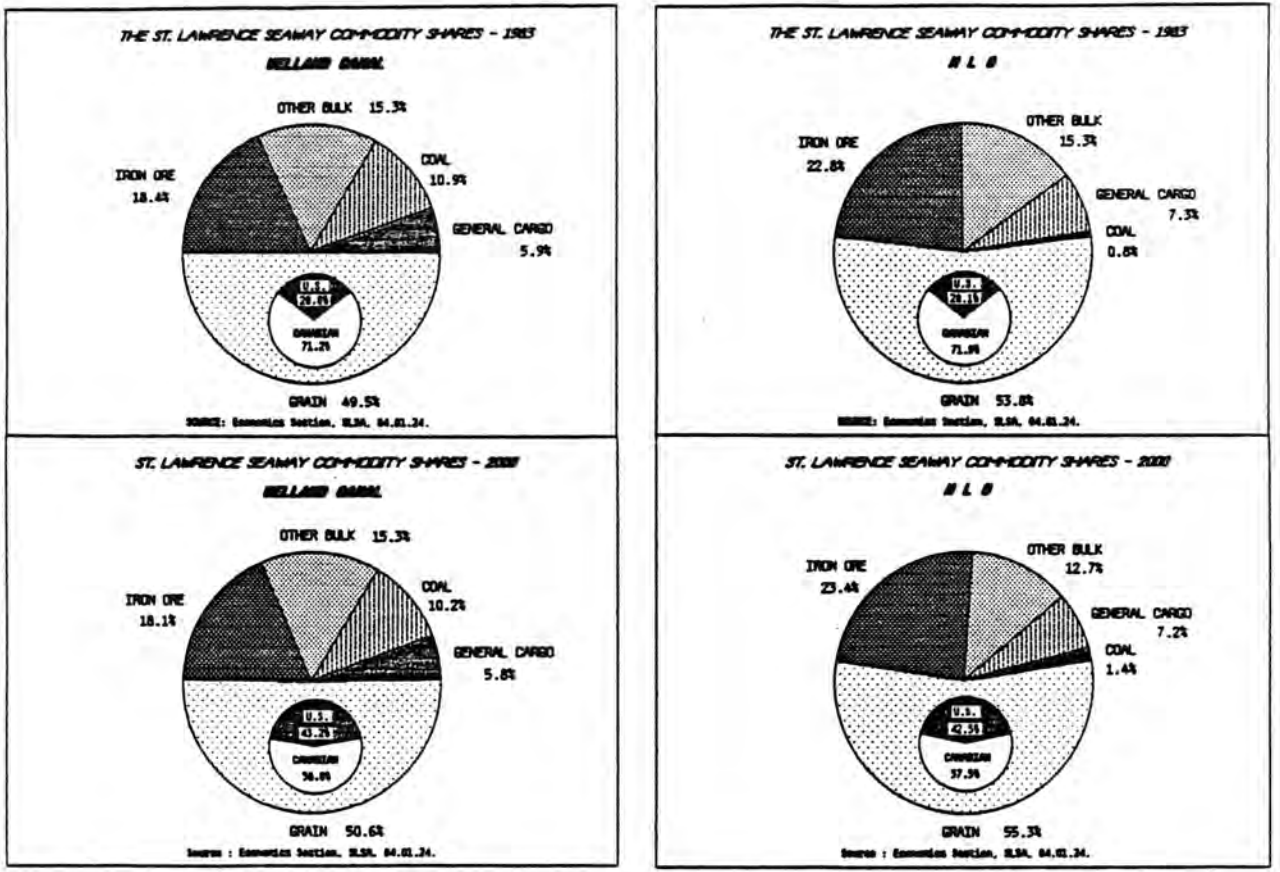
In our efforts to respond efficiently to these growing requirements, we developed and implemented on a micro-computer system, a comprehensive model which simulates most of the economic activities related to the Seaway transportation system and allows us to use our modest resources at optimum efficiency. Although the concept of the SEPS evolved gradually since 1974, its implementation was made possible with the advent in 1980 of the user-friendly and cost effective micro-computer systems. Before describing the SEPS-CMP, it is necessary to illustrate the Seaway traffic and tolls which are the major issues around which the SEPS was developed.

THE SEAWAY TRAFFIC

Cargo traffic through the waterway includes more than fifty five (55) types of commodities which can be grouped under five major categories as follows: grain, iron ore, coal, other bulk, and general cargo. The movement of grain is together with that of iron ore and coal, the most significant of the Seaway since they constituted about 79% of all the 1983 cargo traffic on the Welland Canal. Moreover, downbound movement of grains provides a back-haul for the upbound movement of iron ore. In essence, these three commodities are basic to Seaway economics. The remaining traffic is distributed over a wide range of commodities such as iron and steel products, petroleum products, coke, stone, salt, etc. (see Figure 1).

In 1958, the year before the Seaway opened, total cargo tonnage moving through the old system amounted to 10.7 million tonnes on the Montreal-Lake Ontario section and 19.3 million tonnes on the Welland. In 1959, traffic jumped to 18.7 million tonnes on the former and 25 millions on the latter. With periodic fluctuations, Seaway tonnage trended steadily upwards with a peak of 57.5 million tonnes being recorded during the 1977 season on the Montreal-Lake Ontario section, and 66.2 million on the Welland in 1979. Since the record levels reached in the late 1970's Seaway traffic has declined substantially, mainly due to the deep and prolonged economic recession, and by 1982 shipments on the Montreal-Lake Ontario section had fallen to 42.8 million tonnes

FIGURE 1


THE ST. LAWRENCE SEAWAY COMMODITY SHARES - 1983
WELLAND CANAL
OTHER BULK 15.3%
IRON ORE 18.4%
COAL 10.9%
GENERAL CARGO 5.9%
U.S. 28.8%
CANADIAN 71.2%
GRAIN 49.5%
SOURCE: Economics Section, SLSA, 84.01.24.
THE ST. LAWRENCE SEAWAY COMMODITY SHARES - 1983
M L 8
IRON ORE 22.8%
OTHER BULK 15.3%
GENERAL CARGO 7.3%
COAL 0.8%
U.S. 28.1%
CANADIAN 71.9%
GRAIN 53.8%
SOURCE: Economics Section, SLSA, 84.01.24.
ST. LAWRENCE SEAWAY COMMODITY SHARES - 2000
WELLAND CANAL
OTHER BULK 15.3%
IRON ORE 18.1%
COAL 10.2%
GENERAL CARGO 5.8%
U.S. 43.2%
CANADIAN 56.8%
GRAIN 50.6%
Source : Economics Section, SLSA, 84.01.24.
ST. LAWRENCE SEAWAY COMMODITY SHARES - 2000
M L 8
IRON ORE 23.4%
OTHER BULK 12.7%
GENERAL CARGO 7.2%
COAL 1.4%
U.S. 42.5%
CANADIAN 57.5%
GRAIN 55.3%
Source : Economics Section, SLSA, 84.01.24.

and 49 million tonnes on the Welland. Nevertheless, the economic recovery of 1983 contributed to a slight rebound of the Montreal-Lake Ontario and Welland traffic to 45.1 and 50.1 million tonnes respectively.

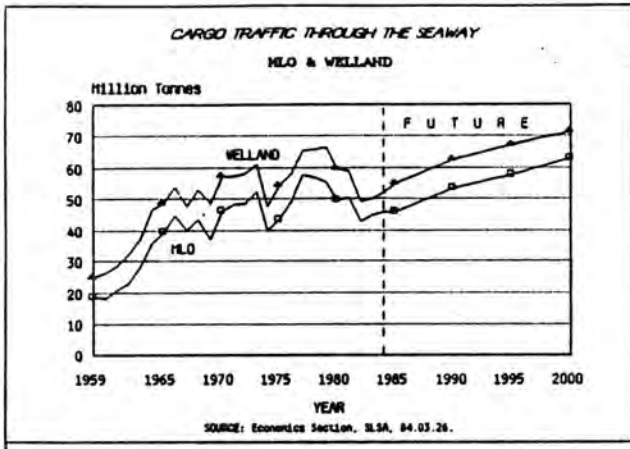
Current forecasts[1] which were prepared using the newly developed Seaway Traffic Forecast Model (STFM) - briefly described later in this paper - indicate that traffic should resume on an upward trend and achieve levels in the order of 63 million tonnes on the Montreal-Lake Ontario and 72 million on the Welland Canal by the year 2000 (see Figure 2).

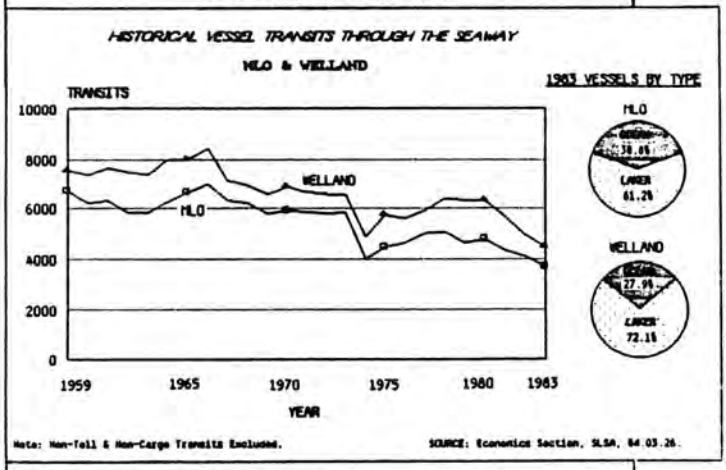
THE SEAWAY TOLLS

With the opening of the Seaway in 1959, a tariff of tolls based on estimates of future traffic was established by agreement between Canada and the U.S. Its purpose was to obtain directly from the users the revenues required to cover operation and maintenance costs for this joint facility as well as interest on loans and repayment of capital over a fifty-year period. This objective was not met, and since the beginning of 1973 with the impact of inflation, revenues were no longer able to keep pace even with the operating and maintenance costs and the operating deficit for the system escalated rapidly. Although the terms of the agreement between Canada and the U.S. permitted periodic reviews of

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1. Based on the August 1983 SLSA most probable forecast scenario which is likely to occur at ± 5% accuracy within one year from the latest update.


CARGO TRAFFIC THROUGH THE SEAWAY
MLO & WELLAND
Million Tonnes
80
70
60
50
40
30
20
10
0
F U T U R E
WELLAND
MLO
1959
1965
1970
1975
1980
1985
1990
1995
2000
YEAR
SOURCE: Economics Section, SLSA, 84.03.26.


HISTORICAL VESSEL TRANSITS THROUGH THE SEAWAY
MLO & WELLAND
1983 VESSELS BY TYPE
TRANSITS
10000
8000
6000
4000
2000
0
WELLAND
MLO
1959
1965
1970
1975
1980
1983
YEAR
MLO
LAKER
61.2%
WELLAND
27.9%
LAKER
72.1%
Note: Non-Toll & Non-Cargo Transits Excluded.
SOURCE: Economics Section, SLSA, 84.03.26.

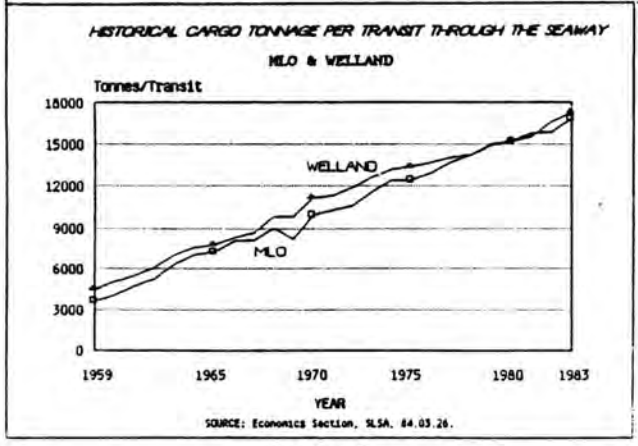

HISTORICAL CARGO TONNAGE PER TRANSIT THROUGH THE SEAWAY
MLO & WELLAND
Tonnes/Transit
18000
15000
12000
9000
6000
3000
0
WELLAND
MLO
1959
1965
1970
1975
1980
1983
YEAR
SOURCE: Economics Section, SLSA, 84.03.26.

FIGURE 2

the Tariff of Tolls in order to meet financial requirements, tolls on the Seaway remained relatively unchanged (tolls on the Welland section were suspended in 1962 and replaced by a modest lockage fee in 1967) until a revision was accepted by the two governments in 1978. The revised tariff provided for increases in tolls to be phased-in over a three-year period ending in 1980. The tariff was further revised to provide for additional revenues to cover O & M costs during the 1982 and 1983 navigation periods.

The present Seaway tolls structure is a composite charge on the cargo tonnes carried by a vessel moving via the waterway, the gross registered tonnage of the vessel (GRT) and, in the case of the Welland Canal, a lockage fee related to the number of locks the vessel goes through. The amount of charges will also vary according to the section of the Seaway the vessel is transiting, the type of cargo carried, and on whether the vessel is loaded or in ballast (see Figure 3).

The basic objective of present tolls policy is to ensure that the two Seaway entities are able to cover the costs of providing satisfactory service to users of the system. Since this policy was inaugurated in 1978, the SLSA has remained on a self-supporting basis without resorting to government appropriations or other outside funding.

HISTORICAL TOLL CHANGES

MONTREAL-LAKE ONTARIO SECTION

	59-77	1978	1979	80-81	1982	1983
Grain Charges ($/Tonne)	0.44	0.41	0.41	0.41	0.48	0.52
Bulk Cargo Charges ($/Tonne)	0.44	0.50	0.62	0.68	0.79	0.85
General Cargo Charges ($/Tonne)	0.99	1.27	1.49	1.65	1.91	2.06
GRT Charges ($/GRT)	0.04	0.07	0.07	0.07	0.075	0.08

WELLAND CANAL SECTION

	59-62	63-66	1967	1971	1978	1979	80-81	1982	1983
Grain Charges ($/Tonne)	0.02	-	-	-	0.20	0.24	0.31	0.31	0.31
Bulk Cargo Charges ($/Tonne)	0.02	-	-	-	0.20	0.24	0.31	0.31	0.31
General Cargo Charges ($/Tonne)	0.06	-	-	-	0.28	0.39	0.50	0.50	0.50
GRT Charges ($/GRT)	0.02	-	-	-	0.07	0.07	0.07	0.07	0.07
Lockage Charges ($/Lock)	-	-	20	100	-	-	-	150	250

FIGURE 3

THE SEPS CONCEPT

The concept used in designing the SEPS visualized the Seaway Transportation System and its major components (waterway, locks, ports, vessels, etc.) at the centre of a huge transportation network comprising alternative routes and modes competing for various cargo flowing between different supply and demand centres. This environment is surrounded and influenced by a multitude of interrelated economic and institutional activities at various levels - establishment, regional, national, and international - (see Figure 4). Therefore, the economic role of the Seaway system could be better understood and the accuracy, speed and consistency of predicting its behaviour increased if we:

a) identify and link the elements of this environment,

b) depict the cargo flows through the arteries of the transportation network located between the supply and demand centers,

c) determine quantitatively and qualitatively the effect of the economic and institutional activities on this environment and on the economic behaviour of the Seaway Transportation System, and

d) simulate the above relationships (a, b and c) in a comprehensive computer model program.

Accordingly, the SEPS was developed and implemented. Although its approach focused on the Seaway, it could be used to analyse other elements of this environment after some modification.

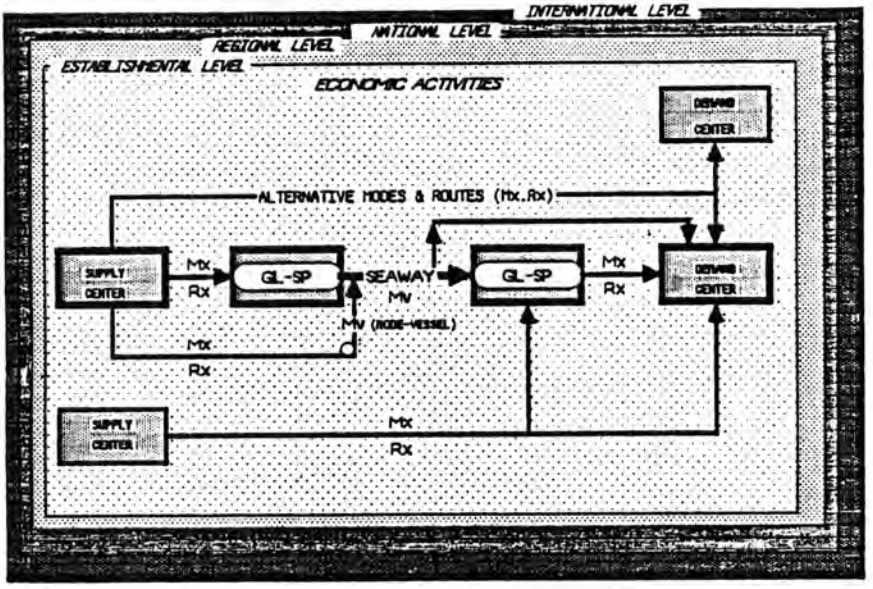


FIGURE 4

An important characteristic of the SEPS concept is that it is developed on a user-friendly and cost effective micro-computer system rather than on a mainframe computer. This allows it to be easily accessible, used, updated, modified and expanded directly by in-house economists without the need of an intermediate programmer nor the continual dependence on expensive consultants. Therefore, the experience acquired by Seaway economists on the economics of the waterway will consistently grow and be used efficiently and consequently, maximum productivity will be achieved. Nevertheless, we will still need to rely on outside organizations and consulting

firms for specific data and information on various elements of this environment which need particular expertise. This however, will be less frequent and at much lower costs than in the past.

MICRO-COMPUTERS AND THE SEPS

As it was mentioned earlier, the concept of the SEPS evolved gradually since 1974. However, due to budgetary constraints and the fact that the system had to be accessible, used and modified directly by in-house economists, its implementation was made possible with the advent of the user-friendly and cost effective micro-computer systems in 1980. The first phase of the SEPS was implemented early in 1981 on an Apple II+ personal micro-computer of only 48 KB RAM (random access memory). At that time, the SEPS consisted of a smaller version of the present Seaway Tolls Model (STM), which was first put to effective use during the 1981 toll negotiations between the Canadian St. Lawrence Seaway Authority (SLSA) and the U.S. Saint Lawrence Seaway Development Corporation (SLSDC) and proved to be extremely helpful in providing the two entities with the necessary data required to conduct the negotiations in a competent manner.

The second phase of this project was implemented during 1982-83 on an Apple /// micro-computer system with a larger memory of 256 KB (kilobytes). This allowed us to expand the Tolls Model and complete the development of the various forecasting models including the

Iron & Steel and the Grain Forecast Models. In both phases, a modular "Electronic Spreadsheet" software (VisiCalc) as well as statistical and graphic packages (Visitrend-plot and Stepwise Multiple Regression) were used to develop the various models. Moreover, a data base software (PFS) was utilized to store and analyse relevant data and information. By mid-1983 we had developed about thirty models, simulating various economic activities of the Seaway Transportation System. Although this had tremendously increased the productivity of the economics group, it had generated a new kind of problem. Besides some irritation and time loss created by moving data between these various models, the advantage of an inte-grated system - in which the flow of information can move directly from one model to another, which is our main objective - was not yet achieved due to the limitation of the 8-bit/256KB memory micro-computer system. Nevertheless, while we were developing the SEPS, we continued monitoring the technological progress in micro-computer hardware and software in order to find the system which suited our need.

During 1983, a new software generation, which had some capabilities for integrating various applications, was introduced. This badly needed tool was available on the more powerful 32-bit/1 Megabyte RAM Apple Lisa micro-computer. This system also included a hard-disk which can store 5 Megabyte of information in addition to six integrated software application packages including spreadsheet, graphics, data management, word processing,

drawing, and project scheduling. With features such as the integrated and multi-tasking capabilities powered by a large memory, this system fulfilled, to a greater degree, our technical requirements. Moreover, since we were able to trade in our Apple /// system, the Lisa was also cost-effective and met our modest budget. Consequently, it was purchased in mid-1983. Since then we have been implementing the third phase of the SEPS on the new Lisa system. The present report, was prepared with the uses of all six integrated application software of the Lisa system.

Total expenditures to date on all hardware and software used since the introduction in mid-1981 of the Apple /// system in the Economics Section totalled less than $25,000 including the Lisa system, a Dot-Matrix printer (for graphics and drawings) and a letter-quality printer.

STRUCTURE OF THE SEPS

The SEPS is a flexible, dynamic and comprehensive Computer Model Program (CMP), developed on a user-friendly and cost-effective micro-computer system. It is presently accessible, used and modified directly by in-house economists. The SEPS simulates the relationships between the various elements of the environment which influence the economic behaviour of the Seaway Transportation System. It is mostly used to answer questions like "What has happened" to the economic situation of the waterway, "How and Why did it happen",

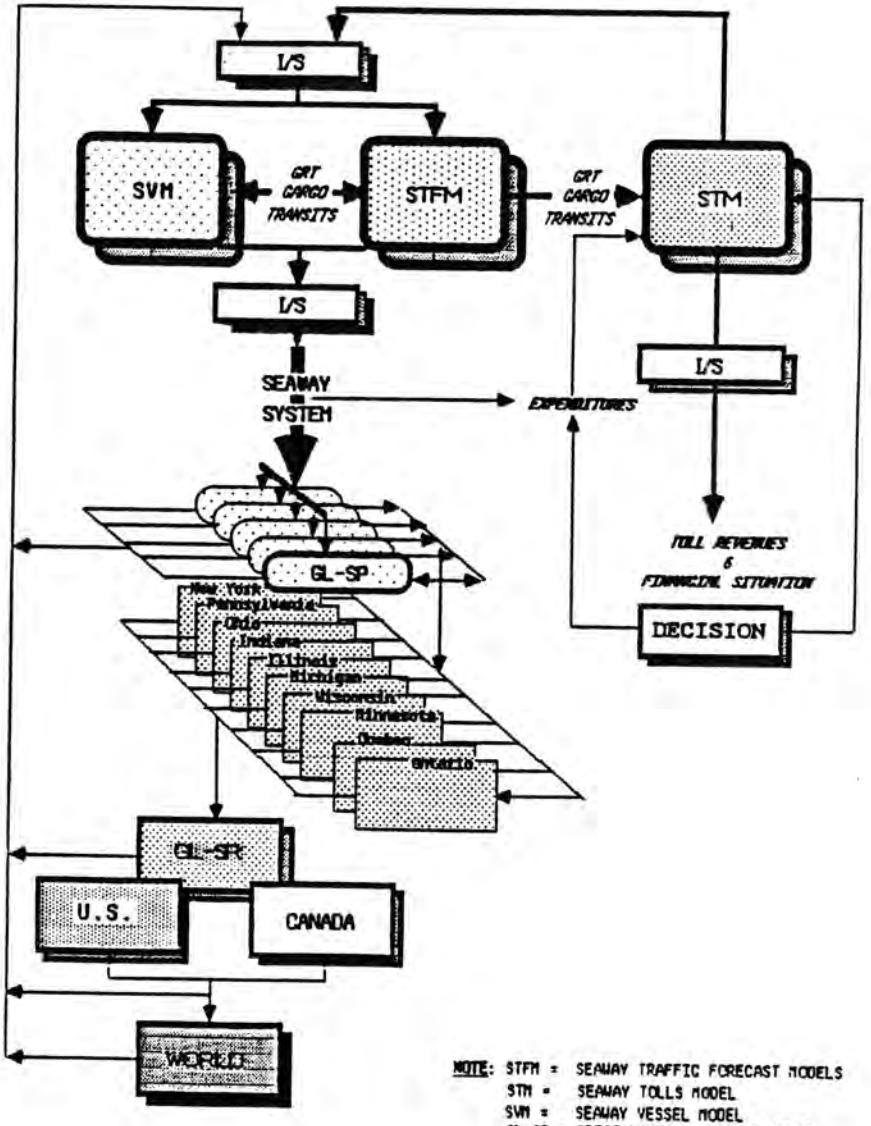
and "What is likely to happen If" the situation changes. The SEPS comprises several integrated computer models, through which the flow of information can move directly. It includes the Seaway Traffic Forecast Models (STFM), the Seaway Tolls Model (STM), the Seaway Vessels Model (SVM) and their respective Impact and Sensitivity Modules. For the purpose of this paper we will focus on the STFM to demonstrate the functions of the SEPS. The specific role of other SEPS components will be discussed when used in conjunction with the STFM for SEPS applications. The logic structure of the SEPS is illustrated in Figure 5.

The Cargo, GRT and Vessel Transit forecasts, which are prepared periodically with the help of the STFM, are automatically fed to the STM (see Figure 6) where they interact with the Seaway toll structures and converted to corresponding toll revenues. The latter estimates will then be correlated with major Seaway expenditures data in the financial module of the STM. The final output is a detailed statistical report about the financial situation of both Seaway entities (SLSA & SLSDC), including their surplus or deficit situations as well as their cash flow positions. The outputs of the STFM are also fed to the SVM - which contains a data base and toll modules for vessels moving via the Seaway by size, type, age, owner, traditional route and cargo carried etc. - in order to project future fleet mix.

If a new financial goal is required, the STM and its Impact and Sensitivity modules could be used in con-

THE SEAWAY ECONOMIC PLANNING SYSTEM
(SEPS - CMP)

OVERVIEW



NOTE: STFM = SEAWAY TRAFFIC FORECAST MODELS
STM = SEAWAY TOLLS MODEL
SVM = SEAWAY VESSEL MODEL
GL-SP = GREAT LAKES - SEAWAY PORTS
GL-SR = GREAT LAKES - SEAWAY REGION
I/S = IMPACT & SENSITIVITY ANALYSES

FIGURE 5

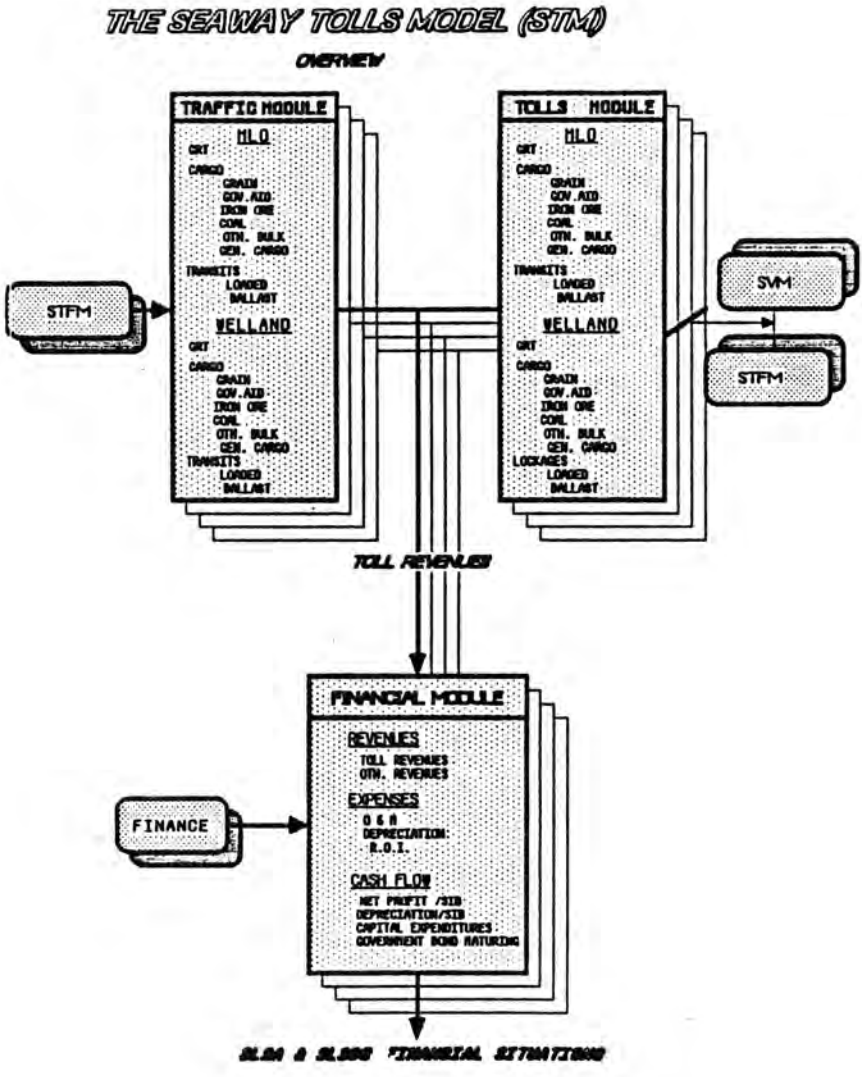

THE SEAWAY TOLLS MODEL (STM)
OVERVIEW
TRAFFIC MODULE
MLO
GRT
CARGO
GRAIN
GOV.AID
IRON ORE
COAL
OTH. BULK
GEN. CARGO
TRANSITS
LOADED
BALLAST
WELLAND
GRT
CARGO
GRAIN
GOV.AID
IRON ORE
COAL
OTH. BULK
GEN. CARGO
TRANSITS
LOADED
BALLAST
TOLLS MODULE
MLO
GRT
CARGO
GRAIN
GOV.AID
IRON ORE
COAL
OTH. BULK
GEN. CARGO
TRANSITS
LOADED
BALLAST
WELLAND
GRT
CARGO
GRAIN
GOV.AID
IRON ORE
COAL
OTH. BULK
GEN. CARGO
LOCKAGES
LOADED
BALLAST
STFM
SVM
STFM
TOLL REVENUES
FINANCIAL MODULE
REVENUES
TOLL REVENUES
OTH. REVENUES
EXPENSES
O & M
DEPRECIATION
R.O.I.
CASH FLOW
NET PROFIT /SIB
DEPRECIATION/SIB
CAPITAL EXPENDITURES
GOVERNMENT BOND MATURING
FINANCE

FIGURE 6

junction with both the STFM and the SVM to determine the optimum toll structure and levels which achieve the desired financial objectives of both entities without undermining the competitive position of the waterway vis-à-vis alternative routes or modes, i.e. the SEPS -CMP will take into account the interests of the various Seaway users in conjunction with any change in the Seaway tolls. If however, this new objective cannot be achieved solely by a change in tolls, then the SEPS can also be used to determine the impact of an optimum change in Seaway expenditures. Moreover, the comprehensive market framework, developed within the SFTM, can be used to identify potential traffic which could move via the Seaway and contribute to the achievement of the desired financial goal. Finally, the above three options can be applied separately or in conjunction with each other.

THE SEAWAY TRAFFIC FORECAST MODEL (STFM)

The STFM is designed to satisfy the requirement for regular updating of Seaway traffic forecasts. It consists of twenty-four (24) modules (22 for Cargo Traffic Forecasts and one for each Vessel and GRT Traffic Forecasts, see Figure 7) which simulate the impacts of alternative economic, technological and institutional conditions on major cargo traffic moving via the waterway. The STFM provides conditional forecasts to pretest the effect of modified assumptions on world macro-economics, regional and modal levels for Canada and the U.S. It is mainly used to produce short, medium and long range

THE SEAWAY TRAFFIC FORECAST MODEL

OVERVIEW

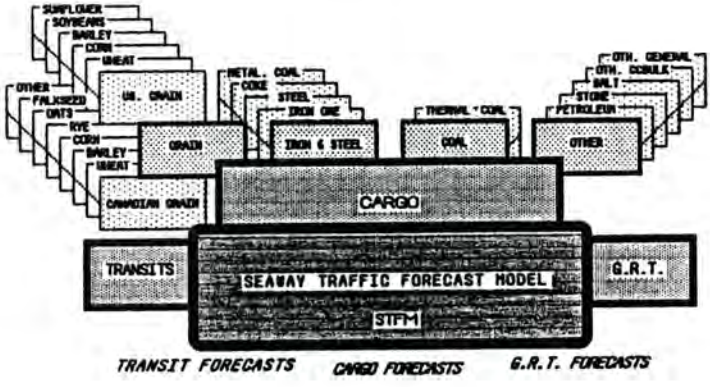


FIGURE 7

Seaway traffic forecasts for twenty two groups of commodities which are subsequently used to generate Vessels Transits (lockages) as well as GRT forecasts. Moreover, the model was designed to interact with the other two major SEPS components, namely the Seaway Tolls Model (STM) and the Seaway Vessel Model (SVM). In conjunction with these two models, it can be used to perform impact and sensitivity analyses related not only to the Seaway traffic but also to the Seaway tolls, to the vessels moving via the waterway and to other components of the Seaway Transportation System.

The modules of the STFM are constructed to allow maximum flexibility in updating, forecasting and modifying. It is possible to specify a set of exogeneous factors which are routinely available from any number of

government agencies or private forecasting organizations such as DRI, Chase Econometric, etc.

The approach used in the STFM follows the general SEPS concept, described earlier, with some slight modifications to suit the different types of commodities. In general, world demand and supply for major commodities transported through the Seaway are first analyzed and projected. Then the North American balances between domestic supply and demand are estimated, and the exports, imports and domestic shipments, which might move via the Seaway, are then segregated. Finally, the weight of the combined factors (wcf) which influence the selection of the mode(s) and route(s) through which the cargo will move, is applied in order to estimate the Seaway share of this movement. Transportation cost differentials are used instead of the (wcf) only when available on a consistent basis and from reliable sources.

The methodology applied to derive the (wcf) as well as the traffic forecasts combines both qualitative and quantitative techniques. Correlation and regression analyses which are used to obtain these estimates consist in using constant and weighted exogeneous variables to derive a set of equations that forecast traffic. Validation and testing the models and their equations consist in running a correlation of estimates with past movements. The degree of accuracy was found to be between (±) 3 to 8% depending on the type of commodity and the length of the forecasted period.

The results of the various regression analyses performed for the development of the SEPS are very encouraging. Generally, the coefficients of determination (R^2) are high averaging 0.9, indicating that the factors selected explain 90% of the past traffic variations. The F-tests, which test against the null hypothesis of no correlation, are greater than 10, indicating that correlation exists between selected variables. The Durbin-Watson statistic (D-W), a test of auto-correlation, is between 1 and 2.5, indicating the absence of auto-correlation between the selected independent variables.

As can be seen from Figure 8, the Iron & Steel Traffic Forecast Model simulates most of the activities involved, from the production of iron ore in the Canadian Supply Center of Quebec-Labrador mines to its consumption in the U.S. Demand Centers. Between these two points, the demand for the Quebec-Labrador iron ore traffic through the Seaway and its competitive position vis-à-vis alternative sources, modes or routes, are influenced by the interaction of several economic, technological, and institutional factors existing at various levels of this worldwide commercial environment. The Iron & Steel Model simulates most of these relationships and produces forecast figures for the iron ore traffic as well as the iron and steel products imported to the U.S. via the Seaway. Traffic forecasts for coke and coal (used by the steel industry) are also produced as by-products of this model.

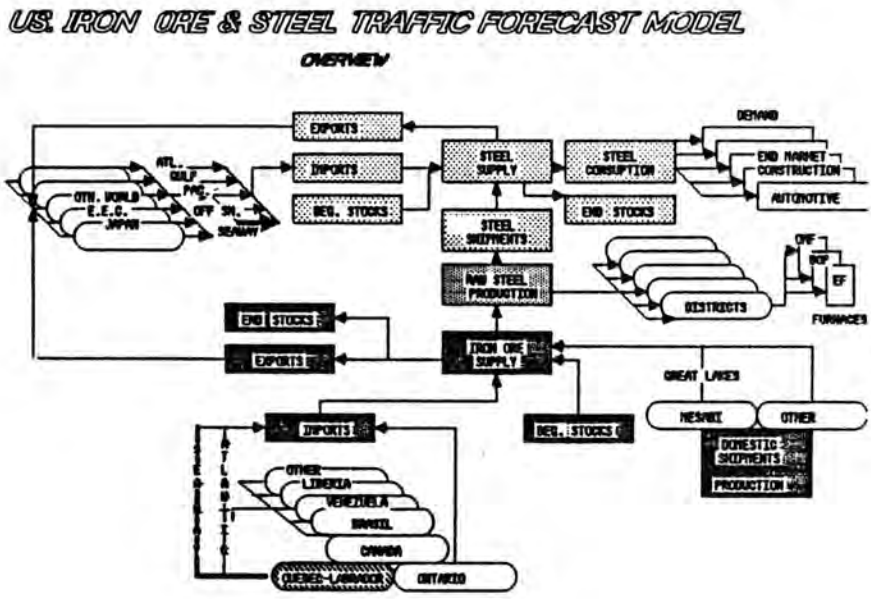


FIGURE 8

Figure 9 shows the World Grain Supply-Demand Model which was developed as an integral part of the Seaway Grain Traffic Forecast Model in order to estimate demand for Canadian and U.S. grain by major importing regions. It simulates the interaction between the factors of supply and demand of major world grain producing and consuming regions as well as the grain trade flows between them. The regions are linked together through the import-export activities, the size of which is determined by many factors, including the forces of supply and demand and the dynamic market share distribution between the regions. The information obtained from this model is fed into the Canadian and U.S. grain forecast models where they interact with other domestically related fac-

WORLD GRAIN SUPPLY-DEMAND

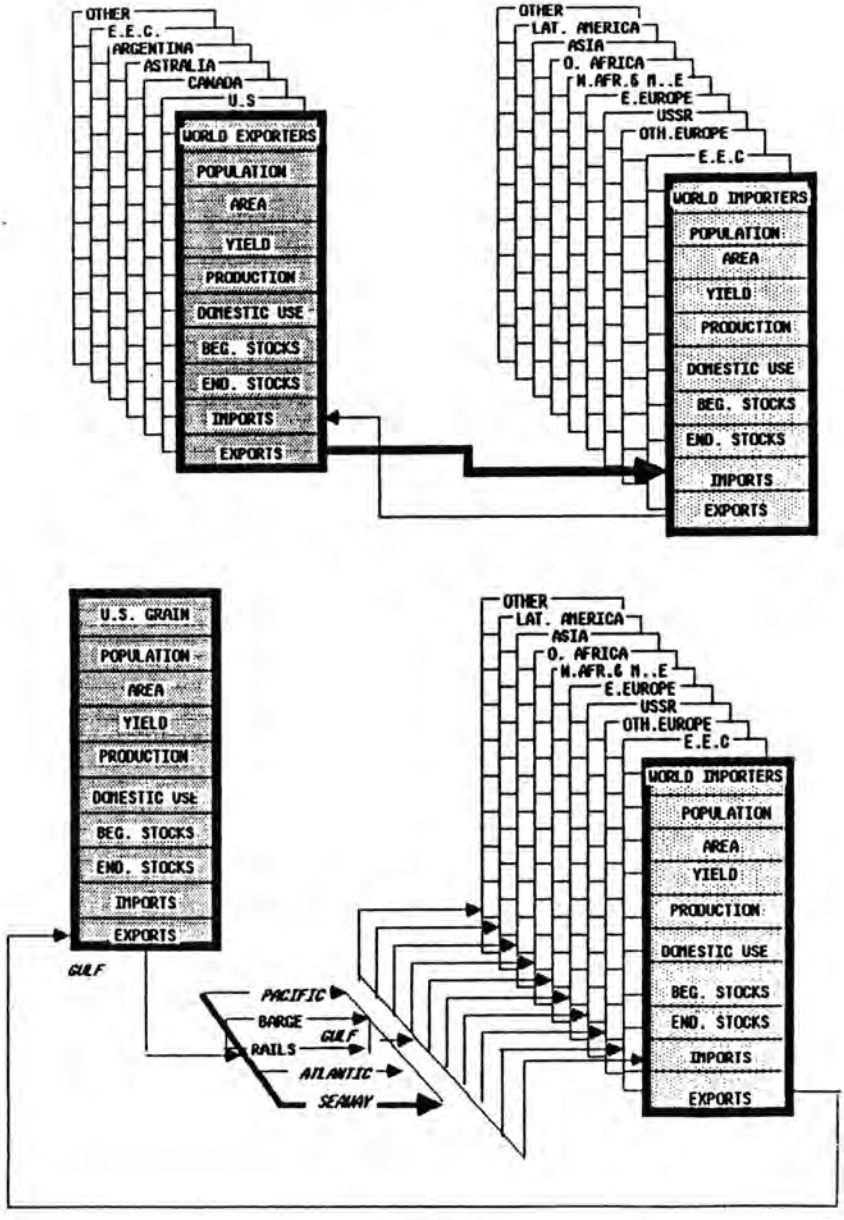


FIGURE 9

tors to derive grain shipments (for exports and domestic uses) by domestic transportation routes and modes. Subsequently, future grain traffic through the Seaway is estimated.

WHAT WE CAN DO WITH SEPS

Following are some hypothetical examples of what we can do with SEPS.

A) Assuming that, due to weather conditions, the wheat production in the U.S.S.R. in 1985 should decrease by 20% below the 1984 level and that all major wheat exporting countries could maintain their market shares. What will be the impact of this development on the Seaway Grain and Total Traffic? on the Seaway Toll Revenues and Financial Situation?

Once the relevent data is fed into the World Grain Supply-Demand module of the STFM Model, we will be able to forecast instantly the following information:

1. Total U.S.S.R. wheat imports in 1985
2. U.S.S.R.'s wheat imports by major exporters
3. Canadian wheat exports to the U.S.S.R.
4. U.S. wheat exports to the U.S.S.R.
5. Canadian wheat exports to the U.S.S.R. via the Seaway
6. U.S. wheat exports to the U.S.S.R. via the Seaway
7. New Seaway grain and total traffic forecasts in 1985

The output from the STFM including the new 1985 cargo traffic as well as its corresponding Vessel Transits and GRT forecasts will be fed to the STM which in turn will generate the new 1985 Seaway Toll revenues by sections as well as by entities i.e. the SLSA and SLSDC. The new financial situation (Surplus or deficit) of both entities will also be provided.

B) What if changes occur in more than one factor at the same time? One such change could be a variation in the market shares of the wheat exporting countries. The model will take this variation into account when computing items 1 through 7 and will present new results for each of these items. A drop in the U.S. or Canadian market share would be a relevant information at this stage.

C) What if the U.S.S.R. wheat production increases by 20% in 1983? This situation will be the reverse of A) and B). A decrease will be noticeable in most of items 1 to 7 and the financial position of the Seaway could be negatively affected. Accordingly, it might be decided that a change in toll levels and or structure is required in order to achieve a new financial objective. Therefore the SEPS will be used to determine the optimum toll structures and levels which fulfill this new goal without undermining the Seaway competitive position. Moreover, the system will also be used to assess the impact of these new toll changes on the various vessels using the Seaway System.

CONCLUSION

Although the third phase of the SEPS-CMP has been implemented, the system is by no means completely developed; continual research and modifications are required to bring the system to an operational and advanced stage which will allow it to respond efficiently to the requirements of the future. Moreover, although the SEPS is a comprehensive system covering a wide scope of the economic environment of the Seaway Transportation System, it should not be regarded as the "answers producer" to all of the Seaway economic problems, but rather as a tool which can help Seaway economists analyse the economic behaviour of the Seaway system.

SUPPLY MODELS FOR DISAGGREGATE ANALYSIS

by

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and

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ABSTRACT

The last decade has seen significant advances in the development of demand models, particularly the introduction of disaggregate demand analyses techniques such as the logit and probit models. The advantages offered by these techniques are that they are sensitive to policy questions of interest to decision makers, require relatively little data to calibrate and are behaviourally based. Unfortunately, this same pace has not been maintained in the development of complimentary supply models required in a comprehensive disaggregate planning process. Such supply models are, however, vital as they are the means of translating between the normal measures of transportation supply (e.g., bus miles of service, bus hours of service, etc) and the measures of the travel experience of commuters (e.g., minutes of in-vehicle travel time, waiting time, etc.) required as input to the disaggregate demand models. The supply models are also key to the efficient aggregation of the demand model forecasts necessary for area wide planning.

This paper presents a two stage approach to generating simplified transit supply models for disaggregate analysis. In the first step, the distributions of the measures of the commuter's travel experience (e.g.,

walking time, waiting time, etc.) required as input to the demand models are measured. In the second step these measures of experience are related to macro measures of transit supply (e.g., bus hour of service, bus route miles, etc.). Estimates on the change in travel demand, can then be predicted directly from changes in transit supply using these simplified relationships. The paper concludes with a discussion of how these simplified supply models can also be used to greatly improve the efficiency of the aggregation process. Very often research papers ignore this important final step entirely or treat it in rather naive or brute force fashion. The simplified transit supply models developed in this paper present a more elegant solution to this problem of preparing unbiased (areawide) demand forecasts from models predicting individual travel behaviour.

INTRODUCTION

Disaggregate modal split models, which represent the strategic heart of many new planning procedures, are specified in terms of a number of key explanatory variables, typically:

Modal Split = f
- In-vehicle travel time
- Out-of-vehicle travel time
- Parking charge
- Out-of-pocket costs (other than parking costs)
- Auto availability

In order to be able to forecast future modal splits resulting from the introduction of new transportation policies or infrastructure, it is first necessary to express the impact of such changes in terms of the

explanatory (independent) variables of the modal split models. The supply models discussed in this paper provide the analyst with the means of making the conversion from fundamental measures of transportation supply, such as bus hours of service, bus miles of service, miles of bus route, etc., to the important modal split model input parameters (i.e., measures of the commuters travel experience), such as minutes of out-of-vehicle travel time, in-vehicle travel time, etc.

Furthermore, disaggregate modal split models such as the logit model are non-linear; consequently to prepare unbiased forecasts using these models, it is necessary to integrate them over the full range of the independent variables. This means that the complete distributions, or at least reasonable approximations of the distributions, of the explanatory variables (e.g., out-of-vehicle time) are required. The supply models discussed in this paper are aimed at estimating these distributions for each of the key policy variables and, hence, play an important role in conditioning the data for the application of efficient modal split aggregation procedures.

Finally, it must be mentioned that the supply modelling procedures developed in this paper provide simple, direct relationships between the modal split model variables and aggregate descriptors of the supply system and therefore and well suited to sketch planning applications.

The introduction of disaggregate demand models has revolutionized the demand modelling field. Unfortunately, supply modelling has not enjoyed the same rapid advance to date. What is encouraging however is that the revolution in demand modelling has opened up a tremendous potential for the development of innovative supply models. These new models can be made far more sensitive to the

policy interests of analysts, yet at the same time, they can be more accurate than traditional approaches and far simpler and quicker to calibrate and exercise. These three objectives of speed (through simplicity), accuracy, and policy sensitivity have been used as the guiding principles in developing the supply models presented in the following pages. The general principles developed in this paper can be applied to preparing supply models for any of the modal split model explanatory variables. However, in the interest of brevity, only one supply model will be described, that being for transit out-of-vehicle travel time.

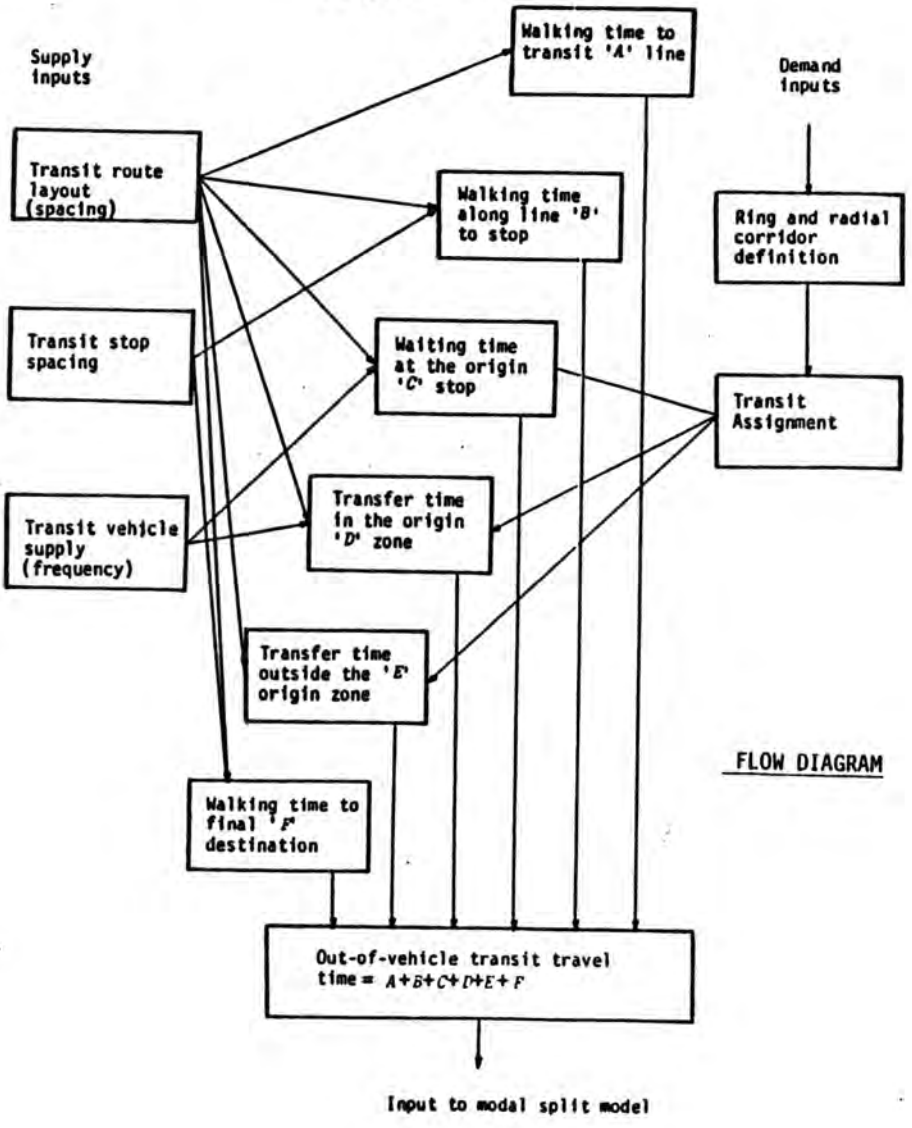
THE THEORY

The basic concept underlying the procedure for estimating transit, out-of-vehicle travel time is based on the concept that the separate components of the total out-of-vehicle time (i.e., walking time, waiting time, transfer time, etc.) can each be modelled as random variables with known means and variances. Furthermore, each component can be assumed, as a first approximation, to be indepent of the others. Since each of these component random variables have distributions that are reasonably well behaved (i.e., no extreme skewing), their summation (i.e., walking time plus waiting time plus transfer time), which yields the random variable for total transit out-of-vehicle time, has a distribution that can reasonably be assumed to be a normal distribution. Simply assuming the transit, out-of-vehicle travel time, random variable to be normally distributed, with mean and variance computed by summing the means and variances of the component distributions, provides a sufficiently precise estimate of this important input parameter of the modal split model for sketch planning purposes. As will be demonstrated later, knowing the approximate shape of

this distribution is very important, as it greatly simplifies the aggregation procedure.

The information and logic flow for the determination of out-of-vehicle time is shown in Figure 1.

Figure 1



In the procedure presented in this paper for estimating out-of-vehicle time, access walking time, waiting time, and so on are first measured for a specific (exisiting) area and transit operation, then in a second step are related to aggregate measures of transit supply such as bus hours and bus miles of service. For sketch planning policy analysis, where a quick, approximate answer is sought concerning the change in modal split (which can be anticipated for a change in bus hours or vehicle miles of service) the transformation from transit supply measures to measures of the individual travellers experience required as input to the modal split models can be made simply and directly.

THE SUPPLY MODEL COMPONENTS

The two step procedure for modelling each of the previously described out-of-vehicle time components and combining them into a single out-of-vehicle time distribution is as follows.

Access Walking Time

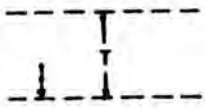
The distribution of access walking times to transit lines for a particular area (traffic zone) can be estimated by first examining the basic areas bounded by the bus lines (rectangles, triangles, etc.) and measuring their dimensions. The distribution of walking times within each area can be estimated quickly and simply using simple probablistic relationships. Examples of distributions of walking times for a few typically shaped areas (given that many urban areas have been laid out on a rectangular grid) are shown in Figure 2.

The walking time distribution for each planning zone can be estimated by combining (summing) the walking time distributions for each of the sub-areas defined (bouned by) the transit lines.

This procedure involves two important assumptions

Figure 2

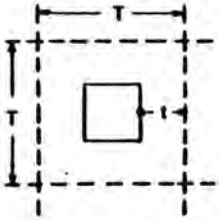
- For parallel transit lines



$$P(x<t) = \frac{2t}{T}$$

$$f(t) = \frac{2}{T}$$

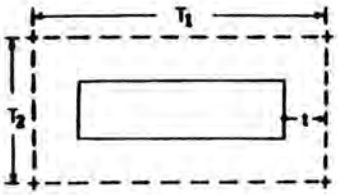
- For a uniform grid system



$$P(x<t) = \frac{1}{T^2}(4tT - 4t^2)$$

$$f(t) = \frac{(4T - 8t)}{T^2}$$

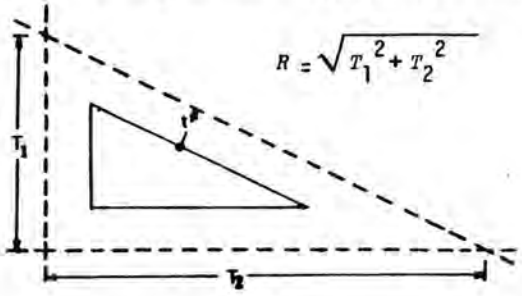
- For rectangular route layouts



$$P(x<t) = \frac{1}{T_1 T_2}(2T_1 + 2T_2 - 4t)t$$

$$f(t) = \frac{(2T_1 + 2T_2 - 8t)}{T_1 T_2}$$

- For triangular route layouts (right-angle triangles)



$$R = \sqrt{T_1^2 + T_2^2}$$

$$P(x<t) = \frac{1}{T_1 T_2}\left(T_1 t + tR + T_2 t - t^2 - \frac{t^2 R}{T_1} + tR - \frac{t^2 R}{T_2} - \frac{t^2 R^2}{T_1 T_2}\right)$$

$$f(t) = \frac{1}{T_1 T_2}\left[T_1 + T_2 + 2R - 2t\left(1 - \frac{R}{T_1} - \frac{R}{T_2} - \frac{R^2}{T_1 T_2}\right)\right]$$

concerning transit commuter behaviour:

1. That commuters will walk to the nearest transit line.
2. That the origins of commuters in the zone are uniformly distributed over the zone.

The first assumption is made for the sake of computational simplicity. It is known that commuters generally do find the walking portion of the trip onerous and hence will generally walk to the nearest available transit line. In certain circumstances, however, it may be quicker and more convenient for a particular commuter to walk further than the nearest line in order to save the inconvenience of a transfer by catching a bus directly routed to his (her) desired destination. This trade-off of walking time versus transfer time is dealt with in the following section on transfers.

The second assumption of a uniform distribution of settlement over the origin zone is also made in the interest of computational simplicity. In actual fact, it is known that high-density accommodation (e.g., high-rise apartments) tend to be located along major arterials close to transit lines or, conversely, transit lines tend to be located so as to conveniently serve such major traffic generators. This means that the estimated walking times tend to be somewhat longer than those that would actually be observed. Where information is available on the size and location of such concentrations of commuters, it can be readily used to adjust the walking time distributions. Failing the availability of such knowledge, however, the assumption of a uniform distribution of commuters over the area would seem to be the most logical alternative.

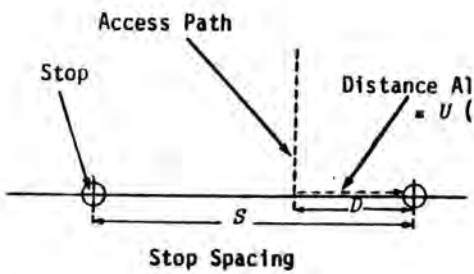
Once the combined distribution has been estimated by combining the component distributions the mean and variance must be computed by using standard statistical

techniques (using integration).

Stop Spacing Walking Time

In addition to the walking distance to the bus line, there is also a walking time along the bus line (or parallel to it) to the nearest bus stop. The distribution of this component of walking time is assumed to be uniformly distributed from zero to one-half the stop spacing.

STOP SPACING



$$\mu_{D_i} = \tfrac{1}{4}S/w$$

$$\sigma^2_{D_i} = \frac{S^2}{48w^2}$$

Let D_i = walking time along a bus line from point of intersection to the nearest bus stop.

where μ_{D_i} = expected walking time along a bus route to a stop (minutes)

S = stop spacing in feet

w = walking rate (feet per minute)

$\sigma^2_{D_i}$ = variance of walking time along a bus route

It must be recognized, of course, that the distribution of walking time along a bus line is not always uniformly distributed and in fact it would only be uniform for the case of commuters served by very long parallel bus lines. At the other extreme, for example, would be commuters served by a uniform grid of bus lines. Far from having a uniform distribution of walking times along the route, these commuters would have a triangular distribution of walking time. In practice, however, since the spacing of bus lines (i.e., distance between adjacent bus lines) tends to be large relative to the bus stop spacing and as many corridor bus lines do follow parallel routes in a corridor along parallel major arterials, it is judged reasonable to assume a uniform distribution of walking times along a bus line in the interests of computational simplicity. Furthermore, this element of total out-of-vehicle travel time is relatively small for most commuters.

Waiting Time

Waiting time is assumed to be distributed uniformly form 0 to the headway (h) of transit vehicles for short headways (i.e., h 10 mins). Therefore, for short headways, the mean and variances of waiting time is as follows:

Let W_k = waiting time for a bus on route k (minutes)

$\bar{\mu}_{W_k} = \frac{1}{2} h_k$

$\sigma^2_{W_k} = 1/12\ h_k^2$

h_k = headways of buses on route k (for $h < 10$ mins)

For longer headways, however, some account may have to be taken of the fact that commuters will anticipate the schedule and attempt to reduce their waiting time.

They will not maintain a constant waiting time, however, as commuters will tend to increase their margin of safety because of the seriousness of just missing a bus when they are infrequent.

The mean and variance of waiting times in a zone are estimated by weighting the expected waiting time for each route by the length of the route in that zone. This assumes that the longer a bus route is in a particular zone, the more area it covers and commuters it serves and, hence, the more transit riders who will have to wait that expected length of time for a bus. This assumption further implies an equal spacing of all lines (i.e., equal loading per unit length of bus line). This assumption is not as onerous as it first might appear because transit planners do strive to position transit lines fairly uniformly in order to provide good area coverage and to minimize walking distances. Furthermore, the arterials on which transit operates tend to be themselves fairly uniformly spaced. If in a particular instance there is a major imbalance in route loading and this information is known to the planner, it can be used to adjust the probabilities of a commuter choosing a particular route.

The mean and variance of waiting times in a zone are estimates as follows:

Let W_i = waiting time for transit in zone 'i'

$$E(W_i) = \frac{\sum_{k=1}^{n} d_{i,k} E(W_{i,k})}{N_i} \qquad \sigma^2_{W_i} = \frac{\sum_{k=1}^{n} d_{i,k} E(W_{i,k})^2}{N_i} - E(W_i)^2$$

where $W_{i,k}$ = waiting time for transit on route 'k' in zone 'i'

$d_{i,k}$ = length of transit route 'k' in zone 'i'

$N_i = \sum_{k=1}^{n} d_{i,k}$ total length of bus routes in zone 'i'

n = total number of routes in zone 'i'

Transfers

An important feature of transit service is that it does not generally provide direct door-to-door service for all passengers, but rather, most passengers must transfer between routes to reach their final destinations. This requirement to transfer adds a further important component to total out-of-vehicle travel time. Since questions of transit connectivity and routing circuitry are important policy issues, they must be explicitly accounted for in the supply modelling procedure.

In the transfer models presented in this paper two transfer possibilities are considered, these are:

A. A transfer inside the origin zone from feeder to line-haul, the probability of which is assumed to be proportional to the coverage of the origin zone provided by feeder buses relative to line-haul buses.

B. A transfer outside the origin zone from line-haul service to line-haul service, the probability of which is assumed to be inversely proportional to the coverage of the destination zone by those transit lines providing direct line-haul service to/from the origin zone.

Details on the procedures for estimating the distributions to transfer waiting times are presented in the following two sub-sections.

Transfer Time Inside the Origin Zone (Feeder-to-Line-Haul Transfers)

In the previous description of the distribution of walking times at the origin end of a trip, it was assumed that transit commuters will walk to the nearest bus line, irrespective of the orientation of that line. If the

line is oriented in the desired direction of travel, commuters will simply board in that direction and ride off toward their final destination. If the nearest transit line does not provide service in the desired direction of travel, commuters will board in that direction which promises to intersect a bus line that is oriented in the desired direction of travel, in effect using the nearest bus line as a feeder service to reach an appropriate line-haul route. A transfer will then be made from the feeder to the line-haul route and the trip continued toward the final destination.

The probability of a commuter not requiring the use of a feeder service in the origin zone in order to gain access to an appropriate line-haul route can be estimated as the ratio of the sum of the lengths of all feeder transit lines in the origin zone to the sum of the lengths of all transit lines in the origin zone.

Let $X_{i,j}$ = event of a transfer in the origin zone 'i' when travelling to destination zone 'j'

$$Pr\left\{X_{i,j}\right\} = 1 - \frac{\sum_{k=1}^{n} d_{i,k}}{\sum_{k=1}^{m} d_{i,k}}$$

where $Pr\left\{X_{i,j}\right\}$ = the probability of requiring a transfer in origin zone 'i' when travelling to destination zone 'j'

$d_{i,k}$ = length of bus line 'k' in origin zone 'i'

n = total number of bus lines in origin zone 'i' serving the desired direction of travel (assigned corridor) for trips taken to zone 'j'

m = total number of bus lines in the origin zone 'i' (feeder + line haul routes)

The transfer waiting time (i.e., the time between descending from one bus and boarding another) is a function of the schedules of the intersecting bus lines. If there is no integration of schedules (i.e., each bus route is scheduled independently), it would be reasonable to assume that for a large number of transfer locations, the transfer waiting time would be uniformly distributed (random) over the headways of the bus routes being intersected and, hence, the expected waiting times would be approximately one-half the headway of the bus lines to which transfers were being made. At the other extreme, for timed focal point transfers (i.e., fully integrated schedules), transfer time can be assumed constant at some reasonable value sufficient to allow people to make the change of vehicle, say two or three minutes. In most scheduling schemes, some combination of these two extremes is the rule, with coordinated transfers being confined to those bus routes operating on longer headways where integration is both more practical and worthwhile.

Modelling the timed transfer case presents few problems as the expected waiting time is simply the product of the scheduled overlap time and the probability of requiring a transfer. For the random case, the distribution of transfer waiting times can be estimated in a manner similar to that used to estimate the distribution of origin waiting times. That is to say, the distribution of transfer waiting times in an origin zone can be approximated as the distribution of headways for each of the bus lines serving a particular direction of travel weighted by its length in the origin zone. Weighting the transfer time expected for each line by its length attempts to account for the fact that longer line-haul routes have a higher probability of intercepting passengers from feeder lines.

Let $T_{i,j}$ transfer time inside the origin zone 'i' when making a transit trip to zone 'j'.

$$E\left\{T_{i,j}\right\} = \frac{\sum_{k=1}^{n} d_{i,k} \cdot E(W_k)}{\sum_{k=1}^{m} d_{i,k}}$$

$$\sigma^2_{T_{i,j}} = \left\{ \frac{\sum_{k=1}^{n} d_{i,k}\left[E(W_k)\right]^2}{\sum_{k=1}^{m} d_{i,k}} - \left(E\left\{T_{i,j}\right\}\right)^2 \right\} + \left(Pr(X_{i,j}) \cdot E\left\{T_{i,j}\right\}^2\right.$$

where $E(W_k)$ = expected transfer waiting time for a connection with transit route 'k' ($\frac{1}{2}$ headway of transit route 'k')

Transfer Time Outside the Origin Zone

As previously mentioned, the very real possibility remains even after a commuter departs the origin zone heading in the desired direction of travel that a further transfer will be required to reach the final destination.

The probability of requiring a transfer after leaving the origin zone can be determined in much the same manner as that of requiring a transfer within the origin zone. These probabilities are based on the availability of a direct line-haul transit link between the origin and destination zones and the coverage of the destination zone by any such direct connection. In other words, if there is no such direct link, then the

probability of requiring a transfer outside the origin zone is 1.0. If there is a direct link between and destination zones, then the probability of requiring a transfer to reach a desired location in the destination zone is inversely proportional to the coverage of the destination zone by the direct link.

The distribution of transfer waiting times outside the origin zone can be approximated as the distribution of headways for those transit routes to which transfers are being made (i.e., those transit routes serving the destination zone but not providing any direct connection to the origin zone).

Egress Walking Time

Work places tend to be far more concentrated and hence more easily served by transit than are residences. Therefore, the walking distances from the destination bus stop to the place of work are generally considerably shorter on average than are the origin walking distances. The walking distances at the destination end of a transit trip can be estimated using a technique similar to that described for the origin end of the trip, except that the estimates should only be performed for employment activity centres, not residences. Due to the concentration of work places along the bus routes and the shorter walking distances, the estimate of walking distance need not necassarily be broken into two parts (i.e., time to the route, time along the route to a stop) as it was at the origin end of the trip, but rather can be estimated as a single random variable (i.e., egress walking time).

TOTAL OUT-OF-VEHICLE TRAVEL TIME

The component parts of total out-of-vehicle time when travelling by transit have been described in the preceding sections as a series of random variables

(i.e., walking time, waiting time, transfer time, etc.), each with estimated mean and variance. What is more, each of these random variables can be assumed to be reasonable independent of the others. It is submitted that summing such a series of random variables to generate an estimate of total out-of-vehicle time produces a random variable (i.e., total out-of-vehicle time) that ahs approximately a normal distribution. Certainly the assumption of a normal distribution is good enough for sketch planning purposes and offers the great advantage that a single, well-documented distribution can be used to model the out-of-vehicle travel time random variable for input to the modal split model. This simplification of the complex, out-of-vehicle travel time variable greatly enhances the efficiency of the modal split aggregation procedure, as will be demonstrated in the next section.

The normally distributed, transit out-of-vehicle time random variable (OVTT) will have the following mean and variance:

$$OVTT_{ij} = N\ (\mu_{ij},\ \sigma^2_{ij})$$

where

$$\mu_{ij} = \bar{A}_i + \bar{D}_i + \bar{W}_i + \bar{T}_{ij} + \bar{T}'_{ij} + \bar{E}_j$$

$$\sigma^2_{ij} = \sigma^2_{A_i} + \sigma^2_{D_i} + \sigma^2_{W_i} + \sigma^2_{T_{ij}} + \sigma^2_{T'_{ij}} + \sigma^2_{E_j}$$

$\bar{A}_i$ ($\sigma^2_{A_i}$) = mean (and variance) of access walking time to the nearest bus line in origin zone 'i'

$\bar{D}_i$ ($\sigma^2_{D_i}$) = mean (and variance) of walking time along the route to a bus stop in origin zone 'i'

$\bar{W}_i$ ($\sigma^2_{W_i}$) = mean (and variance) of waiting time for a bus in origin zone 'i'

$\bar{T}_{ij}$ ($\sigma^2_{T_{ij}}$) = mean (and variance) of transfer time inside the origin zone 'i' for trips made to destination zone 'j'

$\bar{T}_{ij}$ ($\sigma^2_{T'_{ij}}$) = mean (and variance) of transfers outside the origin zone 'i' for trips made to destination zone 'j'

$\bar{E}_j$ ($\sigma^2_{E_j}$) = mean (and variance) of egress walking times in destination zone 'j'

The rationale for approximating the distribution of total out-of-vehicle time by a normal distribution derives from the central limit theorem, which states that

> "Under very general conditions, as the number of variables in the sum becomes large, the distribution of the sum of random variables will approach the normal distribution" (Benjamin and Cornell, 1970, p.251).

Or in mathematical terms,

$$\lim_{n\to\infty} \Pr\left[\frac{Xn}{\sqrt{n}} \leq t\right] = \frac{1}{\sqrt{2\pi}} \int_{-\infty}^{t} e^{-x^2/2}\, dx$$

Among the general conditions referred to in the definition is that the summed random variables be independent, and is argued that the component parts of out-of-vehicle time can reasonably be assumed to be independent, and that each variable has a small effect on the sum. Typical ranges of the variables in question are the following:

0 - 15 min.
0 - 5 min.
0 - 15 min.
0 - 15 min.
0 - 15 min.
0 - 15 min.

So it can be seen that no one of these component parts totally dominates the sum.

It may argued that six is not a large number of random variables summed upon which to appeal to the central limit theorem. It is argued, however, that convergence to a normal distribution is this case will be reasonably rapid, because with the exeption of the two-transfer waiting time variables, the other component time random variables have distributions that are quite "well behaved." That is to say, the distributions do not exhibit any extreme skewing, although there is some tendency to be flatter on the right-hand tail.

The peculiarity of the two-transfer time variable components of the sum is the presence of an impulse function at the origin of each corresponding to the probability of not requiring a transfer and hence zero transfer time. For most applications, the distortion this causes can be safely ignored.

TRANSIT OUT-OF-VEHICLE TIME -- QUICK METHOD

The method described for estimating the distribution of out-of-vehicle times could be used directly to provide

the inputs to the modal split model as it transforms transit supply measures such as headway and route coverage into transit performance measures experienced by and important to users. The procedures for obtaining these estimates however are fairly complicated. There are many situations in sketch planning, however, where this degree of sophistication is not required. For example, an analyst may want a quick estimate of how much increased ridership can be expected by adding more buses to existing routes or more routes to an area. Quick answers to these types of non-geography-specific questions can be obtained by using a plit of out-of-vehicle time versus some generalized measures of transit supply, such as bus hours per route miles as a measure of frequency (i.e., waiting time) and route miles per square mile as a measure of coverage (i.e., walking time).

Figure 4 presents a plot of the expected walking time versus route miles per square mile for Winnipeg, and Figure 5 presents the expected waiting time as a function of the bus hours per route mile. Both plots are for peak-hour conditions. The impact of supply changes can be quickly estimated by entering the plot and determining the change and using this figure in determining total out-of-vehicle time to be input to the demand model.

It must be recogonized that the quick procedure simplifications ignore the practical feasibility of these changes, in effect assuming that they can be made. Care must be taken in making such assumptions that they are reasonable. Once again, in the interests of brevity only two examples are presented however, the same techniques can be adapted to each of the component parts of the out-of-vehicle travel

Figure 4

WALKING TIME VERSUS TRANSIT ROUTE DENSITY

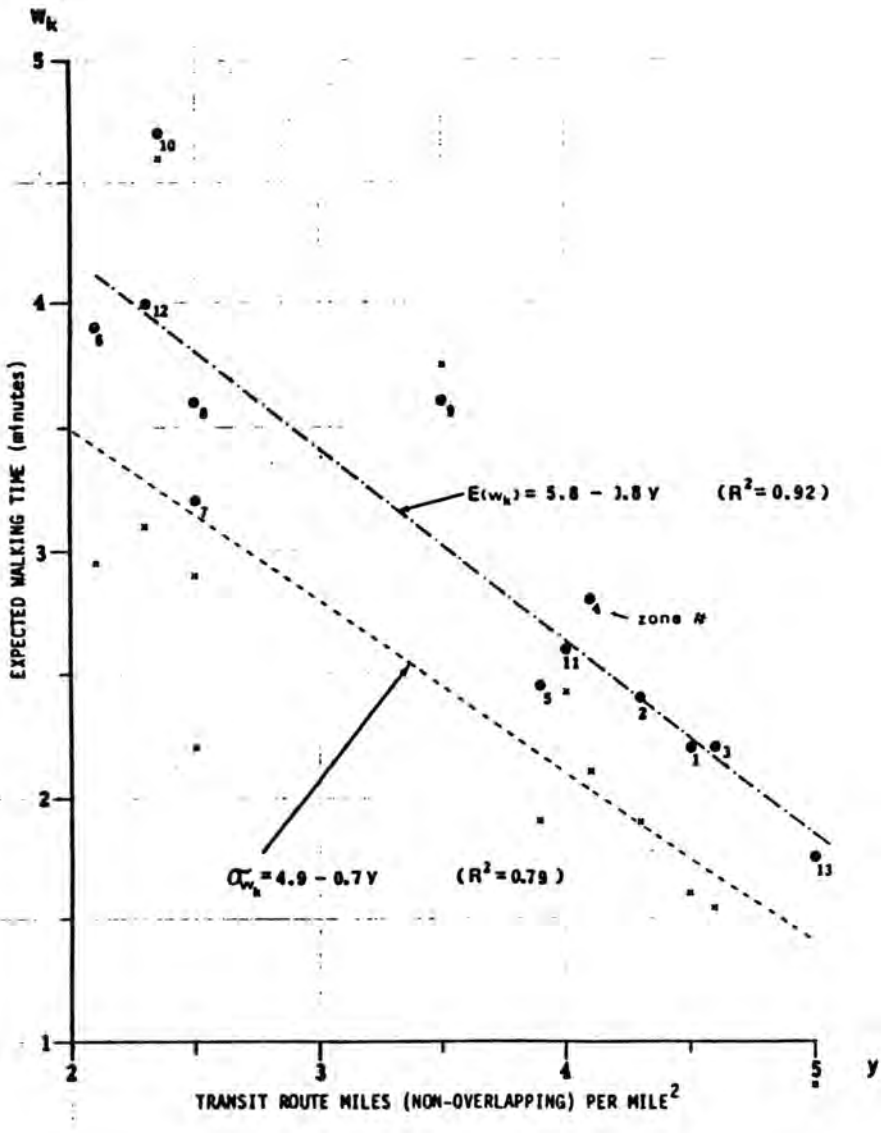
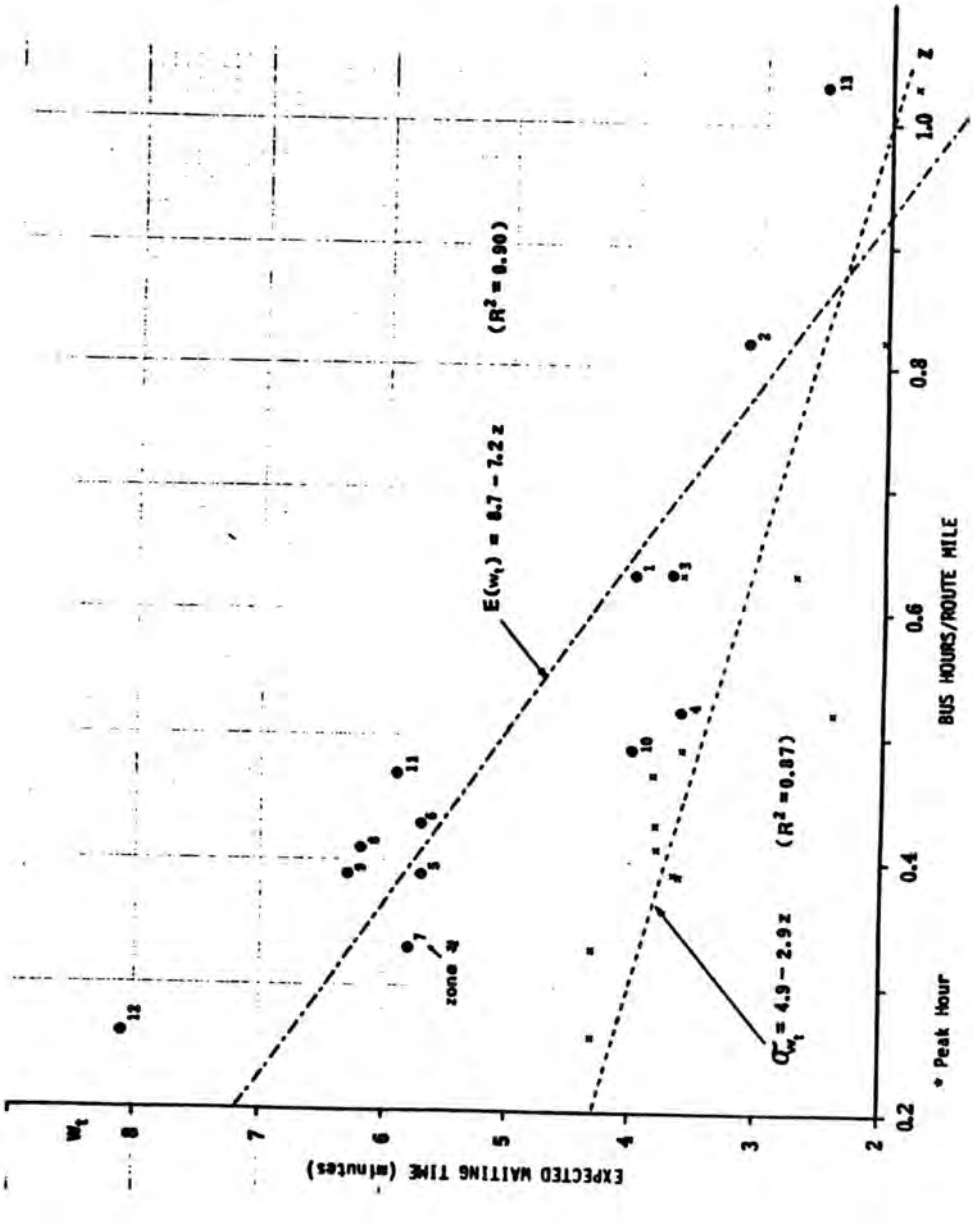


Figure 5

WAITING TIME VERSUS TRANSIT SUPPLY



AGGREGATION

The disaggregate modal split model are so named because they are calibrated using observations on individual trip making, and when exercised, yield predictions on individual trip making. A decision maker, however, is rarely interested in individual behaviour but rather requires aggregate predictions that will forecast the behaviour of an entire population or sub-population. The output of disaggregate modal split models generally, therefore, must be "aggregated" before they can be used in decision making.

Since disaggregate modal split models are non-linear, it is not possible to simply aggregate the values of the input parameters by averaging them, then computing a single "representative" modal split from these mean values. The result of this "naive" approach to aggregation will be biased. Alternately exercising the model using as input the characteristics of each individual commuter then averaging these modal splits is computationally impractical. Individual enumeration is impractical, averaging input parameters is biased; therefore, some other means of aggregation is required. A number of approaches, including random simulation, are described in two references: Koppleman (1974;1976).

The procedure developed in this paper for aggregation is unique and is based on market segmentation and the nature of the supply models previously described. The basic concept uses the explanatory variables of the modal split model to split the commuter market into a number of independent market segments. The modal split is then computed for each market segment. The aggregate modal split estimate (for each O-D zone pair linkage) is prepared by using a weighted average of the market-specific modal splits, where each split is weighted by the

number of commuters contained in the market segment it represents.

Details of the aggregation procedure are described in the following sections.

The disaggregate modal split models (such as the logit and probit models) contain both discrete and continuous variables.

Probability (mode = m) = P •
- In-vehicle travel time
- Out-of-vehicle travel time

} Continous variables

- Parking charge
- Auto availability
- Sex

} Discrete variables

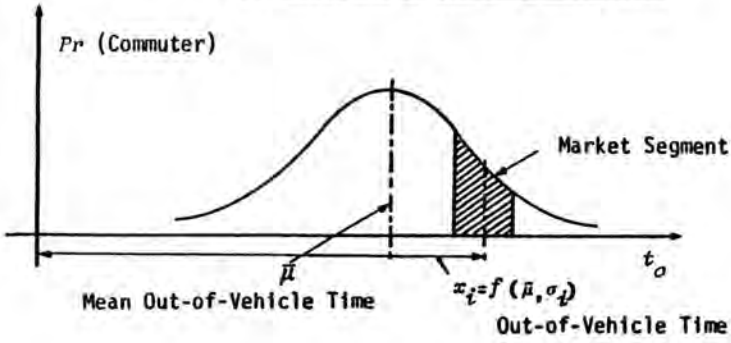
Both types of variables can be used to segment the journey-to-work market. In the case of discrete variables the procedure is straight forward each discrete unit of the variable being a market segment. For example sex defines two market segments: male and female.

In the case of the continuous variables such as out-of-vehicle time and in-vehicle time however, the procedure is somewhat more complicated. Using the supply modelling techniques developed in this paper however a rapid and unbiased aggregation procedure can be applied as described below.

The supply model for out-of-vehicle time described estimates out-of-vehicle time as (approximately) a normally distributed variable with estimated mean and standard deviation. This distribution can be factored readily (using normal distribution tables) into a number of equal market segments (i.e., equal areas under the normal curve).

Figure 6

DISTRIBUTION OF OUT-OF-VEHICLE TIME



The mean value of the waiting time for each of these segments can be determined as a function of the standard deviation.

e.g., if the normal distribution is cut into six equal areas, the second area to the right (or left) of the mean will have a value $X = \mu \pm 0.685$

The model can be run for each of the values of out-of-vehicle time and the aggregate (mean) modal split determined by taking the mean of the resulting modal splits:

$$P(m) = \sum_{q=1}^{r} P(m, i_q) \cdot S_q$$

where $P(m)$ = Probability of choosing mode 'm'

i_q = Characteristics of commuters in market segment 'q'

$P(m, i_q)$ = Probability of commuters in market segment 'q' choosing mode 'm'

S_q = Fraction of all commuters who are in market segment 'q'

r = Number of market segments.

Using this approach to aggregation, the distribution of out-of-vehicle times is "stepped through" and the non-linear nature of the model is fully accounted for. The greater the number of steps, that is, the greater the number of market segments, the more accurate will be the approximation. Twelve equal areas produce excellent results, but quite acceptable results could generally be obtained from six areas.

It is interesting to contrast this deterministic approach to aggregation with the random sampling and simulation used by Talvitie and others. Under the sampling approach, a random selection of commuters (normally not less than 50) is made from each area and their travel time characteristics are input to the model. The resulting modal splits are then averaged to produce the aggregate measure. It is submitted that the determinsitic approach developed in this dissertation is far more efficient. There is also less danger of bias, since covariance is maximized, thus improving the chance that the true mean will be reasonably approximated when the modal split models are averaged.

CONCLUSION

The supply modelling technique described in this paper represents a contribution to the further development of non-network, parametric supply models of the type pioneered by Talvitie and Train at the University of California. The step forward represented by this model is that it can deal with an area-wide transportation system and is not confined to a single corridor as the Talvitie and Train model.

The supply modelling technique illustrated is independent of the need for detailed network modelling. It also can be made sensitive to most of the key policy issues of interest to transit planners such as line

spacing, headways, stop spacing, connectivity, and special services, something not duplicated by most network-based transit models.

The concept of approximating a normal distribution as the input to the modal split model from the sum of a series of random variables (walking, waiting, transfer, egress times, etc.) represents a unique approach to simplifying the out-of-vehicle time input to the modal split model.

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ESTIMATING RAIL LINE CAPACITY AND DELAY BY COMPUTER SIMULATION

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ABSTRACT

This paper describes the Rail Capacity Model (RCM), a simplified simulation model designed to be economical in both data acquisition and computer run costs. RCM simulates the movement of trains between terminals connected by a single track railroad line with passing sidings at various intervals. The user specifies the line configuration, train classes, and traffic flow patterns. RCM generates trains at a given arrival rate, and dispatches and redispatches them as they move between the origin and destination terminals. Delay, run time, and traffic statistics are accumulated for a variety of output reports. A unique feature of the model is its ability to generate a complete delay function for the line being simulated. Application of RCM to representative data shows that the model produces credible capacity and delay estimates which compare favorably to results produced by more complex simulators.

INTRODUCTION

Recent changes in the structure of the railroad network in the United States and Canada and shifts in the demand for rail service have created concerns about railroad line capacity. Unfortunately, in comparison to the other transportation modes, relatively little research has been conducted on railroad line capacity. This has been

due largely to the inherent complexity of the railroad system. Major determinants of line capacity, such as operating policy, traffic mix, line geometry, and terminal configuration, vary widely among rail lines. Traditional methods for capacity analysis rely on manual calculations and empirical observations, and are time consuming and difficult to apply. Simple analytical models, which are the logical alternative, have had great difficulty in realistically duplicating rail operations.

Computer simulation is one technique which is being successfully used for rail line capacity analysis. Simulation can be used to model very complex systems with an outstanding degree of reality. Large numbers of alternatives may be examined without expending large quantities of time and money. The Canadian National Railroad was a pioneer in the use of simulation techniques for capacity analysis, having developed models in the early 1960s (1). As computer languages and hardware became more sophisticated, many other railroads followed suit. By the 1970s, simulation models were in common use among railroads in the United States, including the Southern Railway, the Southern Pacific Railroad, the Burlington Northern, and the Penn Central (2,3,4). The Interstate Commerce Commission (ICC) and several railroads in the United States have used the Train Dispatching Model (5), which is a relatively large and complex rail line simulator.

Although they are extremely powerful, the current generation of models exhibit several tendencies which inhibit their general application. Many of the models are designed for a detailed analysis of rail operations. Their primary focus is upon the behavior of individual trains, not the overall line. This attention to detail produces high data collection and computer run time requirements and

hinders portability and general application of the model. The proprietary nature of many of the models also hinders their general use.

For network level analyses and preliminary planning, a readily available, generalized rail model is needed. To address capacity questions specifically, the model should be oriented towards a macro-level analysis, ignoring the operational characteristics of individual trains. Input data requirements should be held to the minimum sufficient to describe accurately the behavior of the line. Output from the model should be available for several traffic levels, so that a function of delay versus the number of trains could be estimated. With such a model, analysts could test various alternatives and network options simply by changing a few input records. If this initial level of investigation showed capacity problems or other interesting results, a more detailed model could be used for further analysis.

RCM (6) was developed to meet these stated goals of simplicity and economy. This simulator is capable of estimating the average delay incurred by trains moving over a single track line with intermediate passing sidings. The user specifies the line configuration, train classes, and traffic flow patterns. RCM generates trains at a given arrival rate, dispatching and redispatching them as they move between their origins and destinations. Delay, run time, and tonnage statistics are accumulated for a variety of reports. At the end of the simulation period, the model can increment the rate of traffic generation and repeat the simulation. This process continues until a specified number of iterations are performed or until the average delay per train exceeds an acceptable limit. RCM may thus be used to develop a delay function for the line of interest. So far as is known, this is a unique feature among rail line simulators.

The following sections of this paper present an overview of rail line capacity analysis in general, details on RCM, and a discussion of some results and applications.

DETERMINANTS OF LINE CAPACITY

The practical capacity of a railroad line is the volume of a given mix of traffic that can be handled with acceptable delay. This definition recognizes that capacity is dependent upon the type as well as the number of trains that pass over a line segment. As the traffic volume increases, the average delay per train increases in an exponential fashion. This relationship is illustrated in Figure 1. Note that the volume level where delay reaches infinity is never reached in actuality. Customers would either switch to alternative carriers, or the railroad company would attempt to improve the line.

Line capacity is influenced by many factors, the importance of which varies depending upon the specific situation. A few of the determinants of capacity are:

1. Acceptable delay;
2. Track configuration;
3. Control characteristics;
4. Train speeds;
5. Traffic characteristics;
6. Maintenance requirements;
7. Service disruptions; and
8. Terminal efficiency.

The following descriptions of each of these factors will illustrate their potential influence on line capacity.

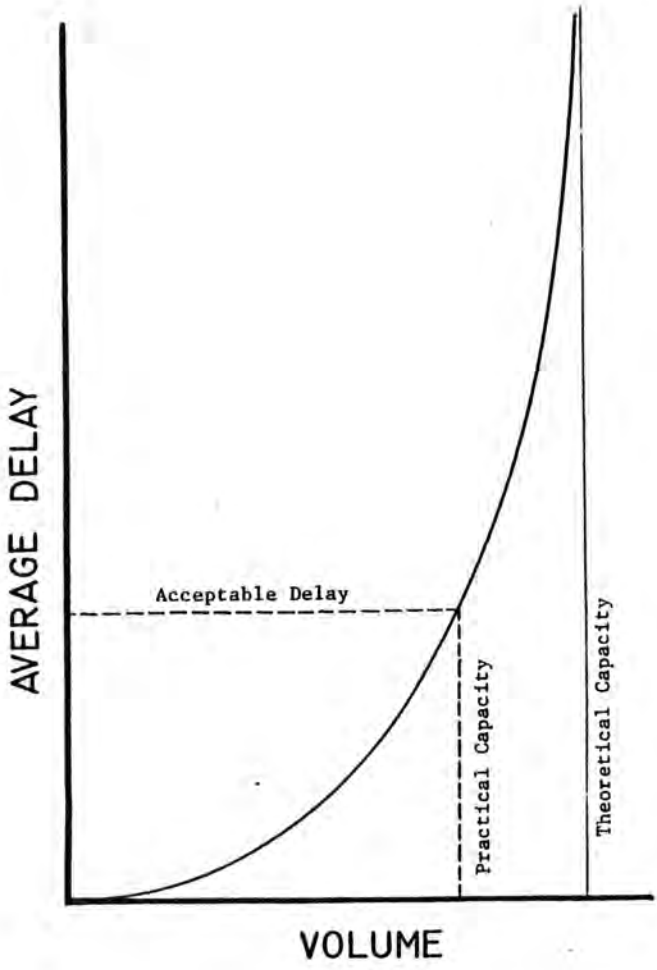


FIGURE 1. Typical Railroad Delay Function

Acceptable Delay

Acceptable delay is the difference between the allowable maximum movement time and the minimum run time from point to point along the line. The minimum run time is the ideal with no restrictions due to weather, other traffic, etc. The maximum allowable movement time is subjectively chosen by railroad management in view of operating and customer service expectations. That component of the movement time caused by meeting and overtaking other trains is called meet delay. When the average meet delay for all trains or for a given train class exceeds the acceptable delay, the line has reached its practical capacity.

Track Configuration

Line capacity generally increases with the number of sidings and the amount of multiple track. Favorable configurations reduce avoidable meet delay. The spacing of sidings and crossovers are an important parameter in capacity analysis. In general, train delay is proportional to siding spacing, assuming that siding lengths are adequate to handle the trains.

Control Characteristics

Railroad control systems are of three major types, listed in the order of increasing sophistication: timetable-train order (TTO), automatic block signal (ABS), and centralized traffic control (CTC). Sophistication in the control system increases capacity by improving the quality of information available to the dispatcher and train crews. This allows the dispatcher to plan meets and passes better,

thus reducing meet delay, and also allows the trains to be operated at a higher rate of speed, increasing the throughput of the line.

Train Speeds

Train speeds are a very important influence on line capacity. Lower speeds decrease segment capacity because throughput is reduced. Uniformity of speed is also important. Differences in train speeds increase the interaction between train characteristics, the signal system, operating rules, and track geometry.

Maintenance Requirements

Maintenance of track and line structures temporarily lowers line capacity by reducing track availability and restricting train speeds. As traffic volume increases, wear accelerates, with a proportional increase in the demand for maintenance time. In most areas of the country, maintenance activities are performed during the summer months. Maintenance therefore tends to have a seasonal impact upon capacity.

Service Disruptions

Accidents, equipment failures, and strikes cause temporary disruptions in line capacity. The frequency of these events can become great enough, depending upon weather conditions, maintenance practices, and traffic volume, to have a definite impact on the overall capacity of a line.

Terminal Efficiency

The effects of terminal operations upon line capacity have only recently begun to be understood. Functions performed at terminals

include the assemblage and break-down of trains, servicing, and crew changes. To the extent that the time durations of these activities can be reduced, acceptable delay on-line can be increased. Furthermore, if the terminal has sufficient capacity to handle traffic demands, then trains need not be delayed on-line awaiting access to the terminal. Failure to include the effects of terminal efficiency in a capacity analysis will likely invalidate the results.

As was mentioned previously, the foregoing is only a general summary of the determinants of line capacity. Not all of these factors will pertain to every case, but the analyst should be aware of the limitations introduced by their treatment in a line capacity model.

THE RAIL CAPACITY MODEL

RCM was designed to provide a macro-level simulation capability for evaluating delay on single track rail lines with passing sidings and terminals at specified locations. The model (6) has a number of features which allow it to be easily applied to capacity analyses.

RCM is an event oriented simulation model written in the SIMSCRIPT II.5 programming language. At The University of Tennessee, RCM runs on an IBM 3081 machine using the MVS operating system. The model is currently run in a batch mode. An interactive version which runs on the CDC Cyber 175 will be available shortly (7).

Features of the Model

The user of RCM has complete flexibility to define the track configuration, terminals, train types, and traffic patterns for the line being modeled. It is possible to model single track lines to a reasonable level of detail.

The rail line is modeled as a series of segments termed blocks. Each block represents a running track, a siding, or a terminal. Although it is possible and legal to model complicated multi-track lines, RCM's dispatching logic will not be able to route trains over such lines with any degree of realism. Each block has allowable operating speeds for each train class. The analyst may generate these using timetable data or a train performance calculator. To enhance the accuracy of the simulation, the blocks should be selected with a careful consideration of prototype operating conditions.

Terminals are specified blocks which can generate and terminate trains. The line modeled must have at least two terminals. Unlike track blocks, terminals can be occupied by more than one train at a time. Trains are created and destroyed at terminals according to user specified probability distributions which give the train movement pattern. The user may also specify entry and exit delay penalties for each terminal.

Train data contain two subsets, car classes and train classes, that together describe the physical characteristics of trains moving over the railroad. The car class data describes the attributes of various generic freight and passenger cars in use on the line. RCM uses the train class data to build general train classes from the car types. The attributes of a given train are statistically determined based upon user supplied parameters.

Obtaining data for the model is not difficult. Much of the information needed for a run can be determined from railroad timetables. With respect to missing or invalid data, RCM is very forgiving. Many variables have default values; invalid entries are corrected whereever possible. A large number of data items can be entered format free.

Theory of Operation

RCM operates with a user specified description of the railroad line being modeled which includes the track configuration, train classes, traffic patterns, and ideal operating speeds. During a simulation, trains enter the system in a random fashion that is modeled as a Poisson process. The model uses Monte Carlo techniques to determine the train origin, destination, and train class. Other train attributes are obtained from the train class and car class data. Each train resides in its origin terminal processing set while it is "readied" for departure. After this processing is complete, RCM removes the train from the terminal processing set and gives it to the dispatcher.

The RCM "dispatcher" is a series of routines that route trains over the simulated line. The dispatcher maintains a list of trains that must be allocated line resources. Each minute of simulated time, the dispatcher examines the list and tries to reserve a route for each train to its next dispatch point. If the line segments can be allocated to the train, it is cleared to proceed. Otherwise, the train incurs a one minute delay while waiting for the next dispatch cycle.

When successfully dispatched, a train moves from block to block along its assigned route. The train remains in a block for the specified running time for its train class. During the time a train occupies a block, the block is unavailable for occupancy by other trains. When the train reaches the end of its current route segment it pauses for new orders. The process is repeated until the train arrives at its destination. Here there may be some additional delay for clearance. When this wait is completed, the train enters the

terminal, completing its run. RCM then adds the train's delay and tonnage to the system totals and removes it from the simulation.

Simulations normally proceed for a user specified duration. After this time, the program resets and issues a report. If the iteration limit has been met, or the average delay per train exceeds the acceptable delay, the program stops. Otherwise, the traffic volume is incremented and another simulation is performed. RCM will also stop if, during any simulation, the average delay reaches twice the acceptable delay. This feature prevents the wasting of computer time when the traffic on the line reaches the jam level.

Dispatching Logic

Modeling the train dispatching process is probably the most difficult task in any rail line simulation. The complexity of the dispatching process depends upon the traffic and control characteristics of the line. Expert decision making minimizes meet delay and maximizes line capacity. Unfortunately train dispatching is much more of an art than a science. A skilled dispatcher uses many subjective rules developed over years of practice. He knows the capabilities of the train crews, where management priorities lie, and the physical layout of the railroad district. These qualities cannot be modeled easily.

Simulating the dispatching process is a complex combinatorial problem. Those models that have attempted to minimize dispatching delay, most notably the ICC Train Dispatching Model, have not been totally successful. As the line complexity and traffic volume increase, the number of alternative routes and conflicts that must be resolved rises in a nonlinear fashion. The computer time penalties are tremendous.

RCM's dispatching logic is designed for speed in execution. The dispatcher attempts to keep traffic flowing over the line. There is no implicit attempt to minimize total delay; sometimes poor decisions will be made. This is not uncommon in the real world.

Each time a train is dispatched, it receives a reserved route from its current position to the next passing location. Except for its initial dispatch, the train always awaits orders at a passing location. This ensures that line operations will not be disrupted should the train be forced to wait.

The dispatch process occurs in three stages. In the first stage, the single track segment between the train's current location and the next passing location must be obtained. The second step involves assignment of the train to a track in the passing location. The dispatcher must then evaluate the route to ensure that line operations will not be impeded. Failure at any stage aborts the dispatch and the train is held.

The dispatcher's route selection process begins with the examination of a train's destination, current block, and direction. The dispatch routine looks down the line to the first facing point turnout, which it assumes to be the beginning of a passing location. Each block to this point is then added to the train's routing, as there will be no alternative path. The dispatcher then checks to see if any of these blocks are reserved. When no blocks are reserved the dispatch is complete and the train proceeds. Otherwise the train is held and the process continues.

In the next step, the dispatcher evaluates each track in the passing location, attempting to find an empty slot for the train. Normally there will be two tracks to examine, the mainline and the

siding. In some cases, however, directional restrictions will limit the available tracks to one.

After determining the number of branches, the dispatcher attempts to reserve one for the train. The first track examined is normally the mainline, or direct segment. The dispatcher locates all mainline blocks up to the point where the siding and mainline converge. The actual point is the first trailing point switch, which is assumed to be the end of the passing location. These blocks are all checked for reservations. If any block is reserved, the side track is examined using this same process. If neither the main nor the side track is free, the train is held for redispatching during the next cycle. When one of these segments is available, the dispatcher adds the necessary blocks to the train's routing set.

Figure 2 presents an example of the dispatcher's route selection process. (a) Eastbound train T_1 is awaiting dispatch at the end of block 4. The dispatcher scans forward to the facing point switch at the east end of block 6. Finding no reservation conflicts, the dispatcher adds blocks 5 and 6 to train T_1's routing set. (b) A scan of the mainline forward to the trailing point switch reveals train T_2, so this path is rejected. (c) Block 7 is available, so this block is added to the routing set. This completes train T_1's route selection. (d) It then advances to the next dispatching point.

After a route has been chosen, the dispatcher must evaluate it to ensure that no conflicts with other traffic will result. Specifically, this means that the line must not become plugged. Figure 3 shows situations the dispatcher seeks to avoid. The following steps comprise the checking procedure:

1. Examine the passing track adjacent to the one allocated to the train. This corresponds to block 8 in Figure 2.

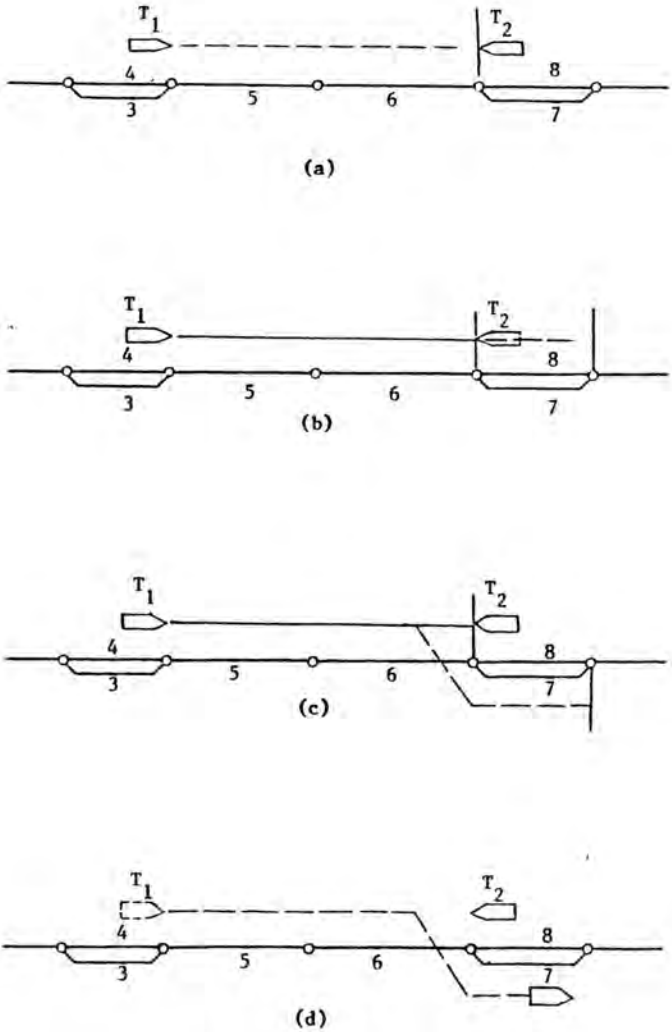
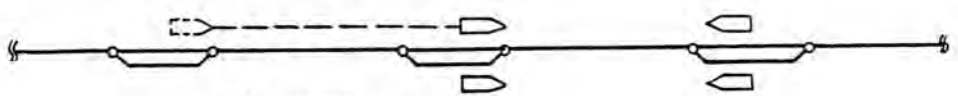
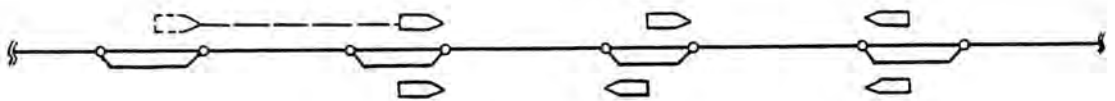


FIGURE 2. The Model Dispatcher's Route Selection Process



(a) Direct



(b) Indirect

FIGURE 3. Potential Dispatching Conflicts

If the track is unreserved or if it contains a train traveling in the opposite direction, authorize the dispatch.

2. Scan ahead to the next passing location. If either track is unreserved, authorize the dispatch.
3. If both tracks contain trains opposing the dispatched movement, a blockage would occur. The dispatch is negated.
4. If both tracks contain trains but they do not both oppose the dispatched train, the process is repeated from step 2.

This logic prevents line blockages even at very high traffic volumes. Should the route be approved, each line block is labeled with the train's identity number to reserve it. The train is then allowed to proceed.

The model's dispatching logic is functional and very fast in terms of computer time. A major dispatching weakness is the model's failure to perform any optimization of the meet delay. This is the price paid to maintain simplicity and speed of execution.

MODEL RESULTS

RCM was run (6) for a prototype rail line to observe the effects of train speed, traffic mix, and siding spacing on capacity. The line was 150 miles long, with sidings every 11 miles in one configuration and every 22 miles in a second. A coal unit train and a trailer-on-flatcar (TOFC) train were selected as representative train types. Running times for each block were estimated with a train performance calculator. Unit trains were restricted to 40 miles per hour and TOFC trains to 60 miles per hour, and both were held to 10 miles per hour

in terminals and 20 miles per hour in sidings. This resulted in overall average running speeds (for the 11-mile siding spacing case) of 33 and 45 miles per hour, respectively, for the unit train and the TOFC train.

For each line, the traffic mix was varied from 100% unit trains/ 0% TOFC trains to 0% unit trains/100% TOFC trains in increments of 25%. Equal numbers of trains were dispatched from each end of the line. Simulations were conducted for three 24-hour operating days after warm-up. Each run started at two trains per day with subsequent iterations increasing the traffic volume by six trains per day. The run was to proceed until the average delay per train exceeded eight hours. Acceptable delays in actual practice would probably not exceed three hours.

In most cases, three delay observations were obtained for each traffic arrival rate and traffic mix. Because the maximum delay fluctuated, some high arrival rates yielded only two observations. The actual number of iterations also varied according to the traffic mix and siding spacing. The averaged values (over the two or three runs) were used to develop capacity curves for the two example lines. Figure 4 shows the curves for the line with an 11 mile siding spacing; those for the 22-mile spacing are similar, but displaced to the left.

From an examination of both sets of capacity curves, the following conclusions were drawn:

1. Increasing the siding spacing decreases the line capacity; and
2. Line capacity rises with increased average train speeds.

These findings are consistent with the capacity theory discussed earlier. Siding spacing governs the amount of avoidable meet delay

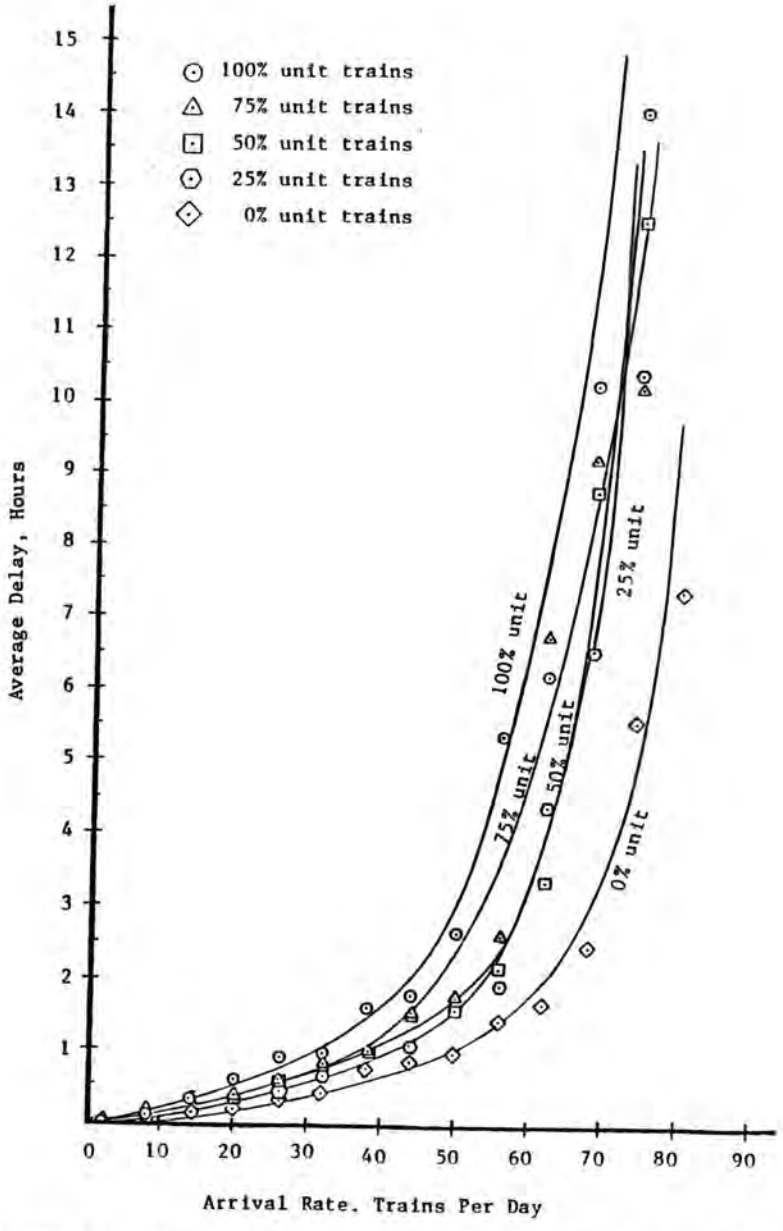


FIGURE 4. Capacity Curves for a Line with Sidings Spaced at 11 Miles

incurred by trains. Assuming a three-hour acceptable delay, the capacity of the line with an 11-mile siding spacing was 50 unit trains per day. Doubling the siding spacing lowered the capacity to 30 trains per day, a 40 percent reduction. The influence of train speed is apparent from a comparison of the capacity curves; as the percentage of unit trains increases and, hence, the average train speed decreases, capacity decreases.

RCM results are compared with those generated for similar cases by other simulators in Table 1. Two types of models are included in this comparison. The Peat, Marwick, Mitchell & Co. (PMM) model (8) is a large and detailed simulator of the same order of complexity as the ICC model referenced earlier (5), which is also included in the table. The CACI model (9) is a very simple simulator developed under the direction of the senior author; in fact, it could be considered to be an earlier version of the RCM, with a less sophisticated dispatcher.

Although the simulations with the different models did not use exactly the same conditions, they are sufficiently similar to permit meaningful comparison. The PMM and RCM runs used a 24-hour operating day, while the CACI and ICC models used a 14-hour day. All traffic levels have been converted to "trains per 14-hour day" to facilitate comparison. All models except the CACI model used a mix of trains of different types with different average speeds; the weighted average train speed is reported in the table.

The PMM and CACI results (8,10) are plotted in Figure 5. Both models were run for exactly the same track configuration and a comparable range of train speeds. The PMM run featured ABS traffic control. The PMM results are very close to the CACI delay curve for the 20 mph

TABLE 1. Rail Line Simulation Results

Model	Line Length (mi)	Average Siding Spacing (mi)	Average Train Speed (mph)	Trains per Day	Average Delay (hr/mi)
PMM (8)	150	8.8	33	6	.002
				12	.005
				18	.0075
				23	.0120
CACI (9)	150	8.8	20	10	.0047
				20	.0082
				40	.0294
				60	.0596
			30	10	.002
				20	.003
				40	.0118
				60	.028
ICC (5)	50	12	36	7	.0033
				14	.0050
				21	.0199
			40	10	.0041
				19	.0106
				29	.0158
RCM (6)	150	11	33	5	.0009
				12	.0041
				19	.0064
				26	.012
				29	.018
				33	.037
				36	.042
				40	.069
				43	.094

Note: Length of Operating Day = 14 hours.

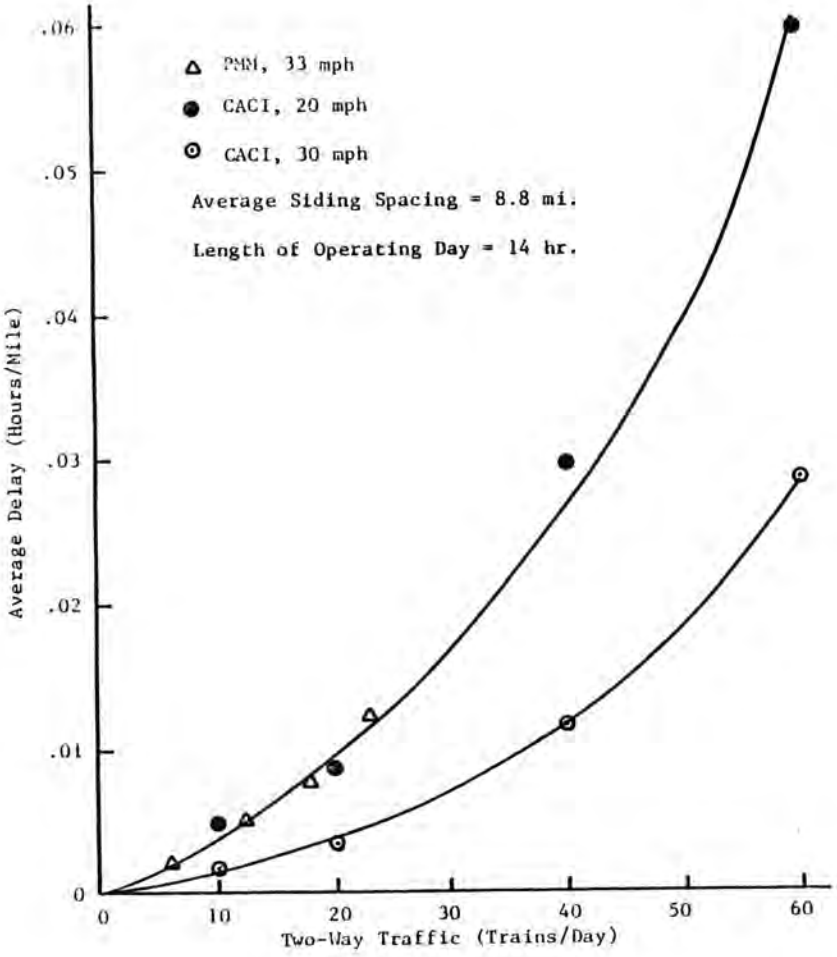


FIGURE 5. Comparison of Train Delay Curves from Two Simulators

case. Even though the average speed for the PMM run was 33 mph, 58% of the trains operated at 25 mph. Also, the PMM run included random track blockages for track maintenance, weather, breakdowns, etc. Although the CACI model tends to overestimate capacity, this comparison indicates that a simplified model is capable of generating train delay curves which have the correct shape and approximately the correct location.

The ICC model and RCM results are plotted in Figure 6. These two cases are grouped because they have nearly equal siding spacings, though the CACI model used CTC and a 50-mile line length. The slightly longer siding spacing in the ICC case is largely offset by the faster train speed, so the ICC results track rather closely the RCM delay curve. Due to the short line length, train speed in the ICC model will not influence capacity very much, so all of the ICC results cluster around the single RCM delay curve. This clearly demonstrates the ability of RCM to provide representative rail line delay curves and capacity estimates.

MODEL APPLICATIONS

RCM has been used to estimate rail link delay curves for a computer model of the railroad network in the United States. Its predecessor, the CACI model, was used in the Freight Transportation Energy Use study (9) and in the National Energy Transportation Study (11). These same curves were later used in a study of coal transportation capacity (12). RCM itself was used to reestimate these delay curves (13), and has been incorporated into a model and data base for investigating alternative rail services for coal shippers (7).

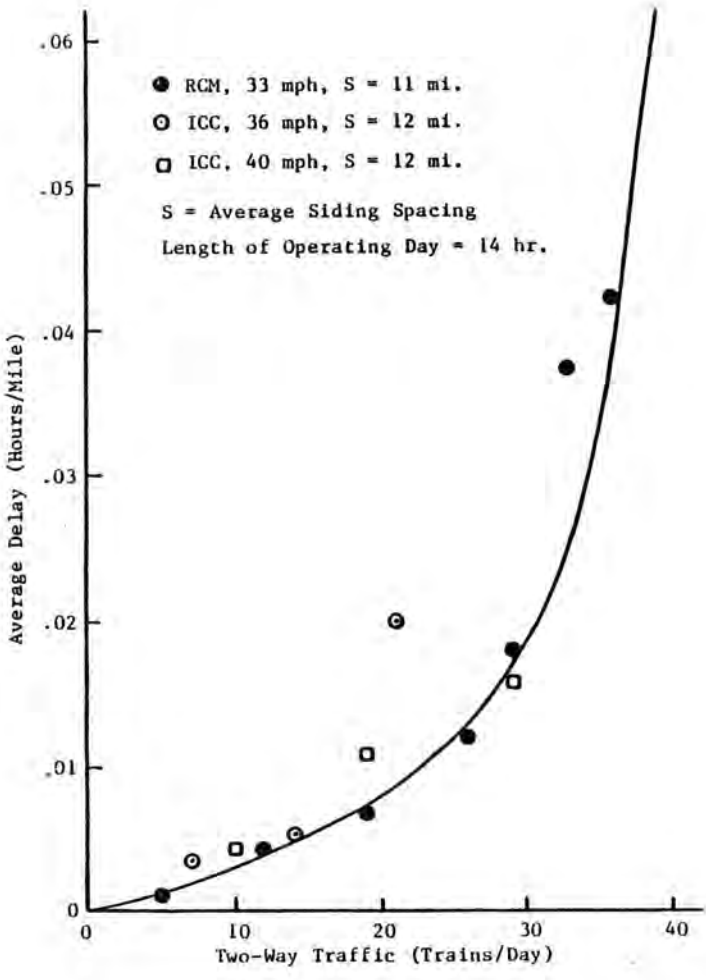


FIGURE 6. Comparison of RCM and ICC Simulation Results

RCM has proven to be useful for developing line capacity and delay estimates within a planning context. Because of its simplicity and low operating costs, RCM fills a void in the set of analytical tools available to the rail planner.

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AIRPORT DEMAND ANALYSIS MODEL (ADAM)

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SUMMARY

ADAM is a computerized analytical model designed to study and analyze traffic demand peaking phenomena at airport terminals. Three types of traffic are handled by the model: enplaning and/or deplaning passengers, departing and/or arriving air carrier aircraft movements, and departing and/or arriving air carrier aircraft seats. The model performs certain statistical analyses on 30-minute traffic throughputs to airport terminals and displays graphically the seasonal and annual distributions of traffic as well as the daily traffic profiles. In addition to its use for analysis of traffic peaking, the model is used in the development of various planning peak standards and determination of planning peak volumes which are utilized in the sizing of airport terminals. The model is also used to synthesize and display the traffic profiles implied by the forecast nominal schedules used in the planning and design of airport facilities.

ANALYSIS TIME INTERVALS

One of the key features of ADAM is its use of a 30-minute time interval as the basic time unit for all analyses. This capability permits the determination of the airport planning peaks and other planning parameters on a "floating" 1/2 hour basis instead of the existing fixed 60-minute clock hour scheme utilized within the Canadian Air Transportation Administration (CATA). Analyses conducted using ADAM and a similar but clock hour-based model[1] for various Canadian airports revealed significant differences, in certain cases, between the planning

peak clock hour and the planning peak floating hour volumes[2]. An interval of 30 minutes was considered appropriate as it represents the average aircraft turnaround time at most airports and entails reasonable data collection and storage requirements for the national airport system. An 18-hour operating day, 6:00 a.m. to midnight, is considered throughout the model analyses. Analysis of air traffic flows at the top 30 airports in Canada showed that this 18-hour period contains, on average, approximately 99% of the 24-hour enplaning passenger traffic and nearly 98% in the deplaning direction[2].

DATA BASE

A semi-hourly traffic activity data base for ADAM has been created from the CATA Station Activity Data System. It presently covers the top 30 airport terminals in Canada (which collectively handle more than 90% of the total annual enplaning/deplaning passengers in the country) over a period of 6 years: 1977 to 1982. The Station Activity Data System comprises only scheduled (mainline unit-toll) operations of Air Canada, CP Air, Canadian regional carriers, and foreign airlines. Up to 15 combinations involving 5 traffic sectors (domestic, transborder, other international, total international, and total all sectors) and 3 travel directions (enplaning/departing, deplaning/arriving, and enplaning plus deplaning/departing plus arriving) can be analyzed in one run of the model. Semi-hourly traffic data for only 6 of these combinations are required as a data base. The model internally synthesizes the data pertaining to the remaining 9 combinations. Exhibit 1 illustrates these combinations for passenger traffic flow. The particular Canadian airport terminals included in the data base and the traffic sectors applicable to each appear in Exhibit 2.

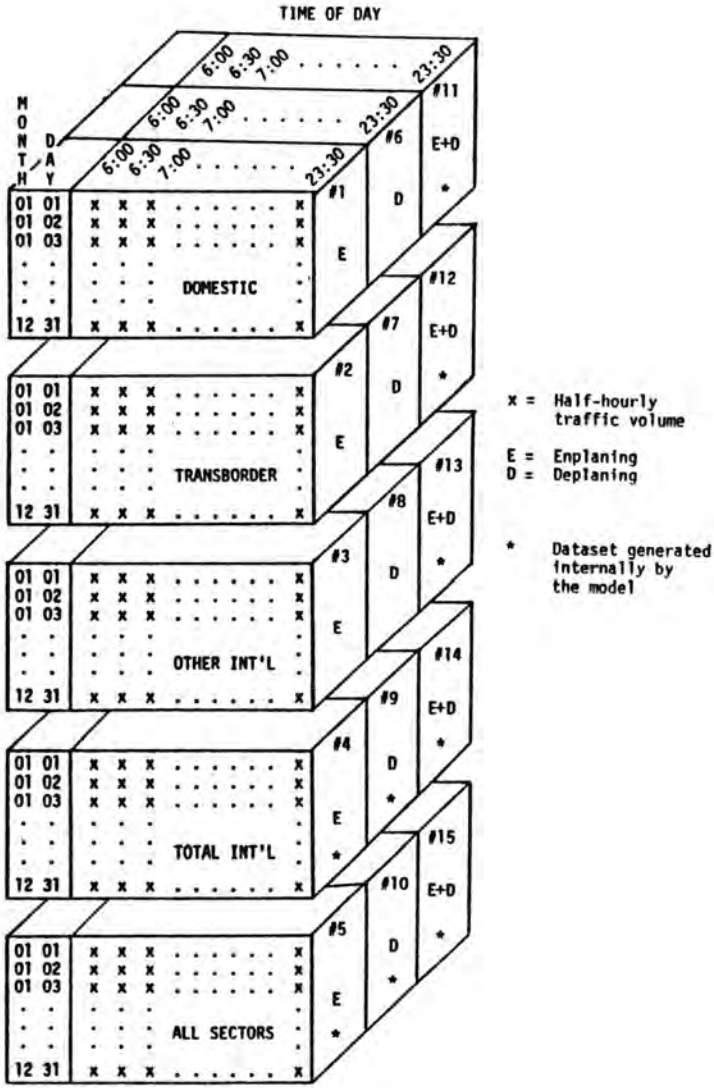


EXHIBIT 1 DATA STRUCTURE AND TRAFFIC SECTOR-DIRECTION COMBINATIONS

AIRPORT	O.A.G. CODE	TRAFFIC SECTOR-DIRECTION*															
		DOMESTIC			TRANSBORDER			OTHER INT'L			TOTAL INT'L			ALL SECTORS			
		E R	D A	E+D R+A	E R	D A	E+D R+A	E R	D A	E+D R+A	E R	D A	E+D R+A	E R	D A	E+D R+A	
Sault Ste. Marie	YAM	x	x	x													
Edmonton International	YEG	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	
Fredericton	YFC	x	x	x													
Halifax International	YHZ	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	
Kamloops	YKA	x	x	x													
Kelowna	YLW	x	x	x													
Mirabel International	YMX	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	
Ottawa International	YOW	x	x	x	x	x	x							x	x	x	
Quebec	YQB	x	x	x													
Windsor	YQG	x	x	x													
Moncton	YQM	x	x	x													
Regina	YQR	x	x	x													
Thunder Bay	YQT	x	x	x	x	x	x							x	x	x	
Gander International	YQX	x	x	x													
Sydney	YQY	x	x	x													
Sudbury	YSB	x	x	x													
Saint John, N.B.	YSJ	x	x	x	x	x	x							x	x	x	
Montreal (Dorval) Int'l	YUL	x	x	x	x	x	x							x	x	x	
Vancouver International	YVR	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	
Winnipeg International	YWG	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	
Saskatoon	YXE	x	x	x													
Fort St. John	YXJ	x	x	x													
Prince George	YXS	x	x	x													
Calgary International	YYC	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	
Charlottetown	YYG	x	x	x													
Victoria International	YYJ	x	x	x	x	x								x	x	x	
St. John's, NFLD.	YYT	x	x	x													
Sept-Iles	YZV	x	x	x													
Pearson Int'l (Terminal 1)	YZA	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	
Pearson Int'l (Terminal 2)	YZB	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	

* E = Enplaning D = Deplaning R = Departing A = Arriving

EXHIBIT 2 CANADIAN AIRPORTS AND ASSOCIATED TRAFFIC SECTORS/DIRECTIONS

MODEL OUTPUTS AND USAGE

The model produces the following outputs for any or all of the above-mentioned 15 sector-direction combinations. Computer printouts produced by ADAM for 1982 domestic enplaning/departing traffic at Lester B. Pearson International Airport - Terminal 2 (arbitrarily coded as YZB) are presented here to illustrate these outputs.

(a) A day-by-day listing of traffic demand volumes throughout the year along with certain "total" and "average" traffic indicators including: total annual traffic volume, total number of active days in the year (an active day means a day with traffic activity), total number of active half-hours in the year, average daily volume, average half-hourly traffic throughput, average number of active half-hours per day, and the highest half-hourly traffic peak. Exhibits 3, 4 and 5 demonstrate these outputs for passenger, aircraft and seat traffic flows, respectively.

(b) A tabulation as well as a graphical representation of the seasonal (monthly and quarterly) distribution of traffic on a total and an average daily basis. Exhibits 6, 7 and 8 illustrate these distributions for the 3 types of traffic analyzed by the model.

In addition to their individual uses, Exhibits 3 to 8 could be used collectively to estimate overall ratios of passengers to aircraft (average aircraft load), passengers to seats (average involvement ratio) and seats to aircraft (average aircraft size) on a daily, monthly, quarterly or annual basis.

(c) An identification of a set of busiest traffic seasons in the year, including: the busiest month, the busiest 2 consecutive months, the busiest 3 consecutive months, the busiest quarter, and the busiest n (user specified) consecutive days in the year.

M-DAY	#PAX	M-DAY	#PAX	M-DAY	#PAX	M-DAY	#PAX	M-DAY	#PAX	M-DAY	#PAX	M-DAY	#PAX	M-DAY	#PAX
1- 1	4284	2-16	7177	4- 3	4773	5-19	8211	7- 4	7686	8-19	10295	10- 4	7807	11-19	7198
1- 2	7144	2-17	7818	4- 4	6897	5-20	9008	7- 5	9211	8-20	9551	10- 5	8132	11-20	3888
1- 3	9364	2-18	7982	4- 5	7627	5-21	9083	7- 6	9330	8-21	7008	10- 6	8291	11-21	6283
1- 4	8209	2-19	8301	4- 6	7805	5-22	4779	7- 7	8482	8-22	6497	10- 7	9089	11-22	6489
1- 5	8902	2-20	5497	4- 7	8420	5-23	3877	7- 8	9168	8-23	10173	10- 8	9445	11-23	6439
1- 6	8757	2-21	7323	4- 8	9019	5-24	6398	7- 9	8482	8-24	9723	10- 9	4187	11-24	7432
1- 7	7408	2-22	7931	4- 9	4754	5-25	8320	7-10	6502	8-25	9723	10-10	3426	11-25	6716
1- 8	6762	2-23	7337	4-10	2980	5-26	7917	7-11	7080	8-26	10018	10-11	6720	11-26	6411
1- 9	4625	2-24	8027	4-11	4381	5-27	8510	7-12	8963	8-27	9032	10-12	8503	11-27	3464
1-10	6109	2-25	8141	4-12	8057	5-28	8275	7-13	9044	8-28	6981	10-13	7935	11-28	6049
1-11	8225	2-26	8624	4-13	7740	5-29	5767	7-14	9120	8-29	8030	10-14	8388	11-29	7518
1-12	8276	2-27	6170	4-14	8179	5-30	7357	7-15	9561	8-30	9808	10-15	7973	11-30	7142
1-13	7497	2-28	7805	4-15	8307	5-31	8470	7-16	9043	8-31	9529	10-16	4973	12- 1	6379
1-14	7240	3- 1	8108	4-16	8078	6- 1	8092	7-17	7281	9- 1	8738	10-17	7178	12- 2	5630
1-15	7504	3- 2	7457	4-17	5345	6- 2	8544	7-18	7585	9- 2	9849	10-18	7687	12- 3	6256
1-16	4408	3- 3	8217	4-18	7999	6- 3	8592	7-19	9207	9- 3	9341	10-19	7701	12- 4	3508
1-17	6415	3- 4	7540	4-19	8411	6- 4	8437	7-20	8783	9- 4	5319	10-20	7988	12- 5	5434
1-18	7101	3- 5	8581	4-20	7954	6- 5	5888	7-21	8846	9- 5	5318	10-21	7984	12- 6	6122
1-19	6471	3- 6	5655	4-21	8621	6- 6	7150	7-22	9252	9- 6	7908	10-22	8218	12- 7	6821
1-20	6898	3- 7	7514	4-22	7922	6- 7	8549	7-23	8378	9- 7	9085	10-23	4733	12- 8	6814
1-21	7484	3- 8	7400	4-23	8320	6- 8	7896	7-24	6828	9- 8	9883	10-24	6815	12- 9	6902
1-22	7409	3- 9	7319	4-24	5531	6- 9	8405	7-25	7099	9- 9	9824	10-25	6927	12-10	6883
1-23	4041	3-10	8380	4-25	7109	6-10	8479	7-26	8883	9-10	8350	10-26	7762	12-11	3725
1-24	6818	3-11	7943	4-26	7902	6-11	8430	7-27	9531	9-11	6046	10-27	7183	12-12	4947
1-25	7310	3-12	8198	4-27	7589	6-12	6298	7-28	9344	9-12	7954	10-28	5879	12-13	6136
1-26	6806	3-13	5718	4-28	7681	6-13	7204	7-29	10045	9-13	8637	10-29	7476	12-14	7898
1-27	7286	3-14	7817	4-29	8167	6-14	8904	7-30	10477	9-14	8291	10-30	4089	12-15	8807
1-28	6955	3-15	8100	4-30	8272	6-15	8387	7-31	7814	9-15	8816	10-31	5868	12-16	8448
1-29	7159	3-16	7378	5- 1	5673	6-16	9022	8- 1	7209	9-16	9072	11- 1	6380	12-17	8016
1-30	4323	3-17	8918	5- 2	7417	6-17	9041	8- 2	8414	9-17	9381	11- 2	6424	12-18	8103
1-31	5270	3-18	9152	5- 3	7717	6-18	9237	8- 3	9485	9-18	5580	11- 3	7445	12-19	4878
2- 1	7324	3-19	8716	5- 4	7542	6-19	8835	8- 4	9541	9-19	7770	11- 4	7173	12-20	6842
2- 2	6266	3-20	6040	5- 5	8188	6-20	7854	8- 5	9514	9-20	8615	11- 5	7041	12-21	7988
2- 3	7111	3-21	7098	5- 6	7854	6-21	9498	8- 6	8798	9-21	8214	11- 6	3988	12-22	8929
2- 4	7322	3-22	7015	5- 7	8056	6-22	8850	8- 7	6809	9-22	8722	11- 7	6152	12-23	9287
2- 5	7476	3-23	6807	5- 8	4861	6-23	9162	8- 8	7861	9-23	8835	11- 8	6256	12-24	6250
2- 6	4590	3-24	6815	5- 9	7152	6-24	9113	8- 9	9721	9-24	8461	11- 9	6510	12-25	2480
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2- 8	6998	3-26	7555	5-11	7674	6-26	6884	8-11	9205	9-26	7071	11-11	6468	12-27	5144
2- 9	6684	3-27	4617	5-12	5374	6-27	7988	8-12	9880	9-27	7755	11-12	5956	12-28	5617
2-10	7536	3-28	6426	5-13	8192	6-28	9818	8-13	9800	9-28	7973	11-13	3758	12-29	5847
2-11	7465	3-29	7144	5-14	8307	6-29	9490	8-14	7324	9-29	8531	11-14	6885	12-30	5857
2-12	7951	3-30	7088	5-15	5587	6-30	10470	8-15	8659	9-30	8732	11-15	7168	12-31	4033
2-13	5155	3-31	7417	5-16	7480	7- 1	7785	8-16	10054	10- 1	8896	11-16	7809		
2-14	6701	4- 1	7711	5-17	8143	7- 2	6875	8-17	10074	10- 2	5399	11-17	7313		
2-15	7502	4- 2	7344	5-18	7532	7- 3	6443	8-18	9837	10- 3	7317	11-18	7144		

TOTAL #PASSENGERS= 2728369
AVERAGE #PAX/DAY = 7475

NO. ACTIVE HALF-HOURS = 11020
AVERAGE #PAX/HALF-HOUR= 248

AV. #HALF-HOURS/DAY= 30.2 (365 ACTIVE DAYS)
HIGHEST HALF-HOUR PEAK IN THE YEAR= 1210 PAX

EXHIBIT 3 DAILY DISTRIBUTION OF ANNUAL TRAFFIC - 1982 'YZZ' ENPLANING DOMESTIC PASSENGERS

ADAM OUTPUT

M-DAY	#A/C	M-DAY	#A/C	M-DAY	#A/C	M-DAY	#A/C	M-DAY	#A/C	M-DAY	#A/C	M-DAY	#A/C	M-DAY	#A/C
1- 1	55	2-16	84	+- 3	65	5-19	89	7- 4	80	8-19	93	10- 4	86	11-19	86
1- 2	63	2-17	86	+- 4	76	5-20	90	7- 5	93	8-20	97	10- 5	88	11-20	63
1- 3	84	2-18	87	+- 5	63	5-21	93	7- 6	94	8-21	74	10- 6	88	11-21	88
1- 4	74	2-19	88	+- 6	88	5-22	84	7- 7	94	8-22	83	10- 7	85	11-22	84
1- 5	87	2-20	87	+- 7	83	5-23	85	7- 8	93	8-23	95	10- 8	93	11-23	81
1- 6	90	2-21	75	+- 8	89	5-24	78	7- 9	97	8-24	95	10- 9	85	11-24	83
1- 7	88	2-22	86	+- 9	74	5-25	89	7-10	78	8-25	95	10-10	86	11-25	83
1- 8	85	2-23	85	+-10	82	5-26	88	7-11	83	8-26	94	10-11	77	11-26	88
1- 9	87	2-24	85	+-11	70	5-27	89	7-12	86	8-27	95	10-12	89	11-27	83
1-10	68	2-25	85	+-12	85	5-28	93	7-13	95	8-28	78	10-13	87	11-28	89
1-11	82	2-26	83	+-13	86	5-29	70	7-14	95	8-29	84	10-14	86	11-29	83
1-12	86	2-27	89	+-14	87	5-30	74	7-15	94	8-30	95	10-15	91	11-30	83
1-13	84	2-28	80	+-15	88	5-31	90	7-16	95	8-31	93	10-16	84	12- 1	80
1-14	81	3- 1	84	+-16	88	6- 1	90	7-17	74	9- 1	91	10-17	89	12- 2	78
1-15	88	3- 2	84	+-17	88	6- 2	88	7-18	83	9- 2	94	10-18	88	12- 3	83
1-16	87	3- 3	84	+-18	78	6- 3	89	7-19	95	9- 3	97	10-19	88	12- 4	82
1-17	76	3- 4	78	+-19	88	6- 4	83	7-20	83	9- 4	76	10-20	89	12- 5	88
1-18	79	3- 5	87	+-20	87	6- 5	70	7-21	91	9- 5	78	10-21	85	12- 6	83
1-19	84	3- 6	87	+-21	87	6- 6	74	7-22	95	9- 6	85	10-22	91	12- 7	85
1-20	85	3- 7	78	+-22	88	6- 7	90	7-23	95	9- 7	95	10-23	84	12- 8	85
1-21	88	3- 8	85	+-23	89	6- 8	91	7-24	78	9- 8	92	10-24	88	12- 9	84
1-22	88	3- 9	85	+-24	88	6- 9	88	7-25	84	9- 9	94	10-25	86	12-10	89
1-23	51	3-10	86	+-25	75	6-10	88	7-26	92	9-10	96	10-26	86	12-11	61
1-24	80	3-11	86	+-26	89	6-11	92	7-27	96	9-11	76	10-27	82	12-12	67
1-25	80	3-12	84	+-27	91	6-12	70	7-28	91	9-12	88	10-28	58	12-13	83
1-26	84	3-13	88	+-28	80	6-13	75	7-29	86	9-13	86	10-29	91	12-14	83
1-27	85	3-14	78	+-29	89	6-14	88	7-30	96	9-14	86	10-30	84	12-15	83
1-28	84	3-15	85	+-30	82	6-15	87	7-31	75	9-15	85	10-31	88	12-16	85
1-29	84	3-16	83	5- 1	70	6-16	86	8- 1	83	9-16	86	11- 1	84	12-17	88
1-30	56	3-17	87	5- 2	75	6-17	89	8- 2	87	9-17	86	11- 2	75	12-18	88
1-31	60	3-18	87	5- 3	90	6-18	91	8- 3	86	9-18	85	11- 3	84	12-19	58
2- 1	80	3-19	87	5- 4	88	6-19	75	8- 4	88	9-19	89	11- 4	83	12-20	78
2- 2	83	3-20	88	5- 5	89	6-20	83	8- 5	83	9-20	86	11- 5	88	12-21	84
2- 3	81	3-21	76	5- 6	90	6-21	95	8- 6	83	9-21	87	11- 6	84	12-22	89
2- 4	85	3-22	83	5- 7	91	6-22	97	8- 7	75	9-22	88	11- 7	88	12-23	88
2- 5	84	3-23	85	5- 8	70	6-23	88	8- 8	83	9-23	87	11- 8	84	12-24	88
2- 6	89	3-24	86	5- 9	76	6-24	93	8- 9	91	9-24	90	11- 9	84	12-25	42
2- 7	78	3-25	72	5-10	89	6-25	94	8-10	94	9-25	66	11-10	85	12-26	54
2- 8	84	3-26	87	5-11	90	6-26	76	8-11	94	9-26	87	11-11	78	12-27	71
2- 9	84	3-27	87	5-12	89	6-27	83	8-12	95	9-27	86	11-12	88	12-28	73
2-10	86	3-28	77	5-13	91	6-28	95	8-13	97	9-28	87	11-13	84	12-29	72
2-11	85	3-29	84	5-14	93	6-29	92	8-14	75	9-29	88	11-14	89	12-30	72
2-12	88	3-30	86	5-15	70	6-30	95	8-15	83	9-30	86	11-15	84	12-31	83
2-13	89	3-31	87	5-16	75	7- 1	80	8-16	95	10- 1	90	11-16	84		
2-14	78	+- 1	88	5-17	89	7- 2	85	8-17	95	10- 2	67	11-17	84		
2-15	84	+- 2	86	5-18	89	7- 3	78	8-18	93	10- 3	66	11-18	83		

TOTAL #AIRCRAFT = 30087
AVERAGE #A/C/DAY = 82

NO. ACTIVE HALF-HOURS = 11059
AVERAGE #A/C/HALF-HOUR= 3

AV. #HALF-HOURS/DAY= 30.3 (365 ACTIVE DAYS)
HIGHEST HALF-HOUR PEAK IN THE YEAR= 12 A/C

EXHIBIT 4 . DAILY DISTRIBUTION OF ANNUAL TRAFFIC - 1982 'YZB' DEPARTING DOMESTIC AIRCRAFT

ADAM OUTPUT

M-DAY	#STS	M-DAY	#STS	M-DAY	#STS	M-DAY	#STS	M-DAY	#STS	M-DAY	#STS	M-DAY	#STS
1- 1	8950	2-16	12508	4- 3	9843	5-19	13315	7- 4	12081	8-19	13813	10- 4	12271	11-19	13428
1- 2	10668	2-17	13424	4- 4	11366	5-20	13175	7- 5	13883	8-20	14580	10- 5	12981	11-20	9746
1- 3	12358	2-18	13365	4- 5	12645	5-21	13890	7- 6	14538	8-21	11185	10- 6	13143	11-21	10345
1- 4	11200	2-19	14083	4- 6	13412	5-22	10048	7- 7	13661	8-22	12083	10- 7	12881	11-22	12357
1- 5	13535	2-20	10307	4- 7	12926	5-23	9409	7- 8	13767	8-23	14423	10- 8	14393	11-23	12284
1- 6	14038	2-21	10623	4- 8	13661	5-24	11370	7- 9	14818	8-24	13992	10- 9	9832	11-24	12269
1- 7	13759	2-22	12989	4- 9	11335	5-25	13107	7-10	11455	8-25	13713	10-10	9253	11-25	12041
1- 8	12925	2-23	12808	4-10	9072	5-26	12791	7-11	12456	8-26	14078	10-11	11584	11-26	13297
1- 9	10711	2-24	13140	4-11	10392	5-27	13110	7-12	14449	8-27	14312	10-12	13264	11-27	9868
1-10	9841	2-25	13327	4-12	12540	5-28	14273	7-13	14383	8-28	11580	10-13	12699	11-28	10376
1-11	12168	2-26	13768	4-13	13281	5-29	10781	7-14	13869	8-29	12527	10-14	12714	11-29	12089
1-12	12887	2-27	10563	4-14	13288	5-30	10748	7-15	13988	8-30	14156	10-15	14518	11-30	12136
1-13	13139	2-28	12088	4-15	13526	5-31	13553	7-16	14413	8-31	13836	10-16	9720	12- 1	11803
1-14	11774	3- 1	12613	4-16	14097	6- 1	13344	7-17	10787	9- 1	13501	10-17	10626	12- 2	11385
1-15	13656	3- 2	12835	4-17	10038	6- 2	12928	7-18	12809	9- 2	14007	10-18	12828	12- 3	11908
1-16	10261	3- 3	13189	4-18	11681	6- 3	13003	7-19	14086	9- 3	14826	10-19	13385	12- 4	9388
1-17	11231	3- 4	12112	4-19	12948	6- 4	13862	7-20	13998	9- 4	11462	10-20	13581	12- 5	10074
1-18	11204	3- 5	13490	4-20	13362	6- 5	10802	7-21	13650	9- 5	11800	10-21	12407	12- 6	11800
1-19	12574	3- 6	10235	4-21	13134	6- 6	10653	7-22	14261	9- 6	12846	10-22	14052	12- 7	12316
1-20	13037	3- 7	11879	4-22	12848	6- 7	13388	7-23	14555	9- 7	14003	10-23	9703	12- 8	12298
1-21	13481	3- 8	12629	4-23	14075	6- 8	13584	7-24	11361	9- 8	13390	10-24	10237	12- 9	12207
1-22	13800	3- 9	12747	4-24	10105	6- 9	13042	7-25	12894	9- 9	13990	10-25	12419	12-10	13347
1-23	8125	3-10	13238	4-25	11054	6-10	13158	7-26	13894	9-10	14611	10-26	12961	12-11	9276
1-24	11868	3-11	12701	4-26	13292	6-11	13808	7-27	14786	9-11	11551	10-27	12352	12-12	10123
1-25	11882	3-12	13100	4-27	13867	6-12	10750	7-28	13253	9-12	10644	10-28	8965	12-13	11719
1-26	12589	3-13	10093	4-28	13349	6-13	11023	7-29	14038	9-13	12571	10-29	13908	12-14	11840
1-27	12959	3-14	11651	4-29	13398	6-14	12882	7-30	15342	9-14	12504	10-30	9804	12-15	12186
1-28	12937	3-15	12458	4-30	14351	6-15	12779	7-31	11594	9-15	12920	10-31	9842	12-16	12419
1-29	12952	3-16	12477	5- 1	10795	6-16	12997	8- 1	12535	9-16	12568	11- 1	12031	12-17	12265
1-30	8877	3-17	13167	5- 2	11763	6-17	12804	8- 2	13006	9-17	13398	11- 2	11151	12-18	10994
1-31	9570	3-18	13158	5- 3	13444	6-18	13928	8- 3	14425	9-18	10111	11- 3	12023	12-19	8911
2- 1	11239	3-19	13440	5- 4	13372	6-19	11438	8- 4	13314	9-19	10863	11- 4	12189	12-20	11589
2- 2	12358	3-20	8973	5- 5	13275	6-20	12861	8- 5	13818	9-20	12417	11- 5	13395	12-21	12537
2- 3	12568	3-21	11148	5- 6	13334	6-21	14259	8- 6	13912	9-21	12720	11- 6	9855	12-22	13236
2- 4	12805	3-22	12334	5- 7	14044	6-22	14388	8- 7	11491	9-22	12426	11- 7	10042	12-23	13411
2- 5	13040	3-23	12780	5- 8	10763	6-23	14042	8- 8	12758	9-23	13230	11- 8	12155	12-24	10499
2- 6	10448	3-24	12986	5- 9	11367	6-24	13948	8- 9	13780	9-24	13582	11- 9	12050	12-25	6586
2- 7	11158	3-25	11170	5-10	12865	6-25	14107	8-10	14191	9-25	10290	11-10	12180	12-26	8056
2- 8	12008	3-26	13635	5-11	14079	6-26	11699	8-11	13854	9-26	10087	11-11	10977	12-27	10176
2- 9	12481	3-27	10203	5-12	13551	6-27	12481	8-12	14114	9-27	12554	11-12	12635	12-28	10382
2-10	12931	3-28	11411	5-13	13716	6-28	14529	8-13	14650	9-28	13035	11-13	9816	12-29	10076
2-11	12752	3-29	12383	5-14	14647	6-29	13954	8-14	11229	9-29	13039	11-14	10274	12-30	10059
2-12	13416	3-30	12958	5-15	10493	6-30	13857	8-15	12364	9-30	12679	11-15	12387	12-31	8740
2-13	10458	3-31	13111	5-16	11334	7- 1	11850	8-16	14123	10- 1	13812	11-16	12578		
2-14	11408	4- 1	13371	5-17	12845	7- 2	12816	8-17	14226	10- 2	10096	11-17	12449		
2-15	12458	4- 2	13494	5-18	13233	7- 3	11586	8-18	13869	10- 3	9808	11-18	12250		

TOTAL #A/C SEATS = 4519026
AVERAGE #STS/DAY = 12381

NO. ACTIVE HALF-HOURS = 11059
AVERAGE #STS/HALF-HOUR= 409

AV. #HALF-HOURS/DAY= 30.3 (365 ACTIVE DAYS)
HIGHEST HALF-HOUR PEAK IN THE YEAR= 22280 STS

EXHIBIT 5 DAILY DISTRIBUTION OF ANNUAL TRAFFIC - 1982 'YZB' DEPARTING DOMESTIC A/C SEATS

ADAM OUTPUT

MONTH	MONTHLY TRAFFIC DISTRIBUTION PAX/MONTH	#DAYS	AV.DAILY	QUARTERLY TRAFFIC DISTRIBUTION PAX/QUARTER	#DAYS	AV.DAILY
1	212459	31	6854			
2	200765	28	7170	641361	90	7126
3	228137	31	7359			
4	218495	30	7283			
5	229885	31	7416	[illegible]	91	7988
6	251288	30	8376			
7	262338	31	8463			
8	279458	31	9015	784370	92	8526
9	242574	30	8086			
10	219449	31	7079			
11	191689	30	6390	632972	92	6554
12	191834	31	6162			

IN 1982, THE BUSIEST MONTH IS ..... MONTH 8
THE BUSIEST TWO CONSECUTIVE MONTHS ARE ..... MONTHS 7 AND 8
THE BUSIEST THREE CONSECUTIVE MONTHS ARE MONTHS 6, 7 AND 8
THE BUSIEST QUARTER IS ..... QUARTER 3
THE BUSIEST 90 CONSECUTIVE DAYS ARE ..... 6-13 TO 9-10

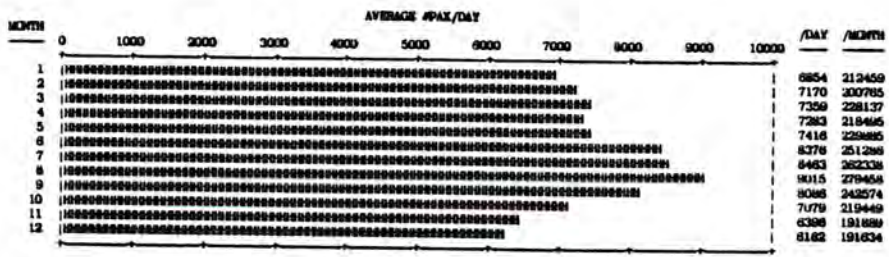


EXHIBIT 6 SEASONAL DISTRIBUTION OF ANNUAL TRAFFIC - 1982 "YES" ENPLANING DOMESTIC PASSENGERS

ADAM OUTPUT

MONTH	A/C/MONTH	#DAYS	AV.DAILY	QUARTERLY TRAFFIC DISTRIBUTION A/C/QUARTER	#DAYS	AV.DAILY
1	2407	31	78			
2	2274	28	81	7200	90	80
3	2519	31	81			
4	2473	30	82			
5	2588	31	83	7678	91	84
6	2617	30	87			
7	2753	31	89			
8	2780	31	90	8056	92	88
9	2523	30	84			
10	2460	31	79			
11	2367	30	79	7153	92	78
12	2326	31	75			

IN 1982, THE BUSIEST MONTH IS ..... MONTH 8
THE BUSIEST TWO CONSECUTIVE MONTHS ARE ..... MONTHS 7 AND 8
THE BUSIEST THREE CONSECUTIVE MONTHS ARE MONTHS 6, 7 AND 8
THE BUSIEST QUARTER IS ..... QUARTER 3
THE BUSIEST 90 CONSECUTIVE DAYS ARE ..... 6-14 TO 9-11

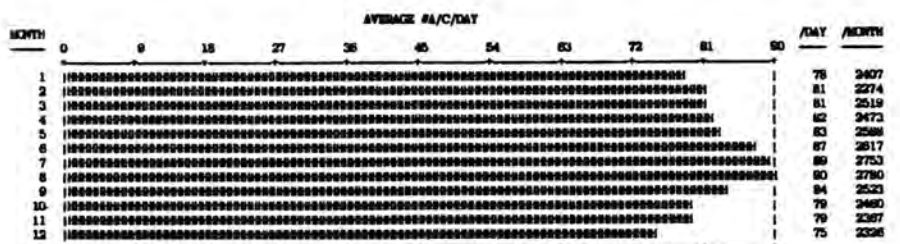


EXHIBIT 7 SEASONAL DISTRIBUTION OF ANNUAL TRAFFIC - 1982 "YES" DEPARTING DOMESTIC AIRCRAFT

ADAM OUTPUT

MONTHLY TRAFFIC DISTRIBUTION				QUARTERLY TRAFFIC DISTRIBUTION		
MONTH	STS/MONTH	#DAYS	AV.DAILY	STS/QUARTER	#DAYS	AV.DAILY
1	368734	31	11895			
2	344332	28	12298	1094158	90	12157
3	381092	31	12293			
4	375228	30	12508			
5	388720	31	12539	1154147	91	12683
6	390198	30	13007			
7	415011	31	13387			
8	415727	31	13411	1207741	92	13128
9	377003	30	12567			
10	369940	31	11934			
11	350343	30	11678	1062980	92	11554
12	342697	31	11055			

IN 1982, THE BUSIEST MONTH IS ..... MONTH 8
THE BUSIEST TWO CONSECUTIVE MONTHS ARE ..... MONTHS 7 AND 8
THE BUSIEST THREE CONSECUTIVE MONTHS ARE MONTHS 6, 7 AND 8
THE BUSIEST QUARTER IS ..... QUARTER 3
THE BUSIEST 90 CONSECUTIVE DAYS ARE ..... 6-14 TO 9-11

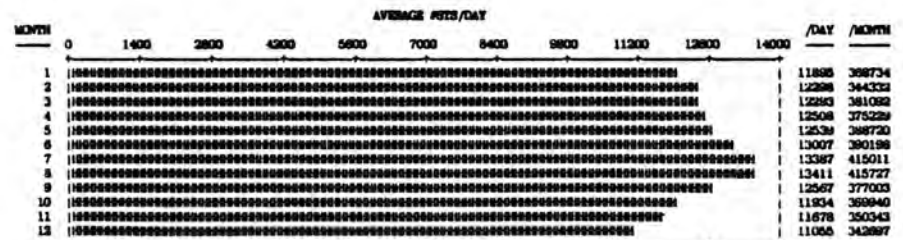


EXHIBIT 8 SEASONAL DISTRIBUTION OF ANNUAL TRAFFIC - 1982 "YZD" DEPARTING DOMESTIC A/C SEATS

ADAM OUTPUT

These are utilized in the development and application of planning peak standards for sizing of air terminal building facilities[2]. Exhibits 6, 7 and 8 show that the busiest season for domestic travel at this particular airport (and indeed at almost all other Canadian airports analyzed by the model) is the summer period. The Exhibits also indicate that the pattern of seasonal variation is almost identical for passenger, aircraft and seat traffic flows, and that the various busiest periods of traffic activity determined independently by ADAM for each of the 3 types of traffic are virtually the same in this particular example.

(d) A ranking of the days of the year in a descending order according to the daily traffic volume. This is produced in a tabular form as well as a graphical cumulative distribution showing the "traffic percentile" and the "Nth highest day" corresponding to each daily traffic volume. Exhibits 9 and 10 present examples of these outputs for passenger traffic. Similar outputs are produced by ADAM for air carrier aircraft and seat traffic flows.

(e) Rankings and graphical cumulative distributions similar to those produced in (d) are also generated for the hourly and half-hourly traffic throughputs throughout the entire year. Exhibits 11 to 14 show examples of these outputs for enplaning passenger traffic. Again, similar tables and graphs are produced by ADAM for air carrier aircraft movements and seats.

These hourly and half-hourly rankings and cumulative distributions along with those produced in (d) above for the planning day are utilized, inter alia, to develop and apply planning peak standards used by CATA for design of airport terminals[2].

•••••••••••••••• PLANNING DAY ANALYSIS - 1982 ••••••••••••••••

M-DAY	RNK	#PAX	%ILE	M-DAY	RNK	#PAX	%ILE	M-DAY	RNK	#PAX	%ILE	M-DAY	RNK	#PAX	%ILE	M-DAY	RNK	#PAX	%ILE
7-30	1	10477	100.0	9-22	74	8722	75.0	9-28	147	7973	52.7	10- 3	220	7317	32.2	11- 1	293	6380	13.8
6-30	2	10470	99.6	3-19	75	8716	74.7	10-15	148	7973	52.4	11-17	221	7313	32.0	12- 1	294	6379	13.5
8-19	3	10285	99.2	10- 1	76	8698	74.3	8-27	149	7968	52.1	1-25	222	7310	31.7	6-12	295	6298	13.3
8-23	4	10173	98.9	8-15	77	8659	74.0	12-21	150	7966	51.8	1-27	223	7286	31.4	11-21	296	6283	13.1
8-17	5	10074	98.5	6-22	78	8650	73.7	8- 8	151	7961	51.5	7-17	224	7281	31.2	2- 2	297	6266	12.8
8-16	6	10054	98.1	7-21	79	8648	73.4	9-12	152	7954	51.2	1-14	225	7240	30.9	12- 3	298	6258	12.6
7-29	7	10045	97.7	9-13	80	8637	73.1	4-20	153	7954	50.9	8- 1	226	7209	30.6	11- 8	299	6256	12.4
8-26	8	10018	97.4	2-26	81	8624	72.8	2-12	154	7951	50.6	6-13	227	7204	30.4	12-24	300	6250	12.2
8-12	9	9980	97.0	4-21	82	8621	72.4	3-11	155	7943	50.4	11-19	228	7198	30.1	2-27	301	6170	11.9
8-16	10	9837	96.6	9-20	83	8615	72.1	10-13	156	7935	50.1	11-10	229	7190	29.8	11- 7	302	6152	11.7
6-28	11	9818	96.3	6- 3	84	8592	71.8	2-22	157	7931	49.8	10-27	230	7183	29.6	12-13	303	6138	11.5
8-25	12	9723	95.9	3- 5	85	8581	71.5	4-22	158	7922	49.5	10-17	231	7178	29.3	12- 6	304	6122	11.3
8-24	13	9723	95.6	6- 7	86	8549	71.2	5-26	159	7917	49.2	2-16	232	7177	29.1	1-10	305	6109	11.0
8- 9	14	9721	95.2	6- 2	87	8544	70.9	9- 6	160	7908	48.9	11- 4	233	7173	28.8	12-18	306	6103	10.8
8-10	15	9717	94.8	9-28	88	8531	70.6	4-26	161	7902	48.6	11-15	234	7168	28.5	11-28	307	6049	10.6
9- 8	16	9883	94.5	5-27	89	8510	70.2	6- 8	162	7898	48.3	1-29	235	7159	28.3	9-11	308	6046	10.4
9- 2	17	9849	94.1	10-12	90	8503	69.9	6-20	163	7854	48.0	5- 9	236	7152	28.0	3-25	309	6046	10.1
9- 9	18	9824	93.8	8-22	91	8497	69.6	5- 6	164	7854	47.7	6- 6	237	7150	27.7	3-20	310	6040	9.9
9-30	19	9808	93.4	7- 9	92	8482	69.3	2-17	165	7818	47.5	11-18	238	7144	27.5	10-31	311	5988	9.7
7-15	20	9561	93.1	6-10	93	8479	69.0	3-14	166	7817	47.2	3-29	239	7144	27.2	12-30	312	5987	9.5
9-20	21	9551	92.7	5-31	94	8470	68.7	2-28	167	7805	46.9	1- 2	240	7144	27.0	11-12	313	5956	9.3
8- 4	22	9541	92.4	9-24	95	8461	68.4	7- 1	168	7785	46.6	11-30	241	7142	26.7	12- 2	314	5930	9.0
7-27	23	9531	92.0	12-16	96	8448	68.1	9-19	169	7770	46.3	2- 3	242	7111	26.4	12-29	315	5847	8.8
8-31	24	9529	91.7	6- 4	97	8437	67.8	10-26	170	7762	46.0	4-25	243	7109	26.2	5-29	316	5767	8.6
8- 5	25	9514	91.3	6-11	98	8430	67.4	9-27	171	7755	45.7	1-18	244	7101	25.9	3-13	317	5716	8.4
8-21	26	9498	91.0	4- 7	99	8420	67.1	4-13	172	7740	45.5	7-25	245	7089	25.7	6- 5	318	5688	8.2
6-29	27	9490	90.6	8- 2	100	8414	66.8	5- 3	173	7717	45.2	3-21	246	7088	25.4	10-28	319	5679	8.0
8- 3	28	9486	90.3	4-19	101	8411	66.5	4- 1	174	7711	44.9	7-11	247	7080	25.1	5- 1	320	5673	7.8
10- 8	29	9445	89.9	6- 9	102	8405	66.2	10-19	175	7701	44.6	9-26	248	7071	24.9	3- 6	321	5656	7.6
8-25	30	9389	89.6	10-14	103	8388	65.9	12-14	176	7698	44.3	3-30	249	7068	24.6	12-28	322	5617	7.4
12-23	31	9387	89.2	6-15	104	8387	65.6	7- 4	177	7686	44.0	11- 5	250	7041	24.4	5-15	323	5587	7.1
9-17	32	9381	88.9	3-10	105	8380	65.3	4-28	178	7681	43.8	3-22	251	7015	24.1	9-18	324	5580	6.9
1- 3	33	9364	88.6	7-23	106	8378	65.0	5-11	179	7674	43.5	8-21	252	7008	23.8	4-24	325	5531	6.7
7-28	34	9344	88.2	5-12	107	8374	64.7	10-18	180	7667	43.2	2- 8	253	6998	23.6	2-20	326	5497	6.5
9- 3	35	9341	87.9	9-10	108	8350	64.4	4- 5	181	7627	42.9	8-28	254	6981	23.3	12- 5	327	5424	6.3
7- 6	36	9330	87.5	5-25	109	8320	64.1	7-31	182	7614	42.6	1-28	255	6955	23.1	10- 2	328	5399	6.1
7-22	37	9252	87.2	4-23	110	8320	63.8	11-16	183	7609	42.4	10-25	256	6927	22.8	4-17	329	5345	5.9
6-18	38	9237	86.9	5-14	111	8307	63.4	10- 4	184	7607	42.1	12- 9	257	6902	22.6	9- 4	330	5319	5.7
7- 5	39	9211	86.5	4-15	112	8307	63.1	4- 6	185	7605	41.8	1-20	258	6899	22.3	9- 5	331	5318	5.5
7-19	40	9207	86.2	2-19	113	8301	62.8	4-27	186	7599	41.5	11-14	259	6845	22.1	1-31	332	5270	5.4
12-15	68	8807	76.9	2-24	141	8027	54.4	2-23	214	7337	33.9	11-23	287	6439	15.2	12-11	360	3725	0.7
8- 6	69	8796	76.6	12-17	142	8016	54.2	2- 1	215	7324	33.6	3-26	288	6426	14.9	12- 4	361	3508	0.6
7-20	70	8783	76.3	4-18	143	7999	53.9	8-14	216	7324	33.3	11- 2	289	6424	14.7	11-27	362	3464	0.5
1- 6	71	8757	75.9	10-20	144	7988	53.6	2-21	217	7323	33.0	1-17	290	6415	14.5	10-10	363	3426	0.3
9- 1	72	8738	75.6	10-21	145	7984	53.3	2- 4	218	7322	32.8	11-26	291	6411	14.2	4-10	364	2980	0.2
9-30	73	8732	75.3	2-18	146	7982	53.0	3- 9	219	7319	32.5	5-24	292	6398	14.0	12-25	365	2480	0.1

TOTAL #PASSENGERS= 2728369

AVERAGE #PASSENGERS/DAY= 7475

AVERAGE #ACTIVE HALF-HOURS/DAY=30.2

EXHIBIT 9 RANKING AND PERCENTILES OF DAILY TRAFFIC FLOWS - 1982 'YZB' ENPLANING DOMESTIC PASSENGERS

ADAM OUTPUT

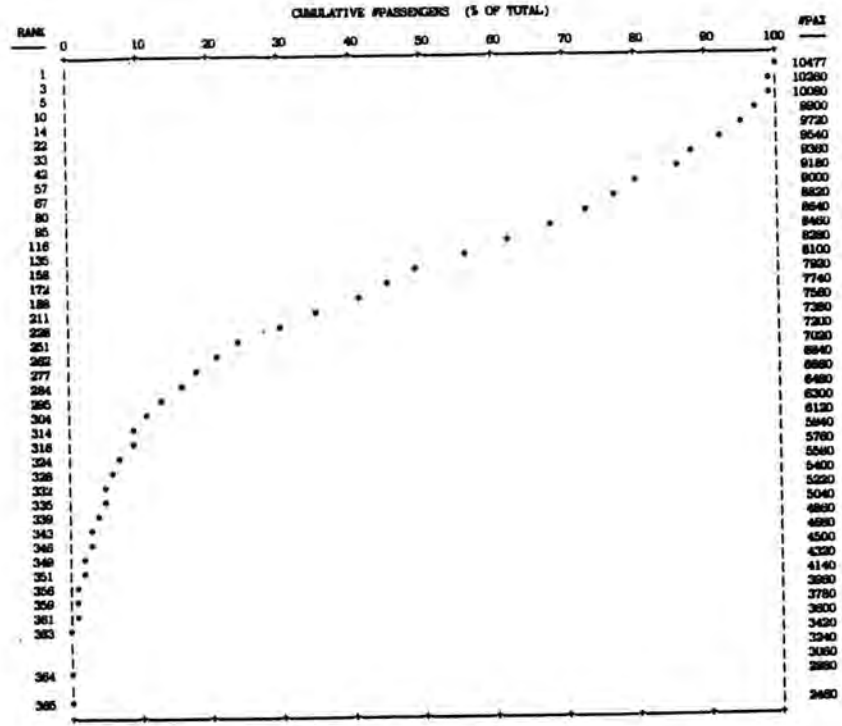


EXHIBIT 10 CUMULATIVE DISTRIBUTION OF RANKED DAILY TRAFFIC FLOWS - 1982 "YZZ" ENPLANED DOMESTIC PASSENGERS

ADAM OUTPUT

•••••••••••••••• PLANNING 60-MINUTE ANALYSIS - 1982 ••••••••••••••••

%ILE	60-M PAX	RANK
100.0	1888-1881	1
99.9	1792-1785	2
99.9	1736-1729	3
99.8	1680-1673	4
99.7	1608-1601	5
99.7	1576-1569	6
99.6	1560-1553	7
99.6	1544-1537	9
99.5	1528-1521	10
99.4	1472-1465	11
99.3	1456-1449	12
99.3	1432-1425	13
99.2	1424-1417	14
99.2	1416-1409	15
99.1	1408-1401	16
99.1	1392-1385	18
99.0	1384-1377	20
98.9	1376-1369	21
98.8	1368-1361	22
98.8	1360-1353	23
98.7	1352-1345	26
98.6	1328-1321	27
98.5	1320-1313	31
98.3	1312-1305	32
98.3	1296-1289	35
98.2	1288-1281	38
98.0	1280-1273	41
97.9	1272-1265	44
97.7	1264-1257	46
97.6	1256-1249	47
97.6	1248-1241	52
97.4	1240-1233	54
97.3	1232-1225	58
97.1	1224-1217	60
97.0	1216-1209	67
98.7	1208-1201	75
98.3	1200-1193	79
98.2	1192-1185	83
98.0	1184-1177	87
95.8	1176-1169	91
95.6	1168-1161	97
95.4	1160-1153	101
95.2	1152-1145	106
95.0	1144-1137	112
94.8	1136-1129	118
94.5	1128-1121	124
94.3	1120-1113	134
93.9	1112-1105	143
93.5	1104-1097	156
93.0	1096-1089	168
92.5	1088-1081	180
92.0	1080-1073	188
91.7	1072-1065	197
91.3	1064-1057	206
91.0	1056-1049	222
90.4	1048-1041	233
89.9	1040-1033	240
89.7	1032-1025	256
89.1	1024-1017	273
88.4	1016-1009	292
87.7	1008-1001	308
87.1	1000- 993	321
86.7	992- 985	340
86.0	984- 977	357
85.4	976- 969	369
84.9	968- 961	393
84.1	960- 953	414
83.4	952- 945	432
82.7	944- 937	447
82.2	936- 929	472
81.4	928- 921	496
80.6	920- 913	513
80.0	912- 905	542
79.0	904- 897	567
78.2	896- 889	597
77.2	888- 881	628
76.3	880- 873	644
75.7	872- 865	671
74.8	864- 857	700
73.9	856- 849	727
73.1	848- 841	752
72.3	840- 833	775
71.6	832- 825	801
70.8	824- 817	825
70.1	816- 809	848
69.5	808- 801	881
68.4	800- 793	913
67.5	792- 785	937
66.8	784- 777	959
66.2	776- 769	983
65.5	768- 761	1013
64.6	760- 753	1056
63.5	752- 745	1083
62.7	744- 737	1108
62.0	736- 729	1137
61.3	728- 721	1177
60.2	720- 713	1221
59.0	712- 705	1265
57.9	704- 697	1297
57.1	696- 689	1344
55.9	688- 681	1384
54.9	680- 673	1423
53.9	672- 665	1465
52.9	664- 657	1504
51.9	656- 649	1541
51.0	648- 641	1583
50.1	640- 633	1623
49.1	632- 625	1659
48.3	624- 617	1701
47.3	616- 609	1758
46.1	608- 601	1793
45.3	600- 593	1825
44.6	592- 585	1870
43.6	584- 577	1908
42.8	576- 569	1949
41.9	568- 561	1986
41.2	560- 553	2026
40.4	552- 545	2066
39.6	544- 537	2110
38.7	536- 529	2148
37.9	528- 521	2190
37.1	520- 513	2219
36.6	512- 505	2262
35.8	504- 497	2297
35.1	496- 489	2346
34.3	488- 481	2389
33.5	480- 473	2433
32.7	472- 465	2489
31.8	464- 457	2544
30.8	456- 449	2582
30.2	448- 441	2637
29.3	440- 433	2691
28.5	432- 425	2746
27.8	424- 417	2793
26.9	416- 409	2840
26.2	408- 401	2904
25.2	400- 393	2953
24.5	392- 385	3001
23.8	384- 377	3047
23.2	376- 369	3113
22.3	368- 361	3174
21.5	360- 353	3228
20.8	352- 345	3295
19.9	344- 337	3361
19.1	336- 329	3413
18.4	328- 321	3472
17.7	320- 313	3531
17.1	312- 305	3594
16.3	304- 297	3653
15.7	296- 289	3714
15.0	288- 281	3779
14.4	280- 273	3862
13.5	272- 265	3924
12.9	264- 257	4000
12.2	256- 249	4078
11.5	248- 241	4163
10.7	240- 233	4244
10.0	232- 225	4324
9.3	224- 217	4401
8.7	216- 209	4473
8.1	208- 201	4549
7.6	200- 193	4635
7.0	192- 185	4724
6.3	184- 177	4809
5.8	176- 169	4898
5.2	168- 161	4975
4.7	160- 153	5075
4.2	152- 145	5164
3.7	144- 137	5235
3.3	136- 129	5333
2.8	128- 121	5409
2.5	120- 113	5482
2.2	112- 105	5550
1.9	104- 97	5631
1.6	96- 89	5709
1.4	88- 81	5784
1.1	80- 73	5860
0.9	72- 65	5969
0.6	64- 57	6059
0.4	56- 49	6155
0.2	48- 41	6216
0.1	40- 33	6279
0.1	32- 25	6319
0.0	24- 17	6333
0.0	16- 9	6350
0.0	8- 1	6355

TOTAL #PASSENGERS= 2728369

#ACTIVE 60-MINUTE PERIODS= 6355

AVERAGE #PASSENGERS/60-MINUTES= 429

EXHIBIT 11 RANKING AND PERCENTILES OF 60-MINUTE TRAFFIC FLOWS - 1982 'YZB' ENPLANING DOMESTIC PASSENGERS

ADAM OUTPUT

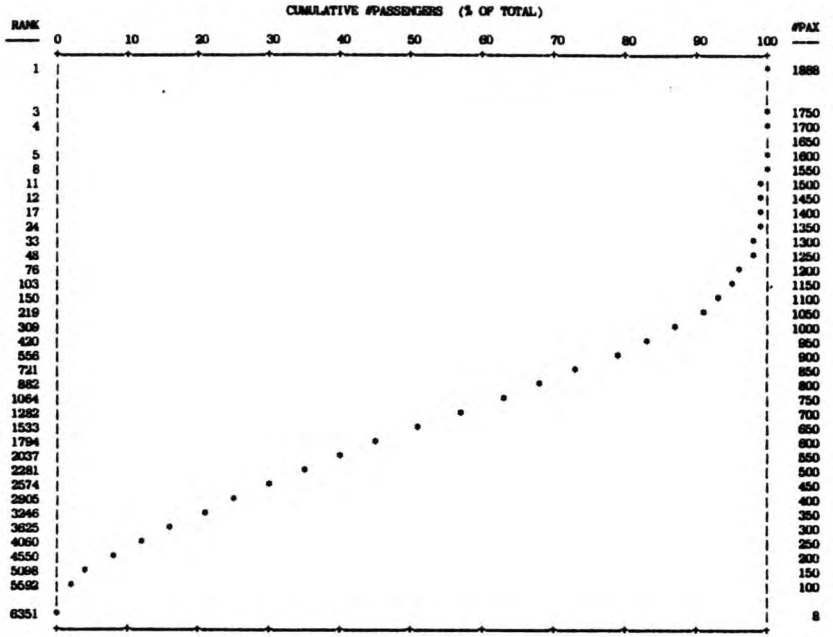


EXHIBIT 12 CUMULATIVE DISTRIBUTION OF RANKED 60-MINUTE TRAFFIC FLOWS - 1982 'YZZ' ENPLANING DOMESTIC PASSENGERS ADAM OUTPUT

•••••••••••••••• PLANNING 30-MINUTE ANALYSIS - 1982 ••••••••••••••••

%ILE	30-M PAX	RANK	%ILE	30-M PAX	RANK	%ILE	30-M PAX	RANK	%ILE	30-M PAX	RANK	%ILE	30-M PAX	RANK
100.0	1210-1206	1	98.3	795- 791	120	85.2	595- 591	591	54.8	395- 391	2342	21.2	195- 191	5589
100.0	1075-1071	5	98.1	790- 786	128	84.8	590- 586	616	54.1	390- 386	2404	20.5	190- 186	5711
99.8	1040-1036	6	95.9	785- 781	137	84.1	585- 581	639	53.2	385- 381	2478	19.6	185- 181	5822
99.8	1035-1031	7	95.8	780- 776	146	83.6	580- 576	661	52.2	380- 376	2538	18.9	180- 176	5955
99.7	1030-1026	8	95.4	775- 771	150	83.1	575- 571	686	51.3	375- 371	2611	18.0	175- 171	6044
99.7	1025-1021	9	95.3	770- 766	156	82.6	570- 566	719	50.3	370- 366	2685	17.1	170- 166	6212
99.6	1020-1016	10	95.1	765- 761	161	81.9	565- 561	753	49.6	365- 361	2734	16.4	165- 161	6375
99.6	1015-1011	11	95.0	760- 756	169	81.2	560- 556	788	48.7	360- 356	2803	15.4	160- 156	6531
99.6	1006-1001	13	94.7	755- 751	173	80.5	555- 551	825	47.8	355- 351	2884	14.5	155- 151	6677
99.5	980- 976	14	94.6	750- 746	182	79.7	550- 546	857	46.7	350- 346	2957	13.7	150- 146	6845
99.5	975- 971	15	94.4	745- 741	191	79.1	545- 541	897	45.8	345- 341	3043	12.8	145- 141	6993
99.4	970- 966	17	94.1	740- 736	199	78.3	540- 536	940	44.7	340- 336	3105	12.0	140- 136	7148
99.4	965- 961	19	93.9	735- 731	213	77.5	535- 531	972	44.0	335- 331	3173	11.2	135- 131	7301
99.3	956- 951	20	93.6	730- 726	220	76.8	530- 526	1006	43.1	330- 326	3242	10.5	130- 126	7445
99.3	945- 941	24	93.4	725- 721	223	76.2	525- 521	1040	42.3	325- 321	3309	9.8	125- 121	7620
99.1	940- 936	25	93.3	720- 716	226	75.5	520- 516	1088	41.5	320- 316	3391	9.0	120- 116	7788
99.1	935- 931	31	93.2	715- 711	232	75.0	515- 511	1107	40.5	315- 311	3465	8.4	115- 111	7923
98.9	930- 926	32	93.1	710- 706	242	74.3	510- 506	1146	39.7	310- 306	3528	7.7	110- 106	8097
98.8	920- 916	33	92.8	705- 701	248	73.5	505- 501	1185	39.0	305- 301	3601	7.0	105- 101	8277
98.8	915- 911	35	92.6	700- 696	258	72.8	500- 496	1224	38.2	300- 296	3686	6.4	100- 96	8487
98.7	900- 896	38	92.4	695- 691	268	72.1	495- 491	1259	37.3	295- 291	3761	5.8	95- 91	8676
98.7	895- 891	39	92.1	690- 686	277	71.5	490- 486	1289	36.4	290- 286	3845	5.0	90- 86	8884
98.6	890- 886	41	91.9	685- 681	289	70.9	485- 481	1339	35.6	285- 281	3928	4.3	85- 81	9127
98.5	885- 881	45	91.6	680- 676	298	70.0	480- 476	1393	34.7	280- 276	4004	3.6	80- 76	9316
98.4	880- 876	47	91.4	675- 671	309	69.1	475- 471	1443	33.9	275- 271	4080	3.0	75- 71	9495
98.3	875- 871	48	91.1	670- 666	320	68.2	470- 466	1488	33.2	270- 266	4163	2.5	70- 66	9688
98.3	870- 866	52	90.8	665- 661	335	67.5	465- 461	1530	32.3	265- 261	4256	2.1	65- 61	9873
98.2	865- 861	55	90.5	660- 656	346	66.8	460- 456	1588	31.4	260- 256	4344	1.6	60- 56	10044
98.1	860- 856	59	90.2	655- 651	354	65.8	455- 451	1643	30.6	255- 251	4467	1.3	55- 51	10214
98.0	855- 851	63	90.0	650- 646	374	64.9	450- 446	1707	29.5	250- 246	4580	0.9	50- 46	10345
97.8	850- 846	65	89.5	645- 641	396	63.8	445- 441	1761	28.6	245- 241	4658	0.7	45- 41	10480
97.8	845- 841	68	89.0	640- 636	416	62.9	440- 436	1827	27.8	240- 236	4747	0.5	40- 36	10578
97.7	840- 836	72	88.6	635- 631	432	61.9	435- 431	1893	27.0	235- 231	4824	0.4	35- 31	10689
97.6	830- 826	77	88.2	630- 626	453	60.8	430- 426	1935	26.3	230- 226	4914	0.2	30- 26	10769
97.4	825- 821	86	87.7	625- 621	480	60.2	425- 421	1981	25.6	225- 221	4997	0.1	25- 21	10839
97.1	820- 816	98	87.1	620- 616	502	59.5	420- 416	2046	24.9	220- 216	5080	0.1	20- 16	10889
96.8	815- 811	101	86.6	615- 611	520	58.5	415- 411	2103	24.2	215- 211	5173	0.0	15- 11	10959
96.7	810- 806	104	86.2	610- 606	536	57.6	410- 406	2167	23.5	210- 206	5284	0.0	10- 6	11003
96.6	805- 801	107	85.8	605- 601	550	56.6	405- 401	2219	22.8	205- 201	5373	0.0	5- 1	11020
96.5	800- 796	113	85.5	600- 596	565	55.9	400- 396	2292	22.0	200- 196	5484			

TOTAL #PASSENGERS= 2728389 #ACTIVE 30-MINUTE PERIODS=11020 AVERAGE #PASSENGERS/30-MINUTES= 248

EXHIBIT 13 RANKING AND PERCENTILES OF 30-MINUTE TRAFFIC FLOWS - 1982 'YZB' ENPLANING DOMESTIC PASSENGERS

ADAM OUTPUT

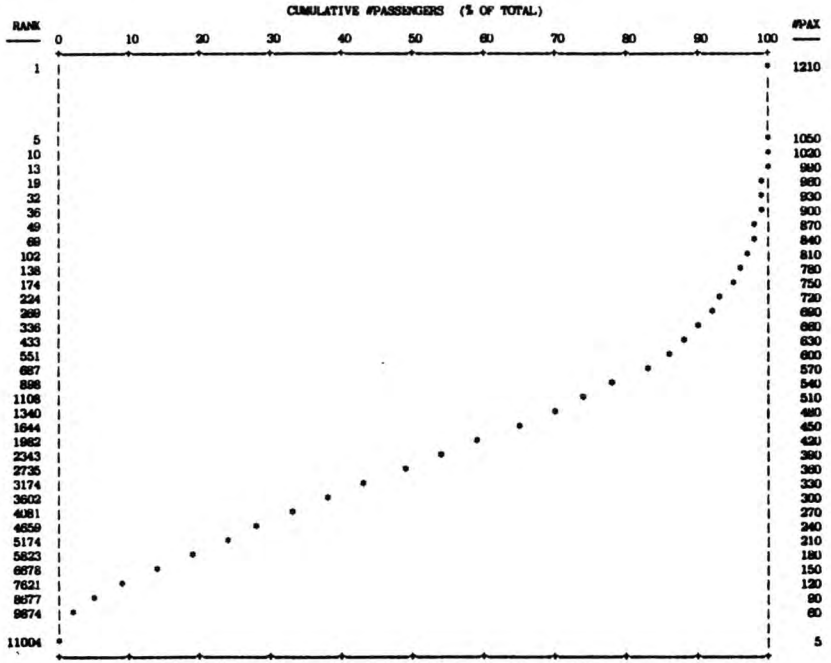


EXHIBIT 14 CUMULATIVE DISTRIBUTION OF RANKED 30-MINUTE TRAFFIC FLOWS - 1982 'Y28' ENPLANING DOMESTIC PASSENGERS ADAM OUTPUT

(f) A listing of traffic flow (at the gates) every 30 minutes from 6:00 a.m. to midnight for each day included in the user-selected design busy season(s) as identified in (c) above or alternatively in any user-specified date or period of the year. Exhibit 15 is provided here as an example of the passenger traffic flow pattern during the busiest month of the year. The model collapses the individual daily traffic distributions (profiles) in the selected design busy season into an average (composite) profile that represents a typical (average) day in that season. An ordinate of the composite profile represents the average traffic throughput in the selected season during the half-hour corresponding to that ordinate. The standard deviation of each ordinate is also determined and displayed. Days with no traffic activity during a given half-hour period are excluded in calculating that half-hour's profile ordinate and its standard deviation. The model also produces an adjusted profile whose ordinates are "weighted averages"; thus including the days with zero-traffic activities in determining the profile ordinates. Composite hourly traffic profiles representing 30-minute "moving" blocks (windows) of 1 to 6 hours are also produced as shown in Exhibit 15. These profiles provide certain airport planning peaks and parameters[2].

(g) Graphical representations of the composite 30- and 60-minute daily profiles of traffic over the 18-hour operating day as determined in (f) above. Any of the busiest seasons determined by the model (c above) or alternatively a user-selected specific date or period of the year could be chosen by the user to produce these composite profiles. Exhibits 16 and 17 show examples of the half-hourly and hourly composite profiles representing enplaning domestic

•••••••••••••••••••• CONCEPT 1 — AVERAGE DAY IN THE BUSIEST MONTH OF THE YEAR (MONTH 8 IN 1982) ••••••••••••••••••••

#PAX PER 30-MINUTES STARTING AT

M-DAY	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	TOTAL
	:30	:30	:30	:30	:30	:30	:30	:30	:30	:30	:30	:30	:30	:30	:30	:30	:30	:30	
8- 1	0	156	528	642	276	66	79	361	205	281	193	173	332	344	298	83	55	0	7209
	0	0	0	217	125	0	78	53	545	107	109	558	236	539	254	82	223	33	
8- 2	0	155	348	636	356	134	0	351	334	420	0	189	424	439	391	59	0	0	8414
	9	136	280	215	106	0	75	41	685	193	147	689	197	580	422	166	157	70	
8- 3	0	301	818	480	303	123	82	430	379	240	150	292	387	514	322	137	0	0	9485
	52	263	157	617	110	0	75	67	675	212	105	642	193	732	290	123	168	46	
8-29	0	101	477	566	237	68	71	412	314	442	199	431	355	486	320	246	0	87	8030
	0	0	0	192	75	0	97	50	649	35	117	659	97	789	141	187	85	47	
8-30	0	306	762	853	423	140	124	370	207	403	184	371	425	474	361	69	0	0	9808
	34	265	142	297	133	0	69	47	893	89	133	642	153	583	304	154	160	38	
8-31	0	329	785	623	363	110	101	315	384	697	234	312	575	565	397	72	0	0	9529
	0	242	182	182	87	0	69	45	397	71	133	675	228	418	570	147	169	52	
NO. DAYS	0	16	31	23	31	27	31	31	31	28	31	0	26	28	31	25	31	31	31	31	30	31	31	31	31	31	31	30	31	31	2	30	7	31	

TOTAL #PAX= 279456 (AV. 9015/DAY) #ACTIVE HALF-HOURS= 954 (AV. 30.8/DAY) AV.#PAX/30-MIN= 293 (ST DEV= 209)

THE COMPOSITE (AVERAGE) 30-MINUTE PROFILE OF THESE 31 DAYS IS AS FOLLOWS:

AVRGE.	0	228	672	651	333	144	99	382	388	495	210	358	384	495	398	92	186	111	
	61	200	196	329	119	0	80	77	561	108	112	585	199	567	299	170	156	49	
ST DEV	0	107	181	147	91	50	38	65	91	170	93	110	137	100	75	45	131	19	
	42	49	85	163	42	0	21	44	146	54	32	111	90	133	87	60	47	14	
WTD AV	0	228	672	651	333	144	83	382	388	495	204	358	384	495	398	92	12	25	
	31	148	171	329	108	0	72	62	561	108	112	585	199	567	299	170	151	49	

AND THE COMPOSITE HOURLY PROFILES REPRESENTING 30-MINUTE MOVING BLOCKS (WINDOWS) OF 1- TO 6-HOURS ARE:

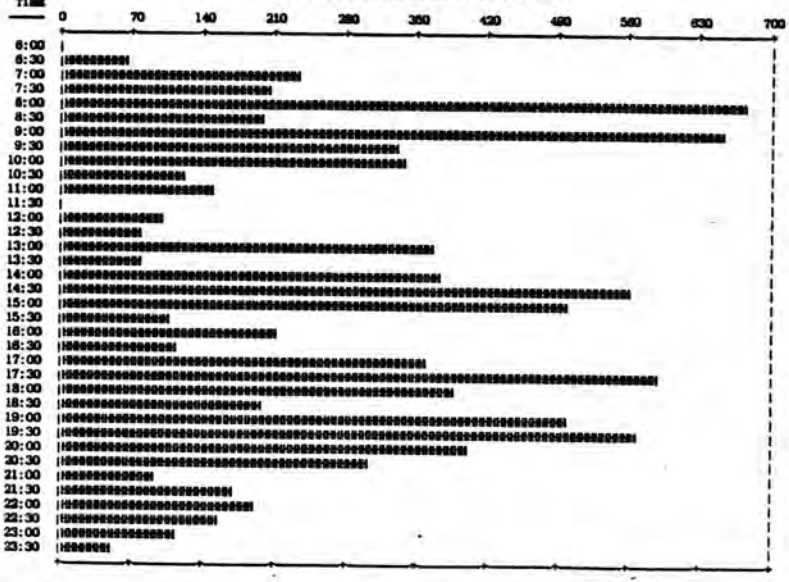
1-HR	61	376	843	980	441	144	155	434	929	602	315	943	583	1062	698	262	168	74	
	259	820	821	663	251	99	434	430	1056	311	469	989	694	985	381	182	176		
2-HR	204	610	912	711	293	150	290	677	786	459	529	763	823	875	475	212	119		
	540	821	742	457	167	258	432	743	884	391	719	832	830	673	282	179			
3-HR	417	733	755	522	247	241	503	652	616	620	614	862	777	670	371	166			
	634	768	579	332	256	316	640	599	612	583	711	876	680	509	246				
4-HR	556	660	602	430	291	413	528	568	698	611	726	819	649	544	297				
	641	639	455	358	300	501	558	567	701	611	774	752	556	426					
5-HR	534	557	513	429	419	451	485	643	674	701	718	707	551	450					
	583	528	451	372	451	463	540	647	700	682	696	638	480						
6-HR	469	490	498	512	449	428	561	633	739	699	642	617	472						
	483	512	447	486	428	464	612	655	744	632	610	561							

EXHIBIT 15 ANALYSIS OF DAILY 30-MINUTE TRAFFIC FLOWS - 1982 'YZB' ENPLANING DOMESTIC PASSENGERS ADAM OUTPUT

CONCEPT 1 — AVERAGE DAY IN THE BUSIEST MONTH OF THE YEAR (MONTH 8 IN 1982)

31-DAY COMPOSITE PROFILE (WEEKENDS INCLUDED)

#PAX PER 30-MINUTES STARTING AT TIME SHOWN



PLANNING PEAK PERIOD ...	1/2 HR	1-HR	2-HR	3-HR	4-HR	5-HR	6-HR	DAY
PLANNING PEAK STARTS AT	8:00	19:00	8:00	17:30	17:00	16:00	14:30	
PLANNING PEAK PASSENGERS	672	1082	1823	2628	3275	3580	4484	9015
% OF PLANNING PEAK DAY	7.45	11.78	20.22	29.15	36.33	39.82	49.52	100.

EXHIBIT 16 30-MINUTE TRAFFIC FLOW PROFILE & PLANNING PEAKS - 1982 "YZB" ENPLANING DOMESTIC PASSENGERS

ADAM OUTPUT

31-DAY COMPOSITE PROFILE (WEEKENDS INCLUDED)

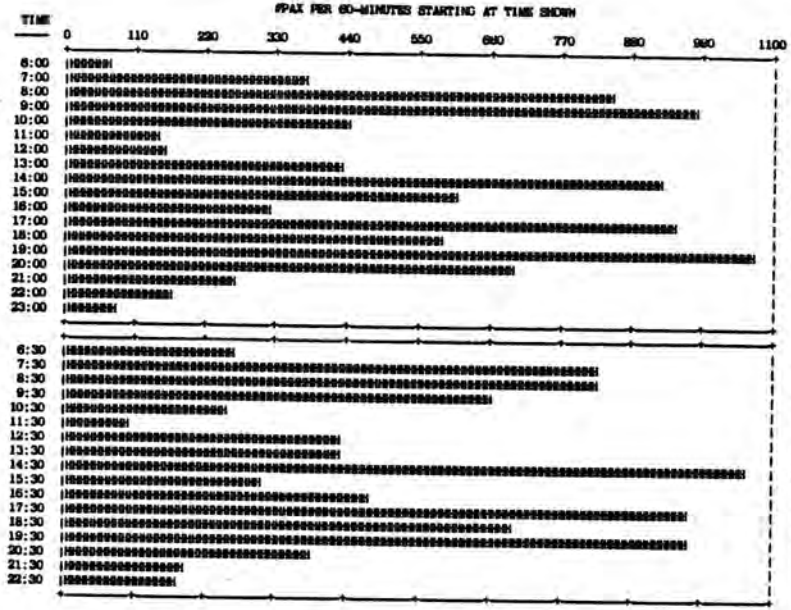


EXHIBIT 17 60-MINUTE TRAFFIC FLOW PROFILE & PLANNING PEAKS - 1982 'YES' ENPLANING DOMESTIC PASSENGERS

ADAM OUTPUT

passengers in the busiest month of the year. Exhibits 18 to 21 present the corresponding profiles generated by the model for the air carrier aircraft and seat flows. The information presented in Exhibits 16 to 21 is used to study the diurnal peaking characteristics of traffic at a given airport by sector and direction of travel. Average half-hourly and hourly ratios similar to those described in (b) could also be estimated from these Exhibits.

The hourly profile is produced by ADAM in two formats: a profile in which the 60-minute time interval starts at the clock hour and another in which it starts at the half-hour. Such a scheme captures any "uneven" half-hourly distributions of traffic flows within the hour and ensures that the resulting profile and the airport planning peaks generated from it are realistic.

(h) A summary of planning peaks for day and 1/2,1,2,3,4,5, and 6 hour peak intervals. The model determines the time of day and traffic volume associated with each of these peaks and expresses their values as percentages of the planning day volume. The development and application of these planning peaks can be found elsewhere[2].

As an illustration, the planning peak half-hour passengers for a given traffic sector-direction r at a given airport $(PPhP)_r$ is obtained from the half-hourly composite profile produced by ADAM for a certain design busy period of the year (e.g. Exhibit 16) as follows:

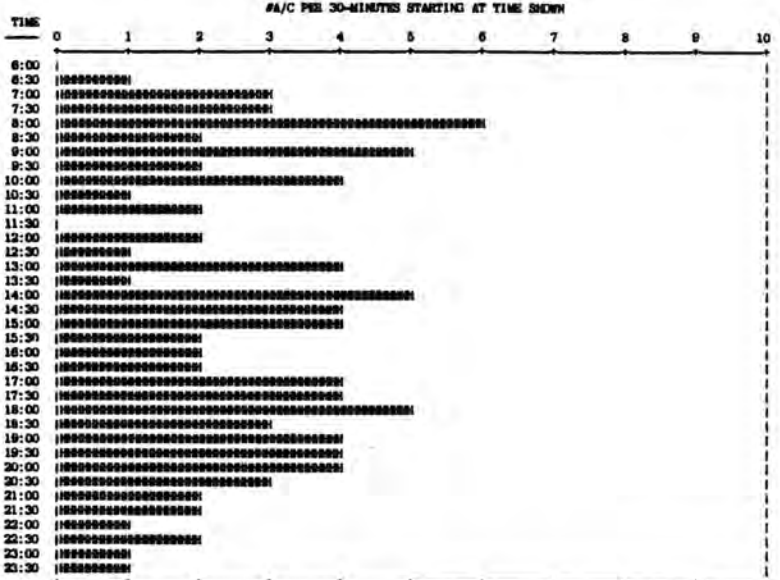
$$(PPhP)_r = \max_i \{ h_{ir} \} \qquad i = 1,2,3,\ldots, 36$$

$$\text{subject to} \quad f_{ir} \geq \bar{f}_r \qquad \forall\ i$$

********** CONCEPT 1 — AVERAGE DAY IN THE BUSIEST MONTH OF THE YEAR (MONTH 8 IN 1982) **********

31-DAY COMPOSITE PROFILE (WEEKENDS INCLUDED)

#A/C PER 30-MINUTES STARTING AT TIME SHOWN



PLANNING PEAK PERIOD ...	1/2 HR	1-HR	2-HR	3-HR	4-HR	5-HR	6-HR	DAY
PLANNING PEAK STARTS AT	8:00	7:30	7:30	17:00	17:00	14:00	14:00	
PLANNING PEAK AIRCRAFT	6	8	15	23	30	33	41	90
% OF PLANNING PEAK DAY	6.67	8.89	16.67	25.56	33.33	36.67	45.56	100.

EXHIBIT 18 30-MINUTE TRAFFIC FLOW PROFILE & PLANNING PEAKS - 1982 'YES' DEPARTING DOMESTIC AIRCRAFT

ADAM OUTPUT

31-DAY COMPOSITE PROFILE (WEEKENDS INCLUDED)

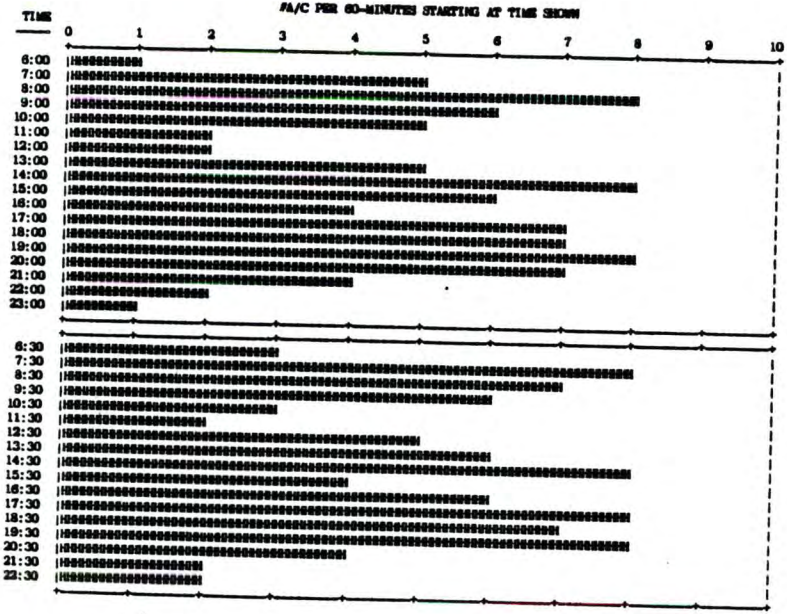
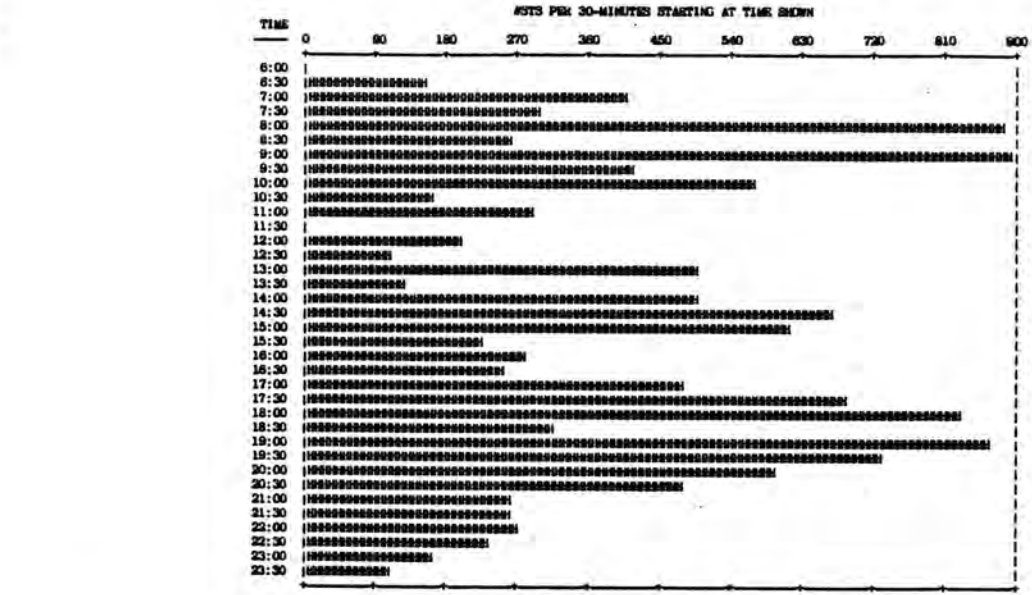


EXHIBIT 19 60-MINUTE TRAFFIC FLOW PROFILE & PLANNING PEAKS - 1982 'YZB' DEPARTING DOMESTIC AIRCRAFT

ADAM OUTPUT

********** CONCEPT 1 — AVERAGE DAY IN THE BUSIEST MONTH OF THE YEAR (MONTH 8 IN 1982) **********

31-DAY COMPOSITE PROFILE (WEEKENDS INCLUDED)



PLANNING PEAK PERIOD ...	1/2 HR	1-HR	2-HR	3-HR	4-HR	5-HR	6-HR	DAY
PLANNING PEAK STARTS AT	9:00	19:00	18:00	17:30	17:00	16:00	14:30	
PLANNING PEAK A/C SEATS	889	1563	2743	4026	4970	5500	6540	13411
% OF PLANNING PEAK DAY	6.63	11.66	20.45	30.01	37.06	41.01	48.77	100.

EXHIBIT 20 30-MINUTE TRAFFIC FLOW PROFILE & PLANNING PEAKS - 1982 'YES' DEPARTING DOMESTIC A/C SEATS

AIRAM OUTPUT

31-DAY COMPOSITE PROFILE (WEEKENDS INCLUDED)

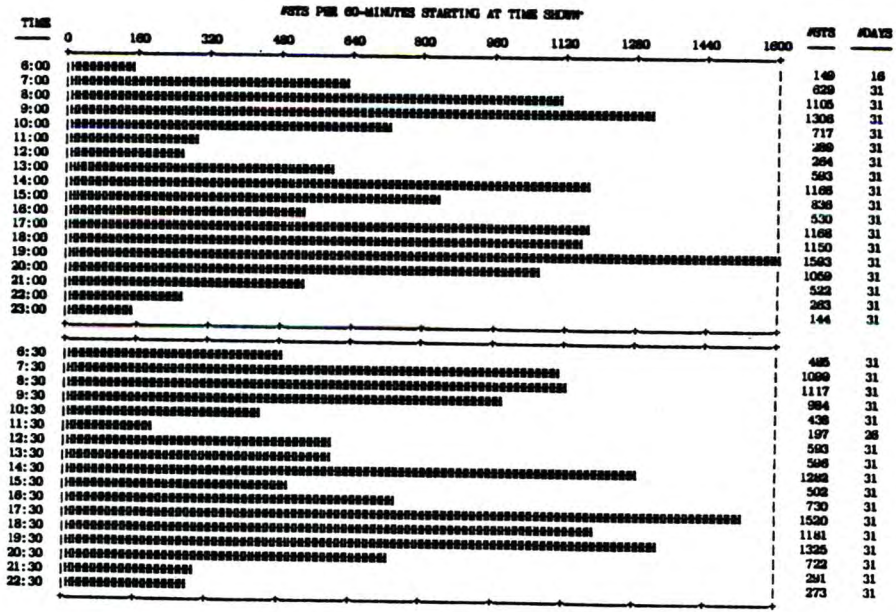


EXHIBIT 21 60-MINUTE TRAFFIC FLOW PROFILE & PLANNING PEAKS - 1982 'YZB' DEPARTING DOMESTIC A/C SEATS

ADAM OUTPUT

where

h_{ir} = i^{th} ordinate of the half-hourly composite profile representing the selected design busy season for traffic sector-direction r.

f_{ir} = traffic frequency (in days) of the i^{th} ordinate of the profile - i.e. number of days with traffic in that particular i^{th} half-hour of the profile.

$\bar{f}_r$ = minimum frequency (in days) below which an ordinate of the above profile is not considered "reasonably frequent" to qualify as a candidate for PPhP.

OTHER CAPABILITIES OF THE MODEL

In addition to its ability to handle 3 types of traffic: passengers, aircraft and seats, and its capacity to analyze up to 15 traffic sector-direction combinations in one run, the model has other capabilities:

1. The model outputs described in (f),(g) and (h) above are produced for any, all or a combination of six alternative planning peak day concepts:

Concept 1: Average day in the busiest month of the year.

Concept 2: Average day in the busiest 2 consecutive months of the year.

Concept 3: Average day in the busiest 3 consecutive months of the year.

Concept 4: Average day in the busiest quarter of the year.

Concept 5: Average of the busiest n (user-specified) consecutive days in the year.

Concept 6: Average day in <u>any</u> user-specified period of the year.

The significance of these planning day concepts can be found elsewhere[2].

2. Option is provided by the model to include or exclude the weekends from the analysis of any of the above six concepts. Traffic patterns during the weekends may, for some traffic sectors, be significantly different from those pertaining to the Monday-to-Friday portion of the week. In such cases, inclusion of the weekends affects the generated composite profiles and planning peak volumes.

3. The model contains an algorithm for synthesizing and graphically displaying the half-hourly and floating hourly traffic profiles implied by a given "nominal schedule". The nominal schedule is a prediction of the arrival/departure pattern of air carrier flights at a given airport in the design year and the associated passenger traffic loads. The synthesis and graphical display of its traffic profiles is performed by the model for all possible combinations of traffic sectors and directions. Corresponding base-year planning traffic profiles are produced by ADAM, as described earlier, to which the design-year nominal schedule profiles and peaks are compared for reasonableness.

SOME TECHNICAL DATA

ADAM was developed and coded in FORTRAN IV computer language by the author. It requires a total core of approximately 150K to run. The total processing (CPU) time on Transport Canada's IBM System 3081 computer relating to the passenger traffic sample outputs presented in this paper is only 2.7 seconds (cost: less than $1.00).

ABBREVIATIONS

AV. (AVRGE.)	Average
A/C	Air carrier aircraft movements
HR	Hour
M-DAY	Month-Day
PAX	Passengers
RNK	Rank (i.e. Nth Highest Day, Hour, etc.)
ST DEV	Standard Deviation
STS	Air carrier aircraft seats
WTD AV	Weighted Average
%ILE	Percentile
30-M(30-MIN)	30-Minute

ACKNOWLEDGEMENTS

The author acknowledges the assistance of J. Imbert, who prepared the data base to run ADAM. D. Johnson and W. Christoff developed a WYLBUR Macro front end to permit running the model in a conversational mode.

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2. Hamzawi, S.G., "Study of the Air Terminal Building Planning Standard", Technical Report TP 4771E, AK-42-02-400, Transport Canada, (July 1983).

COST STRUCTURE OF THE CANADIAN AIRLINES AND REGULATORY POLICY IMPLICATIONS

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SUMMARY

In this paper we develop a general multiple input/multiple output cost model for the Canadian air carriers. The model

is able to take account of firm specific effects of network and market characteristics across firms and non-neutral technical change over time. We specify three outputs — scheduled passenger, scheduled freight and charter passenger and freight services — and three inputs — labour, fuel and capital. The network and market characteristics include average stage lengths for each output, load factors, seats or tons per departure and number of points served. The model is specified in a generalized translog form with log-linear hedonic aggregator functions as its arguments. The model is estimated from yearly pooled cross-section and time-series data for the six Canadian level I and level II airlines (Air Canada, C.P. Air, Pacific Western, Quebecair, Eastern Provincial and Transair) over the period 1964-81.

The model is used to test a variety of functional forms and production structures. The findings indicate the production technology of the Canadian airline industry is best characterized by a general, non-homothetic joint-cost structure. Restrictive structures which are clearly rejected include input-output separability, homotheticity, log-linear structure and cost independence among products.

Measures of overall and partial economies of scope are calculated among the three outputs. The results vary across airlines, and with the combination and level of outputs under consideration. Generally we find mutual cost-comple-

mentarity between scheduled passenger and freight services when the proportion of freight service is less than 15% of scheduled passenger services. All airlines except P.W.A. and Quebecair realized cost savings by the joint production of scheduled passenger and charter services; the extent of the cost savings decreases rapidly over time.

Our model is used to calculate marginal and average cost figures. We find the elasticity of fare (per passenger mile) with respect to distance to have always exceeded the elasticity of average cost with respect to average stage length, indicating discriminatory pricing against long haul passengers. However the magnitude of the difference between the two elasticities has been shrinking implying the fare structure is more closely approaching the cost structure.

Measures of total factor productivity indicate the industry has experienced an average annual rate of growth of 3-7%. This measure from the estimated cost function is adjusted for the effects of scale of operation and network and market characteristics. This increase (in total factor productivity) appeared in the form of average productivity growth of inputs in the following order: labour, capital and fuel. The airlines with the higher growth rates throughout the 1964-81 period were E.P.A., Nordair, Quebecair and Transair.

The elasticities of factor substitution and the price elasticities of demands for labour, fuel and capital inputs

have exhibited the following: (i) labour and capital inputs are very weak gross substitutes while they are strong partial substitutes, (ii) although a fairly strong complementary relationship between capital and fuel inputs was observed between 1964 and 1971, the complementarity has rapidly decreased since 1972. Air Canada has the highest fuel-capital complentarity throughout the period except the last year. The own price elasticity of ordinary demand for fuel input during the pre-1972 period was about 0.0 -.30, but it has increased to -.47 -.65 in 1978.

Finally, we have measures of the effect of network and market characteristics on the cost function. These measures indicate route awards by regulatory agencies can have differential impact across airlines.

AN INTERNATIONAL COMPARISON OF AIRLINES

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I. Introduction and Motivation for the Research

In 1978 the U.S. deregulated its domestic airline industry. Subsequently, it attempted to export that policy by extending it to international air carrier operations originating or terminating in the U.S.[1] The evidence on the success of U.S. deregulation is generally positive but there are dissenters. A study authored by analysts David R. Graham and Daniel P. Kaplan at the U.S. Civil Aeronautics Board (CAB) states:

> "We find that, although the transition is not complete, deregulation is leading to a more efficient airline system than the one that evolved under regulation. ... As the distortions introduced by regulation are being undone, the industry is becoming more productive and service convenience is improving."[2]

Secor D. Browne, a former (regulation era) CAB chairman claims that deregulation has been a great mistake. He sums up the current U.S. policy options as follows:

> "We are approaching a major fork in the road for the United States air transport system ... One fork points to an oligopoly of an airline system with fewer carriers whose management duty will be to maximize profits to their investors and stockholders without more public service obligation than that of management of the cement works or

girdle factory. The other fork points to a system of airlines under Government supervision to assure an adequate domestic and international United States airline system to meet the air transport needs of the Nation and its Government."[3]

U.S. airline deregulation has had two major impacts on Canada. First, the exporting of deregulation has required the Canadian carriers to respond to the new competitive environment on their transborder markets. There is also evidence of diversion of Canadian traffic to U.S. gateways. For example, enplanements at Burlington, Vermont, a short drive from Montreal, have grown from 115,000 in 1976, to 204,000 in 1979, and to 374,000 in 1983. Second, the highly visible example of U.S. deregulation has been leading to some calls for similar regulatory reform in Canada. Because of the high visibility of the U.S. experience with deregulation and the controversy surrounding CTC rate regulation, it is unlikely that the question of Canadian airline regulatory reform will fade away. There is a clear need to examine what policy options are available to Canada to achieve its social goals with respect to air transport.

The U.S. experience is not wholely relevant to Canada. There are at least three major differences in the structures of the U.S. and Canadian airline industries. First, there is higher concentration in Canada. Air Canada accounted for 52% of total industry revenues in Canada in 1977. In contrast, the largest U.S. carrier, United Airlines, accounted for less than 15% of revenues in the U.S. (1977 was the year prior to deregulation.) Second, all carriers in the U.S. are privately owned. Canada has several publicly owned carriers, including Air Canada, the largest. Third, all Canadian

carriers provide essential services to small and remote communities. The large U.S. trunk carriers such as United had dropped small communities from their networks well before 1978. With the exception of some directly subsidized bush operations in Alaska and Hawaii, none of the U.S. carriers provided servide to remote communities for whom air transport is a critical link.

There is yet another issue facing Canadian air transportation in the coming years. There is some interest in returning all or part of the publicly owned air carriers to the private sector. This might be done by outright sale of the carriers, partial sales, or simply by allowing the airline to issue new equity in the private market place. The potential change in federal government within the year could make this an important issue. Furthermore, there are important international examples of privatization that may give added impetus to examining this option. The United Kingdom is preparing British Airways for sale to the public, and in the U.S., Conrail, the government owned railroad, is slated for sale or dismemberment within the next few years.

One approach to studying these and related issues is to gather evidence from the experiences of other countries. In a recent study of public regulation Joskow and Noll stated:

> "Most of the empirical literature on regulation focuses entirely on U.S. industries. Little effort has been made to exploit available data on the costs, prices, quality and rate of technical change in the same industries in other developed countries."[4]

Throughout the world we observe many different combinations of ownership form, industry organization, type of regulation, and use

of taxation or subsidy as policy instruments to achieve social goals. For example, in countries such as Canada and Australia we observe publicly and privately owned carriers competing with each other. In others a single carrier operates; sometimes privately owned (China Air Lines) sometimes publicly owned (Aer Lingus), and sometimes jointly owned (roughly 25% of Swissair is owned by the government). There are cases of multicountry ownership of airlines. Air Afrique is owned by the governments of eleven African nations. SAS is roughly equally owned by companies in Denmark, Norway and Sweden. These three companies are in turn 50% owned by their respective governments and 50% by private interests.

Carriers also differ in terms of the scope of services they provide. The Australian carrier Qantas, for example, only provides long-haul international services. Saudia, in contrast, provides international services, including essential services to remote communities. Countries with multiple carriers may allow them to compete on the same routes, as in Australia, or may attempt to segregate them, perhaps by region as in Canada, so they operate monopoly routes.

Countries differ in terms of the regulatory environment. The U.S. and Chile have largely moved to unregulated domestic airline industries. Some, such as Canada, have loosened regulatory reigns to allow more innovation and changes in service. Others regulate with a heavy hand.

Social goals with respect to air transportation generally include: economic efficiency, service to small or remote communities, national prestige, balance of payments improvements, encouraging tourism, acquisition of high technology, and national defense.

Economic efficiency has two aspects. The first involves deviations of prices (social values) from costs. The second is known as X-efficiency. An X-inefficient industry is one where there is no incentive to keep costs down. Costs, therefore, creep upward. Overgenerous wage settlements that are passed on to consumers via the regulatory process might be an example.

The diversity of social goals and policy choices among the international carriers and countries provides us the opportunity to identify the impacts of various policy instruments on the achievement of social goals by air carriers. This paper is one part of a larger project whose intent is to gather evidence from the wide diversity of international airlines on the roles of regulation, ownership, industry organization and taxation/subsidy in meeting social goals. This project will involve measuring the performance of the world's carriers and gathering data on the ownership, regulation and subsidy of each. Models explaining carrier performance will be estimated. From these conclusions on the relative roles of each policy instrument will be drawn. The conclusions of the study will be used to make inferences as to the success and consequences of regulatory and ownership changes in Canada.

This paper takes the first step by gathering data on a cross section of 110 of the world's carriers. The data is used to measure labour productivity and unit costs of the carriers. Models are estimated to see whether much of the differences in performance between the world's carriers can be explained by various factors in the operating environment. From these results conclusions are drawn as to whether additional study will be fruitful.

The paper is organized as follows. Section 2 discusses the measures and models of performance that will be used. Section 3 briefly introduces the data, Section 4 describes the results, and Section 5 draws conclusions.

II. Measures and Models of Carrier Performance

Two measures of carrier performance are used in this study: labour productivity (LP) and unit cost. LP is the ratio of output, Y, to labour input L. This measure has been widely used to assess performance in almost all industries. LP, as a measure of carrier performance, admittedly has some undesirable features. Specifically, it cannot distinguish carriers with high output per employee due to true economic efficiency from those where it is due to substitution of other inputs, such as capital or purchased services, for labour. A better measure would be total factor productivity (TFP), or output per unit of total resources expended.[5] TFP measurement, however, is time consuming and expensive. The purpose of this paper is to determine whether the more elaborate (and more revealing) TFP measurement will be worthwhile.

A second measure of carrier performance is unit cost, or total operating costs divided by output. If all carriers used the same technology and faced the same relative prices, then unit cost (in a single cross section) would be the inverse of TFP.[6] While these conditions are not likely to hold completely in our sample, investigating unit cost will give us some indication as to whether the source of LP for particular carriers is due to true efficiency or to substitution of other inputs.

Measurement of LP and unit cost is relatively straightforward. Comparisons using these measures often appear in the popular

press.[7] It is tempting to draw conclusions such as "privately owned CP Air is more efficient than government owned Air Canada". However, there are many factors other than government ownership that may account for LP differences. Before making an assessment as to the effects of government ownership, one must control for these factors. CP Air, for example, operates with an average stage length that is 20% longer than Air Canada's and has an average passenger trip length that is 50% longer. Caves, Christensen and Tretheway (1983) developed models to explain productivity in terms of output, stage length and load factor.[8] The same methodology will be applied here to both LP and unit cost. The unit cost coefficient on output will be of particular interest, since it may give some indication as to whether or not economies of scale exist.[9]

Due to the large variation of the variables in our sample, a linear functional form would be inappropriate. We use the Cobb-Douglas form where regressors and regressands are in natural logarithm form. The advantage of this is that coefficients can be interpreted as elasticities. The disadvantage is that this form restricts these elasticities to be the same for all sizes of firms.

In defining both unit cost and labour productivity an appropriate output variable must be used. Revenue ton-kilometers (RTK) is used here. This measure includes both passenger and freight, although it gives too much weight to the latter which can be produced with fewer resources. Some have argued that air carriers in fact produce available ton kilometers (ATK) and that this is the proper measure. The ATK measure, however, will make airline A which provides 100 million RTK at a 50% load factor seem more efficient than airline B which provides the same 100 million RTK at a 65% load

factor. Anyone can produce ATK while only efficient, well managed carriers can produce RTK at low unit cost or high LP. Nevertheless, the coefficients of a model using ATK as the output measure can be inferred from the model estimated. The estimating equation using RTK as the measure of output are:

$$(1)\quad \log(RTK/L) = b_0 + b_1 \log(RTK) + b_2(RTK/ATK) + b_3 \log(T)$$

$$(2)\quad \log(TC/RTK) = a_0 + a_1 \log(RTK) + a_2 \log(RTK/ATK) + a_3 \log(T)$$

where L is labour, TC is total cost, and T is trip length. Note that RTK/ATK is load factor. Due to the properties of the following logarithms we can transform equations (1) and (2) to yield the following equations which use ATK as the output measure. The parameters b_1, b_2, b_3, etc. are the same as in equations (1) and (2).

$$(3)\quad \log(ATK/L) = b_0 + b_1 \log(ATK) + (b_1 + b_2 - 1)\log(RTK/ATK) + b_3 \log(T)$$

$$(4)\quad \log(TC/ATK) = a_0 + a_1 \log(ATK) + (a_1 + a_2 - 1)\log(RTK/ATK) + a_3 \log(T)$$

In equations (1) and (2) the coefficient on load factor should be positive. Unit cost falls as load factor increases, when output is defined as RTK. In contrast, in the second set of equations, the load factor coefficient should be negative. Cost per ATK will rise as more of that output is sold and needs servicing.

III. Data

The source of data for this study is the International Civil Aviation Organization (ICAO), a U.N. agency headquartered in Montreal.[10] The sample consists of all of the 110 scheduled carriers appearing in the 1981 edition of ICAO's Air Carrier Financial

Statistics. The carriers vary in size from United Airlines (USA) with 6,293 million revenue ton kilometers (RTK) to Aerovias Del Cesar (Columbia) with 3.9 million RTK. The distribution of carriers within this range if fairly uniform. Included in the sample is Aeroflot (USSR) which reported carrying 109 million passengers in 1981. This is in contrast to the next largest, Eastern (USA), with 36 million.[11] Nine of the carriers in the sample, including EPA and Quebecair from Canada, provided only domestic services.

We collected data on traffic, costs, revenues and employment. These are described in Appendix A. Appendix B contains a listing of the data for each carrier. All cost and revenue data were converted by ICAO to U.S. dollars. Table 1 gives some descriptive statistics for the key variables in the study. Firms with incomplete data were excluded from the regressions.

IV. Results

Appendix B gives LP and unit costs for each of the 110 carriers. As can be seen, there is the expected inverse relationship of LP and unit costs. There also seems to be a correlation of LP with stage length and output. To test this, a series of simple regressions are reported in Table 2. In the table, b_o is the constant term and b_1 is the slope. All the slope coefficients are of the expected signs and are significant at the 1% level. Output, load factor and trip length are all postively correlated with labour productivity and negatively correlated with unit cost. The coefficients on load factor and trip length are large, while that on output is relatively small.

The next step is to determine whether the three factors jointly influence costs and productivity. Column 1 of Table 3 presents the

Table 1
Descriptive Statistics*

Variable	Mean	Std. Error	Max.	Min.
Labour Productivity RTK/employee (000s)	114.7	87.3	568	15
Unit Cost US¢/RTK	91.8	36.6	212	27
Trip Length (km.)	1876	1455	8891	58
RTK (millions)	1086	1475	6293	4
Load Factor (%)	57.0	10.0	89	21

* Statistics based on samples used for the regressions.

Table 2
Simple Regressions*
(Standard Errors in Parentheses)

		Regressors		
		Trip Length	Output	Load Factor
Labour Productivity:	b_o	-.228 (.647)	3.236 (.214)	-.335 (1.444)
	b_1	.647 (.088)	.216 (.034)	1.205 (.358)
	R^2	.39	.32	.12
Unit Cost:	a_o	7.682 (.421)	5.199 (.145)	8.517 (.916)
	a_1	-.444 (.057)	-.130 (.024)	-1.014 (.227)
	R^2	.39	.25	.18

* All regressors in natural log form.

multiple regression model for LP. Again, the coefficients are of the expected sign, although load factor is insignificant. In column 2 we reestimate the model dropping load factor. This does not significantly change the remaining coefficients. Column 1 of Table 4 gives results for the unit cost regressions. Here, load factor is significant at the 1% level. Both the LP and unit cost models indicate that trip length has a strong and significantly positive influence on carrier performance. A 1% increase in trip length results in a 0.47% increase in labour productivity and a 0.30% decrease in unit cost. Since stage length is missing from the model, the trip length coefficients reflect both the cost advantage of increasing stage length and the advantage of carrying a single passenger for a long trip on a carrier's system rather than two separate pasengers. More detailed analysis to distinguish these two are left for a future paper.

The output coefficients indicate that at the mean of our sample (roughly the size of CP Air) there may be very mild economies of scale present. The unit cost regression indicates that a 1% increase in output may lead to a .06% drop in unit cost. While the output coefficient is significant its magnitude is small. This is not too surprising. The firms in our sample range in size from four million TKP to 6,293 TKP, a factor of 1,500, whereas unit cost varies from 27 cents per RTK to 212, a factor of roughly eight.

For 56 of the 110 carriers we were able to document whether they were publicly versus privately owned and controlled. In the last column of Tables 3 and 4 we repeated the regressions adding a dummy variable that was unity if publicly owned. Both the LP and unit cost models indicate that publicly owned carriers, on average

Table 3
Labour Productivity Regressions*
(Standard Errors in Parentheses)

	base model	without load factor	with dummy
Constant	-.926 (1.162)	.383 (.641)	-.817 (1.563)
Trip Length	.419 (.106)	.466 (.100)	.423 (.107)
Output	.120 (.037)	.120 (.037)	.055 (.050)
Load Factor	.411 (.305)	-- --	.550 (.443)
Dummy-Public Ownership	-- --	-- --	-.486 (.101)
R^2	.47	.46	.60
Number of Observations	86	86	48

* All regressors in natural log form.

Table 4
Unit Cost Regressions*
(Standard Errors in Parentheses)

	base model	with dummy
Constant	9.085	9.173
	(.768)	(.941)
Trip Length	-.303	-.258
	(.069)	(.064)
Output	-.057	-.031
	(.024)	(.029)
Load Factor	-.522	-.681
	(.199)	(.264)
Dummy-Public Ownership	--	.141
	--	(.060)
R^2	.47	.58
Number of Observations	95	51

* All regressors in natural log form.

in the sample, are associated with a lower level of performance. Unit cost, on average, is 14% higher for government carriers while labour productivity is 49% lower. Results from these admittedly simple models do not imply that public ownership per se negatively impacts on performance. There may be many reasons for the result, not the least of which is that government carriers may be charged with objectives other than economic efficiency. The results do indicate that further investigation into the linkages between social goals toward air transport and the instruments used to achieve them may be worthwhile.

V. Conclusions

There are many limitations to the analysis conducted here. The output measure treats a ton of freight the same as a ton of passengers (roughly 10 passengers, including baggage). No attempt has been taken to control for heteroskedasticity. The model ignores differences in traffic mix, size of the network operated by the carrier, and differences in factor costs between countries.

Nevertheless, the results are quite stimulating. They are consistent with previous results using only data from a single country. Caves, Christensen and Tretheway, using U.S. data on a similar model, found a strong, positive relationship between total factor productivity and stage length, a weak insignificant one with output, and a positive but insignificant result with respect to load factor. [12] Gillen and Oum, using data for the transcontinental and regional Canadian carriers, found similar results in total cost models, but with a stronger relationship with output for the smaller Canadian carriers.[13]

The models also indicate that roughly half of the intercarrier differences in productivity or unit costs can be explained by dif-

ferences in trip length, output and load factor. Column one of Table 5 indicates the relative ranking of the Canadian and U.S. carriers in terms of labour productivity. In the second column we indicate the ranking based on the unexplained part of productivity. This is constructed by subtracting the predicted value of labour productivity (using the regression reported in column one of Table 3) from the actual value. This residual reflects a combination of true carrier efficiency and unmodelled factors affecting performance. Several changes in ranking are apparent. PWA, for example, has risen from being the 57th most efficient carrier to being 25th. PWA operates with a relatively short passenger trip length; its trip length is 88th out of 101 worldwide. After controlling for this we see PWA has a much higher ranking, moving from position 4 to position 1 among the Canadian carriers. There are also interesting changes in position for the U.S. carriers. Pan Am, operating with long trip lengths, drops from 13 to 38 in worldwide rankings. Texas International, PSA, Frontier and US Air all rise in rank to the top 30's. Not included in the table is British Airways (UK), currently slated for privatization, which falls from position 42 of the 94 carriers for whom we are able to measure labour productivity, to position 90.

The results also indicate that government owned airlines have a significantly lower level of performance; 14% in terms of unit cost and 49% in terms of labour productivity. Due to the simplicity of the models, the results do not indicate that public ownership per se is the cause of lower performance. An alternative explanation is that these carriers are charged with social goals other than, or in addition to, economic efficiency. Government owned Saudia, for

Table 5
Ranking of Air Carriers
Canadian and U.S. Carriers

	Worldwide Rankings	
	actual labour productivity	unexplained labour productivity
Canada		
CP Air	22	72
Air Canada	32	69
Nordair	37	55
PWA	57	25
EPA	59	47
Quebecair	98	49
U.S.		
Flying Tigers	1	1
Transamerica	2	3
World	4	4
Capitol	5	6
Northwest	6	8
Pan Am	13	38
TWA	17	71
Western	18	19
American	20	33
Braniff	21	17
United	25	68
Continental	27	23
Delta	38	30
Eastern	39	42
Texas International	43	21
PSA	48	18
Frontier	51	28
US Air	58	29
Republic	60	35

example is expected to provide domestic services at fares potentially below costs in order to link the isolated communities of Saudi Arabia. Other airlines are charged with the sole goal of bringing tourist traffic to their countries -- even if a loss is sustained.

These preliminary results do suggest the need to control measures of carrier performance for the social goals their managements are charged with. The simple models have yielded plausible results suggesting that more detailed analysis may prove to be fruitful.

Notes:

1. The June, 1978 CAB show cause order virtually ended the conference rate making process for all markets to or from the U.S. The International Air Transportation Act of 1979 made clear that a fundamental objective of U.S. international aviation policy is to promote competition in the international marketplace. For a discussion of these two policies see Nawal K. Taneja, U.S. International Aviation Policy, 1980, Lexington Books, Lexington, Massachusetts.

2. David R. Graham and Daniel P. Kaplan, "Competition and the Airlines: An Evaluation of Deregulation," Staff Report, Office of Economic Analysis, Civil Aeronautics Board, December, 1982, Washington, D.C., pages 5-6.

3. Secor D. Browne, "Salvage of the United States Air Transport System," in J. Rhoads Foster, ed., Airline Deregulation: Lessons From Public Policy Formation, 1983, Institute for Study of Regulation, Washington, D.C., page 74.

4. P.L. Joskow and R.C. Noll, "Regulation in Theory and Practice: An Overview," in G. Fromm, editor, Studies in Public Regulation, MIT Press, 1981, p. 57.

5. For an example of using TFP to assess carrier performance, see D.W. Caves, L.R. Christensen and M.W. Tretheway, "Productivity Performance of U.S. Trunk and Local Service Airlines in the Era of Deregulation," Economic Inquiry, July, 1983.

6. Unit cost equals $(P_L L + P_K K)/Y$, where L,K and P denote labour, capital and price. TPF equals Y/I, where I is real input. I in turn equals $(P_L L + P_K K)/P_I$ where P_I is a real input price index. P_I is a function of P_L, P_K and the production relation.

7. See for example "Government Airlines' Efficiency often Matter of Interpretation," by Edward Clifford, Globe and Mail, Toronto, 29 August, 1981.

8. Op. Cit.

9. Several authors have distinguished economies of density from economies of scale. In a recent paper Caves, Christensen, Tretheway and Windle point out that in a cost regression using a single cross section and no measure of the size of a carrier's network, the output coefficient at best reflects economies of scale. Proper measurement requires the use of pooled time-series cross-section data. See D.W. Caves, L.R. Christensen, M.W. Tretheway and R.J. Windle, "Network Effects and the Measurement of Returns to Scale and Density for U.S. Railroads," Faculty of Commerce Working Paper 1014, University of British Columbia, Vancouver, British Columbia, March, 1984.

10. ICAO publications used are Financial Statistics, Traffic Statistics and Fleet and Personnel.

11. "Aeroflot only reported international RTK in 1981. The 1982 data, which became available too late to use in the analysis, indicates that in 1981 Aeroflot flew 18,494 million RTK in domestic and international service. Aeroflot is the only airline in the USSR and its activities are so broad that they include crop dusting. In 1982, when Aeroflot flew 108 million passengers and 18.5 billion RTK, the 31 largest U.S. carriers flew a combined 293 million passengers and 50.3 billion RTK. Aeroflot does not report any labour data, and thus does not enter in the labour productivity regressions. Unit cost computed for Aeroflot is based only on its international services.

12. D.W. Caves, L.R. Christensen and M.W. Tretheway, "U.S. Trunk Air Carriers, 1972-1977: A Multilateral Comparison of Total Factor Productivity," in T.G. Cowing and R.E. Stevensen, eds., Productivity Measurement in Regulated Industries, Academic Press, 1981.

13. D.W. Gillen and T.H. Oum, "Cost Structures of the Canadian Airline Industry," Working Paper 82-22, School of Business, Queen's University, Kingston, Ontario, 1982.

Appendix A
Variables Used in the Study

1. Revenue Ton Kilometers. Total ton kilometers performed.* Measured in millions of RTK.

2. Passengers Carried.* Measured in thousands per year.

3. Load Factor. Ratio of RTK to ton kilometers available, multiplied by 100.*

4. Trip Length. Source: 1982 ICAO Traffic Statistics. Formed as the ratio of revenue passenger kilometers to passengers carried. Measured in kilometers.

5. Unit Cost. Ratio of total operating expenses to revenue ton kilometers. Measured in U.S. cents per RTK.

6. Labour Productivity. Ratio of RTK to number of personnel at year end. Measured in thousands of RTK per employee per year.

* Includes scheduled, nonscheduled, domestic and international.

Appendix B
Data Used in the Study
Carriers Ranked by Labour Productivity

Carrier	Country	Lab. Prod.	Unit Cost	RTK	Trip Length	Load Fact.	Passengers
FLYINGTIGR	USA	568.	27.	3210.	8891.	70.	377.
TRANSAMER	USA	391.	37.	790.	7034.	62.	814.
JAPN-ASIA	JAPN	351.	84.	152.	1696.	67.	666.
WORLD	USA	337.	40.	890.	4162.	65.	2036.
CAPITOL	USA	272.	42.	426.	3590.	74.	1206.
NORTHWEST	USA	247.	57.	3223.	2230.	49.	11306.
KAL	KORE	239.	46.	2066.	2877.	69.	4210.
JAL	JAPN	235.	60.	5016.	2441.	62.	14115.
SIA	SING	226.	6.	2388.	3954.	71.	4409.
AIRBRIDGE	UK	220.	106.	10.	0.	41.	0.
AVIACO	SPAI	204.	75.	308.	1244.	61.	2937.
AVIATECA	GUAT	196.	126.	21.	1389.	45.	124.
PAN AM	USA	185.	66.	5992.	3444.	57.	13939.
LAN CHILE	CHIL	180.	90.	257.	3572.	55.	449.
QUANTAS	AUST	144.	64.	1859.	7062.	63.	1911.
AIRPANAMA	PANA	140.	72.	45.	1739.	89.	168.
TWA	USA	140.	76.	4468.	2320.	54.	18014.
WESTERN	USA	140.	77.	1469.	1398.	52.	9380.
INAIR	PANA	139.	68.	12.	0.	62.	0.
AMERICAN	USA	139.	76.	5083.	1791.	53.	24902.
BRANIFF	USA	139.	87.	1479.	1295.	47.	10505.
CP AIR	CAN	136.	55.	1243.	2874.	62.	3892.
KLM	NETH	136.	65.	2594.	3661.	64.	4455.
UTA	FRAN	135.	85.	964.	5486.	57.	937.
UNITED	USA	134.	73.	6293.	1899.	52.	29189.
TAN	HOND	134.	80.	28.	1461.	49.	94.
CONTINENTL	USA	131.	78.	1453.	1551.	49.	8426.
CALEDONIA	UK	129.	66.	823.	2574.	58.	2257.
AIRFRANCE	FRAN	124.	71.	4160.	2352.	63.	11592.
GARUDA	INDO	120.	71.	868.	1475.	45.	4292.
DAN AIR	UK	118.	89.	324.	1392.	83.	3052.
AIR CANADA	CAN	117.	65.	2698.	1858.	51.	12497.
LUFTHANSA	WGER	117.	80.	3601.	1698.	62.	12981.
SAM	COLO	117.	63.	63.	637.	55.	622.
THAI INTL	THAI	116.	53.	896.	3462.	61.	2145.
LADECO	CHIL	115.	98.	56.	1124.	65.	437.
NORDAIR	CAN	111.	74.	143.	1278.	0.	1193.
DELTA	USA	110.	88.	4035.	1160.	46.	8435.
EASTERN	USA	108.	87.	4352.	1181.	53.	36102.
FAUCETT	PERU	107.	71.	98.	845.	56.	850.
ICELANDAIR	ICE	107.	98.	124.	2550.	72.	509.
BRIT AIR	UK	106.	74.	4794.	2509.	64.	15297.
TEXASINTL	USA	105.	93.	342.	893.	49.	3918.
SOUTH AFR	SAFR	103.	79.	1171.	2339.	51.	4009.
SABENA	BELG	98.	94.	941.	2639.	66.	2055.

Appendix B - cont.
Data Used in the Study
Carriers Ranked by Labour Productivity

Carrier	Country	Lab. Prod.	Unit Cost	RTK	Trip Length	Load Fact.	Passengers
CYPRUS AIR	CYPR	98.	68.	95.	1882.	69.	455.
SWISSAIR	SWIZ	97.	93.	1506.	1924.	60.	6263.
PSA	USA	97.	105.	336.	606.	44.	6159.
PAL	PHIL	96.	67.	836.	1859.	55.	2920.
ALIA	JORD	96.	68.	409.	0.	59.	1467.
FRONTIER	USA	92.	97.	540.	951.	52.	6457.
AIR NZ	NZEA	90.	81.	731.	1970.	63.	3212.
SAS	SCAN	89.	100.	1429.	1239.	58.	8486.
ALITALIA	ITAL	85.	102.	1583.	1762.	59.	7006.
LAB	BOLI	83.	71.	129.	669.	65.	1240.
AIRAFRIQUE	YAOU	82.	79.	413.	0.	57.	555.
PWA	CAN	81.	85.	283.	635.	54.	4221.
USAIR	USA	81.	123.	857.	662.	53.	13706.
EPA	CAN	81.	92.	73.	0.	63.	0.
REPUBLIC	USA	81.	120.	1189.	815.	43.	17006.
VARIG	BRAZ	79.	66.	1334.	1908.	51.	4514.
LASCA	COST	78.	47.	77.	1715.	75.	332.
AEROLINEAS	ARGN	76.	155.	769.	1561.	48.	3660.
FINNAIR	FIN	74.	86.	402.	1255.	57.	3098.
AEROPERU	PERU	71.	95.	111.	1066.	45.	928.
AIR INDIA	INDI	71.	59.	1089.	4647.	63.	1573.
AIR INTER	FRAN	67.	146.	394.	546.	58.	0.
ALISARDA	ITAL	65.	128.	33.	557.	63.	646.
TACA	ELSA	65.	100.	38.	1316.	60.	242.
AVIANCA	COLO	63.	73.	556.	1004.	57.	3823.
KUWAITAIR	KUWA	62.	101.	384.	2461.	48.	1260.
AER LINGUS	IRLD	61.	91.	379.	1367.	68.	2399.
MAS	MALY	60.	68.	618.	1095.	69.	4952.
ATI	ITAL	58.	212.	112.	478.	53.	1.
BRIT MID	UK	56.	151.	59.	585.	45.	1081.
TAPAIR	PORT	51.	98.	504.	1942.	55.	2160.
AUA	AUST	50.	175.	132.	936.	43.	1358.
CRUZEITO	BRAZ	49.	105.	208.	939.	51.	2374.
SAHSA	HOND	46.	110.	25.	750.	46.	318.
ZAMBIA AIR	ZAMB	41.	140.	71.	2207.	54.	279.
ETHIOPIAN	ETHI	38.	89.	113.	1825.	57.	318.
MERPATI	INDO	36.	108.	46.	522.	64.	856.
EGYPTAIR	EGYP	34.	95.	352.	1472.	50.	2532.
PIA	PAKI	34.	75.	812.	1930.	53.	3101.
TAC	THAI	33.	96.	30.	549.	48.	695.
BIMAN	BANG	31.	72.	134.	0.	60.	0.
AIRFERRIES	UK	31.	139.	15.	1171.	46.	62.
AIR MADGR	MADG	31.	139.	56.	851.	40.	446.
AERMEDITER	ITAL	31.	206.	9.	702.	44.	0.
INDIANAIR	INDI	27.	76.	484.	789.	64.	6012.

Appendix B - cont.
Data Used in the Study
Carriers Ranked by Labour Productivity

Carrier	Country	Lab. Prod.	Unit Cost	RTK	Trip Length	Load Fact.	Passengers
AEROCESAR	COLO	26.	110.	4.	588.	21.	0.
COPA	PANA	22.	175.	9.	665.	69.	146.
AIRMALAWI	MALA	15.	150.	11.	828.	61.	133.
AEROFLOT	USSR	0.	49.	1221.	1594.	66.	108864.
AIR LANKA	SRIL	0.	60.	180.	3452.	61.	407.
ECUATORIAN	ECUA	0.	73.	117.	0.	59.	0.
ROYAL AIR	MORO	0.	74.	298.	2183.	61.	1140.
QUEBECAIR	CAN	0.	97.	74.	836.	60.	188.
TUNISAIR	TUNI	0.	91.	211.	1383.	63.	1596.
AVENSA	VENZ	0.	124.	68.	431.	63.	0.
SAUDIA	SAUD	0.	133.	1302.	1208.	44.	9383.
PLUMA	URAG	0.	175.	19.	918.	41.	180.
AIR ZIMBAB	ZIMB	0.	158.	39.	1218.	59.	230.
AERODOMIN	DOMI	0.	0.	0.	491.	0.	0.
AIR UK	UK	0.	0.	0.	344.	0.	1028.
ARCO	URAG	0.	0.	0.	58.	0.	0.
ARNARFLUG	ICE	0.	0.	0.	1605.	0.	34.
LIAT	ANTG	0.	0.	0.	281.	0.	395.
SAFE AIR	NZEA	0.	0.	0.	0.	0.	0.
TAT	FRAN	0.	0.	0.	0.	0.	447.

ECONOMIC EFFICIENCY AND THE EVOLUTION OF AIRPORT PRICING

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ABSTRACT

Landing fees at the vast majority of world airports are based on aircraft weight and are uniform throughout the day. The failure of airport authorities at the more congested airports to adopt efficient peakload pricing schemes has been criticized by economists and others for the past several years. While the failure to modify the pricing system to deal with the problems of congestion deserves to be criticized, the method of assessing landing fees has evolved over the years in response to the changing nature of airports and aircraft. This paper relates the changes which have occurred in the method of assessing landing fees since the 1940s to the changing airport/aviation environment and evaluates the changes based on their economic efficiency. Such factors as the diversity of aircraft, trip length and the extent of congestion are addressed.

I. INTRODUCTION

The development of aviation during the years since the Wright brothers' historic flight in 1903 has been dramatic. The size, speed and range of modern aircraft dwarf those of the pre-war era. Concurrent with the changing aircraft technology, airports also evolved, both physically and economically. Prior to the 1930s, airports were often privately owned. During the depression of the 1930s, private ownership collapsed, and was replaced by public ownership, initially motivated by public works concerns. Today, all air carrier airports in the U.S. are publically owned, typically at the local level, with the largest airports having annual budgets in excess of $100 million.

Airport officials have been justly criticised by economists and others in the last several years for their failure to adopt efficient peak-load pricing systems. However, historically, airport pricing systems have not been static, but have evolved in conjunction with the changing airport/aviation environment. This paper traces the changes since the 1940s in the methods airport authorities use to assess landing fees, relates these changes to the changing nature of aircraft, and evaluates them based on their impact on economic efficiency. Section II traces the changing methods of assessing landing fees since the 1940s. Section III presents a Ramsey pricing model of optimal pricing in the face of a revenue constraint specifically for the case of airports. Section IV evaluates the changes which have occurred in airport pricing based on the model in Section III. A summary is in Section V.

II. THE EVOLUTION OF AIRPORT PRICING

Several sources allow the evolution of airport pricing to be traced back to at least the early 1940s (Bollinger, et al., 1946; Zettel and Horonzeff, 1956; Stanford Research Institute, 1961; U.S. Senate, 1968; Levine, 1969; and Walters, 1978). Landing fee determination is composed of two steps. First, the decision of what airport or landing area costs to allocate to users of the landing area as a group must be made. The second step involves deciding how this burden should be distributed among the users of the landing area. The first step has remained basically unchanged throughout this period. The airport authority sets

rates in the non-landing area (of most significance are terminal concessions and parking lots) in order to maximize net revenue. The "excess revenue" thus generated is then used to partially offset (i.e., subsidize) landing area costs. Landing fees are then calculated to make up any revenue shortfall (after including government subsidy, if any). However, the manner in which this remaining revenue requirement is allocated among users of the landing area has changed.

The almost universal practice in the early 1940s (and probably earlier) was to charge a fixed amount per landing regardless of aircraft size, trip distance, etc. Specifically, users were charged a fixed amount per month for each scheduled landing per day. Frequently, there was a sliding scale arrangement with a declining rate per landing as number of monthly landings increased. Shortly after the end of World War II, two general methods of assessing fees developed: (1) in addition to the basic scheduled landing fee, an overweight charge for every 1000 pounds of aircraft weight above a certain point (usually approximately 25,000 pounds); and (2) a flat rate per 1000 pounds aircraft weight or a sliding scale with a declining rate per 1000 pounds for a large number of operations. By the mid-1960s, a broad range of pricing schedules existed at airports, including no landing fee (common at small airports), a rate per actual or scheduled landing (small airports), and a flat rate per 1000 pounds aircraft landing weight. This last method was the most common, with the frequency of its use increasing with the size of the airport. Currently, weight-based landing

fees are by far the most common system used to price runway services at airports throughout the world.

III. A MODEL OF OPTIMAL AIRPORT PRICING

The airport pricing problem consists of determining prices which maximize net benefits while raising sufficient revenue to meet airport costs (after deducting any subsidies). If the airport is overbuilt, due to inefficient investment or indivisibilities, marginal cost pricing may, depending on airport construction technology, be unable to generate the requisite revenue.[1] This necessitates a departure from marginal cost prices. Taking the size of the airport as given, we have

$$\underset{Q_1,\ldots Q_N,\lambda}{\text{Max}} = \sum_{i=1}^{N} \int_0^{Q_i} P_i(Q_i)dQ_i - C(Q_1,\ldots,Q_N) - F + \lambda\left(\sum_{i=1}^{N} P_i Q_i - C(Q_1,\ldots Q_N) + S - F\right), \tag{1}$$

where $P_i(Q_i)$ = the inverse demand function for users in catetory i (a category is characterized by time of day and demand elasticity, which is a function of aircraft type and length of flight);

$C(Q_1,\ldots,Q_N)$ = total variable cost (including both costs borne by the airport and congestion cost borne by the airlines);

F = the fixed cost which must be covered;

S = the subsidy to the landing area;

λ = the Lagrargian multiplier.

Solving the first-order conditions for a maximum yields

$$\frac{P_i - MC_i}{P_i} = \left(\frac{\lambda}{1+\lambda}\right)\frac{1}{\epsilon_i} \qquad i = 1,\ldots,N, \qquad (2)$$

$$\lambda = -\left(\frac{P_i - MC_i}{P_i + Q_i \frac{dP_i}{dQ_i} - MC_i}\right) \qquad i = 1,\ldots,N. \qquad (3)$$

Equation (2) is the familiar Ramsey pricing rule which indicates that in order to maximize net benefits while meeting a revenue constraint, the markup of price over marginal cost should be inversely proportional to the demand elasticity for landings, ϵ_i (Baumol and Bradford, 1970). The factor of proportionality is a function of the Lagrangian multiplier λ which can be interpreted as the gain in net benefits arising from a one dollar increase in subsidy (S). Equation (3) shows that λ equals the negative of the difference between price and marginal cost (i.e., the incremental welfare loss) divided by the difference between marginal revenue and marginal cost (the incremental net revenue gain). This ratio is equal for all i, indicating that the welfare loss per marginal dollar of net revenue gain should be equal for all categories of users.

Because the proportions are fixed (one airplane plus one landing equals one flight), the elasticity of demand for landings equals the product of the passengers' demand elasticity with respect to ticket price times the fraction which landing fees are of the total cost of the flight (Layard and Walters, 1978, p. 262). Thus,

$$\epsilon_i = \eta \left(\frac{P_i}{P_i + FC_i}\right) \qquad i = 1,\ldots,N, \qquad (4)$$

where η = passengers' elasticity of demand with respect to ticket price;
FC_i = total flight cost (exclusive of congestion) for user in category i).

Therefore, the elasticity is high for flights which have low total costs (e.g., small planes and/or short flights) and low for flights with high total cost (e.g., large planes and/or long flights).

Substituting (4) into (2) and solving for P_i yields,

$$P_i = \alpha MC_i + \beta FC_i \qquad i = 1,\ldots,N,$$

$$\text{where} \quad \alpha = \frac{1}{1 - k/\eta} \quad \beta = \frac{k/\eta}{1-k/\eta} \quad k = \frac{\lambda}{1+\lambda} . \qquad (5)$$

Thus, airport landing fees designed to maximize net benefits, in the face of a revenue constraint, should be made up of a component based on marginal cost (including both congestion cost and airport maintenance cost) and a component based on total aircraft operating cost.[2] The relative importance of these two components depends on the values of α and β. Both α and β depend on the elasticity of passengers' demand (η) and on the extent to which the revenue constraint is binding (λ).

Consider the case of an airport which initially is uncongested, and where the subsidy (S) received by the airport is insufficient to cover the fixed costs (F),

necessitating prices in excess of marginal cost, implying a positive value of λ. With no congestion, marginal cost is zero so that landing fees, P_i should be a fraction (β) of the total costs of the flight, resulting in price discrimination. As traffic at the airport grows over time, (assuming the subsidy and fixed cost remain constant), congestion develops, marginal congestion cost increases, λ decreases, causing α and β to decline. Landing fees should then equal a multiple of marginal cost plus a (decreasing) fraction of the total cost of flight, reducing the extent of price discrimination. Finally, when traffic has grown sufficiently, such that marginal cost pricing raises enough revenue to cover costs (given the subsidy), the value of λ is zero with α equal to one and β equal to zero. This reduces the pricing rule to $P = MC$, since price discrimination is no longer necessary.

IV. EVALUATION

In the evaluation of the changes in airport pricing, it will be useful to divide the history of aircraft/aviation development into four phases based on variety of aircraft and trip lengths, and on the extent of airport congestion. There is no congestion during the first three phases. Congestion develops during phase four. During the first phase, homogeneous aircraft make homogeneous trips. (This corresponds to the era during which the DC-3 predominated - the mid-1930s to the mid-1940s.) Phase two involves heterogeneous aircraft making homogeneous trips, while phase three involves heterogeneous aircraft making heterogeneous

trips. Phase four includes the present, with heteroegeneous aircraft, hetereogeneous trips, and airport congestion.

Since airports were uncongested during phase one, marginal cost pricing would not raise any revenue. In this case, the pricing rule in equation (5) indicates prices should be proportional to total flight costs. Since aircraft and trip lengths were both homogeneous during phase one, this reduces to a uniform charge per landing, as was actually the case. As aircraft types became varied during phase two, uniform fees were no longer appropriate. Fees should be proportional to total flight cost. As long as trip length is uniform, aircraft weight provides a rough proxy for total flight cost. Thus, the transition to weight-based fees was appropriate based on economic efficiency grounds, given the changing nature of aircraft.

As aviation moved into phase three, however, the weight-based pricing system appropriate in phase two, did not change. With heterogeneous trip distances, aircraft weight no longer provides a good proxy for total flight cost. Weight-based fees would over-assess large aircraft on short flights and under-assess small aircraft on long flights. Fees based on passenger miles, seat miles, passenger revenue, or some other measure with a distance component would be superior to aircraft weight during this phase.3

Congestion is added to heterogeneous aircraft and trip length during phase 4. At this point, weight-based fees become even less appropriate. As long as the revenue constraint is binding, fees should have a marginal (congestion)

cost component in addition to a flight cost component. When congestion varies by time of day, peak-load prices are appropriate. If airport activity is great enough, or if the subsidy is large enough such that the revenue constraint is not binding, the fees should equal marginal cost, once again being the same for all users, as during phase one.

This raises the issue of the role of subsidy. Typically, this subsidy comes from the "excess revenue" generated in other areas of the airport. To the extent that these subsidies are due to high rents of accessibility based on competitive bidding for space and not due to monopoly profit from artificially limiting rentable space, they are non-distorting. If this subsidy reduces landing fees closer to marginal cost, net benefits arising from the landing area increase. However, this subsidy reduces net benefits during phase four whenever marginal cost fees are sufficient to cover costs. Continued subsidy would necessitate reductions in fees below marginal cost with its attendant welfare loss. Thus, although this subsidy method was once justified based on economic efficiency, its use at many airports today is no longer appropriate.

Sliding scale landing fees, whereby rates decline with increased use, can also be justified on the basis of economic efficiency. The Ramsey pricing rule in Section III represents one form of price discrimination by using market segmentation to increase economic efficiency due to the reveneue requirement (i.e., third degree price discrimination). Users in any class pay the same fees, but users across classes pay different fees. Uniform fees with

a sliding scale, which were used during the 1930s, represent second degree price discrimination. Weight-based fees with a sliding scale combine elements of second and third degree price discrimination. Not only do users in different classes pay different fees, but users in the same class face different fees depending on the extent of their use of the airport. Employing such a pricing mechanism is only appropriate when the revenue from marginal cost pricing is insufficient to cover costs. This was the case in the early years of aviation at most airports and is true today at many small uncrowded airports. However, continued use of such discriminatory pricing at the larger congested airports is no longer justified on economic efficiency grounds.

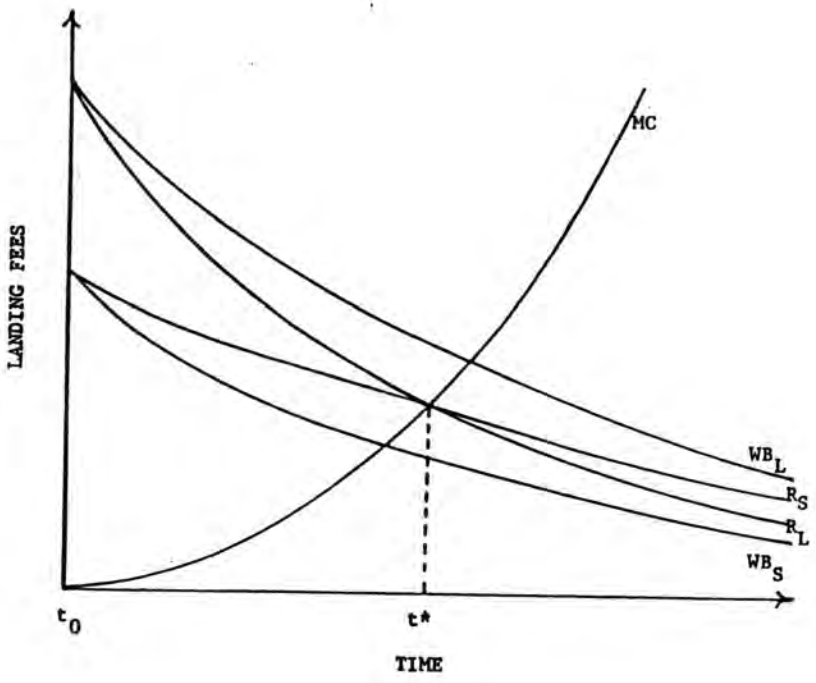
V. SUMMARY AND CONCLUSIONS

The extent to which weight-based fees, marginal cost fees and Ramsey-based fees differ over time is shown in Figure 1. Landing fees are measured on the vertical axis with time on the horizontal axis. There are assumed to be only two aircraft types which differ in size but not in trip distance (i.e., large aircraft, denoted by subscript L and small aircraft with subscript S). The time path of marginal congestion cost is labeled MC.[4] At t_o, there is no congestion, thus marginal cost is zero. Fees based on marginal cost increase with the passage of time as airport activity increases.[5] At time t^*, marginal cost fees are sufficient to cover costs (given any subsidy). Beyond that point, revenue exceeds cost.

Weight-based fees (WB) and Ramsey fees (R) are identi-

FIGURE 1

TIME PATH OF LANDING FEES



cal at time t_0 given the assumptions of this example. As airport activity increases, weight-based fees decline since more users are available to share the cost. The Ramsey fees, composed of a congestion component and a total flight cost component, follow a different path. As congestion increases, the total flight cost component of fees becomes less important, while the congestion component assumes a greater role. At t*, the Ramsey prices for the two aircraft types are identical and equal to marginal cost. Beyond t*, weight-based fees decrease, while marginal cost fees increase. Ramsey fees decrease, but with small plane fees greater than large plane fees. This seemingly perverse situation would occur if the airport were prohibited from making a "profit." In order to maximize net benefits given this constraint, prices would have to be reduced below marginal cost to dissipate the excess revenue. Fees would be lowered most to the users whose use is less influenced by price, i.e., the large planes.

In summary, previous generations of airport managers developed methods for pricing runway services which can be justified on efficiency grounds. As aircraft evolved, so did the pricing systems. This evolution has apparently stopped so that in many cases the current methods of airport finance are not appropriate.[6] Fees based on passenger miles, seat miles, or passenger (and freight) revenue are appropriate at uncongested airports. Marginal cost pricing is appropriate at (sufficiently) congested facilities, with a mixture of both systems (i.e., Ramsey pricing) useful at intermediate levels of congestion. The use of subsidies and

sliding fee arangements has also outlived its usefulness at many airports.

NOTES

1. For example, if runways can be constructed under constant returns to scale, marginal cost pricing with optimal investment yield revenue equal to cost. However, if the airport is overbuilt, marginal cost pricing results in revenue less than cost.

2. P_i is the "full price" faced by users. Since each users' necessarily bears the average congestion cost, the landing fee actually charged by the airport should equal the difference between P_i and average congestion cost.

3. The structure of Ramsey prices at uncongested airports is discussed in Morrison (1982).

4. In fact, the curve labelled MC represents the difference between marginal congestion cost and average congestion cost. Likewise, the Ramsey fees are also adjusted by subtracting average congestion cost from the fees given by equation 5, for the reason explained in note 2. Also, for simplicity marginal airport maintenance cost is assumed to be zero.

5. For simplicity, it is assumed that traffic grows uniformly, by both aircraft types and during all time periods.

6. This statement holds true for North American airports. Some airports under the direction of the British Airports Authority change fees with a distance component as well as fees that differ based on the degree of congestion as suggested here.

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TRUCKING OF BULK COMMODITIES - INCREMENTAL COSTS AND REVENUES

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INTRODUCTION

This paper described the results of a research project regarding the costs and revenues associated with trucking. The objective of this research was to assess the extent to which the incremental public costs occassioned by the movement of certain bulk commodities by truck in New Brunswick would be recovered in the form of user fees. The principal interest of the client (Canadian National Railways) was whether trucking companies would receive an unfair competitive advantage in the transportation of such commodities because of the failure of government to recover full incremental costs. It was undertaken following the completion of work by the Canadian Institute of Guided Ground Transport (CIGGT). While the two studies relate to the same general research area, their scope and analytical approach differ markedly.

The CIGGT study addressed the question of highway finance from a broad perspective. It attempted to allocate a set of costs to highway users with a view of determining the revenue shortfall related to the trucking mode. This

study is more limited in nature, focusing only upon heavy truck moving specific bulk commodities. The study seeks to assign, by means of direct analysis, the incremental public costs involved in the movement. These costs are then compared with incremental revenues to determine a net financial position. No attempt has been made in the study to allocate the common or residual costs to any class of user. The study has a more "technical" as opposed to "accounting" orientation in its estimation of costs and revenues. For these reasons, the results of the two studies cannot be directly compared.

LITERATURE REVIEW

General Background

The issue of user pay is one which has attracted attention in the United States for several decades. However only within the recent past has it become a national policy issue in Canada. Consequently, much of the relevant literature is American.

One major difficulty encountered in any attempt to adapt an American study, such as the recently completed Highway Cost Allocation Study, to the case of New Brunswick is the United States philosophy of 'pay-as-you-go'. Under this approach, any costs which are incurred in a given year are allocated to the traffic of that year. There are several problems with the approach. Firstly, it must be recognized that the highway system is not user-optimized.

Other motives for highway building intrude into the analysis. Secondly, it ignores the problems of indivisabilities in the provision of the infrastructure. Finally, it ignores the fact that the provision of a highway represents the creation of a major piece of capital, one which will provide a service for many years to come.

An improved approach to the question is one which has been developed in the Canadian context, beginning with the early work of Haritos. He begins by estimating, on a systemwide basis, an annualized total cost figure under a life-cycle costing methodology. He then compares the resulting figure with the revenues earned in a particular year to determine the extent of public sector subsidy provided to system users because of user fees which are set too low.

A moment's reflection will suggest that the analysis needs to be taken one step further. The life cycle approach needs to be adopted on the revenue side as well. Only over the life of the facility is it possible to judge the presence or absence of public sector subsidy.

At the system level, when coupled with the assumption that highway capital expenditures are constant in real terms through time, both approaches could be expected to yield the same result, at least in the long-run. This however, involves analysis at the level of the individual link. At this level of disaggregation, a pay-as-you-go philosophy would result in a series of cost allocations which would fluctuate widely over time, depending on the

capital investment on the link in a given year.

A second problem deals with the existance of excess capacity. The result of this excess capacity is inevitably a residual of cost which can only be allocated among units of traffic by some arbitrary means. In the context of the present study, the issue may be bypassed altogether, for it is really an issue of financing the system rather than cost assignment. The difference between the two is well presented by Wohl and Hendrickson. They suggest that cost attribution (the focus of this study) involves "the identification of valid cause-and-effect relationships between highway cost and highway use..." (p.223). Most other studies have focused upon cost allocation, the first step of which usually involved cost attribution or assignment.

These generalizations are not meant to dismiss previous studies. Rather, they are made to point out some of the limitations which are applicable to link studies, and to demonstrate the inadvisability of adopting without question the methodologies presented in such studies. Furthermore, they do explain why some of the estimates of cost responsibility obtained later in the paper are lower than estimates made by others. Therefore estimates of cost assignment will always lie below estimates of cost allocations. The difference between the two is explained by the existance of an excess capacity generated residual of costs which can only be allocated according to some accounting rule.

Where such costs are admitted to the analysis, the results will tend to differ because the accounting rules employed by various parties tend to differ.

Specifics of Highway Cost Assignment

The purpose of this section of the paper is to identify some generally accepted relationships between the costs incurred by government in providing the highway system and the characteristics of highway users. It therefore relates to the highway cost assignment problem noted above rather than to highway cost allocation.

Broadly speaking, there are two approaches to the division of highway costs among classes of user. These are the benefit principle and the incremental cost approach. In the case of the former, costs are allocated in proportion to benefits received. In the case of the latter, costs are assigned on the basis of the costs incurred in providing the specific facilities required by specific traffic.

Both approaches are highly disaggregative, allowing the analysis to proceed by vehicle class, and, as in the case of the present investigation, at the level of the individual link. However, because of the desire to relate user charges to costs, the benefit approach tends to be rejected. Consistent with most of the literature, attention should be focused on the incremental approach.

With this approach, one begins by identifying a number of vehicle classes. The 1982 Highway Cost Allocation Study,

for example, used a variety of groupings, settling on 12 for the reporting of results, and a 38 vehicle grouping for all analytical work (p. IV-19). Whatever the grouping, the usual approach is to define the 'basic road', one sufficient to carry a normal load of light traffic. Then, as vehicle characteristics change, and place increasing demands on the facility, the costs of the improved design characteristics are initially assigned to the class which necessitated their incurrance. As each class is added, it pays not only the costs of its own increment, but also some proportion of all earlier increments.

Special Vehicle Requirements

It frequently occurs that one class of vehicle requires some particular infrastructure component not required by others. The literature contains several examples of such specialized facilities, and extended discussions as to the proper means of cost assignment.

The provision of climbing lanes for instance occurs because different vehicles react differently to hills. Is the benefit approach or the incremental cost approach applicable? The class receiving most of the benefit is clearly that with the higher speed, the automobile. The class which is generally regarded as necessitating the cost is, however, the slower moving truck. Wohl and Hendrickson argue that the approapriate approach to adopt is the incremental cost approach and capacity improvements such as climbing lanes should properly be assigned to the heavier, slower moving traffic.

Facilities required for access to land or to a particular resource would be another case in point. In the case of an access interchange required by a newly developing subdivision the incremental cost approach would lead one to conclude that the costs should be allocated to the land developer. Where the access is directly related to a transportation movement, and the facility would not otherwise be constructed, then the cost of the facility should be fully allocated to the movement or the mode of transport in question.

Complications arise when an additional class of vehicle, beyond that which made necessary the improvement, are loaded onto the highway. The cost separations then become cloudy, as Wohl and Hendrickson point out:

> this incremental method permits only one increment of costs to be unambiguously attributed to a single class. All other (i.e. except the last one) increments are attributable to combinations of two or more vehicle classes, and the division of these costs within these vehicle classes is a problem of joint or common cost allocation rather than attribution. (p. 226)

Therefore a given vehicle class being added in the incremental analysis is responsible for: (a) the additional costs incurred by that class; and (b) some share of the costs of all previous increments.

Weight and Pavement Damage

Pavement costs are a major component of highway cost. The literature recognizes that they are extremely sensitive to vehicle and axle weights. After suggesting that a distinction must be made between new pavement costs and pavement

rehabilitation costs, the 1982 Highway Cost Allocation Study recommends the following approach:

> New pavement costs are assigned based on current pavement design practice. Vehicles from each class are hypothetically removed in equal proportions until further removal does not reduce pavement thickness. Pavement repair and reconstruction costs are assigned based on each vehicle's anticipated contribution to the wearing out of the pavement (p. IV-43).

With respect to the former, the key variables are traffic volumes by class of vehicle, and of course, forecasts of traffic volumes by class; the distribution of axle loads by class both present and future, and a set of appropriate multipliers. With respect to the latter, the critical factor is the rate of pavement deterioration. Among the important distress elements are: loss of serviceability, alligator cracking, rutting, transverse cracking and loss of skid resistance. The study relates each of these to traffic through a series of distress models. The crucial variable in all of this appears to be the ESAL value, that is the Equivalent 18,000 lb. Single Axle Load value, for various types of traffic.

The impact of the heavier traffic is to shorten the period between pavement rehabilitations, and to increase interim maintenance. Wohl and Hendrickson suggest that the impact results in "earlier or larger maintenance and restoration/rehabilitation/resurfacing than would otherwise occur" (p. 228). This results in an earlier expenditure on the part of government, and to that earlier

expenditure there is an opportunity cost. This is the difference between the present value of the costs that would be incurred with the traffic and the present value of the costs that would be incurred without the traffic. In the case of the present study, this opportunity cost is readily identifiable, and is assigned to the traffic in question.

Increased Capacity

Finally, it should be noted that one potential impact of increased traffic as a consequence of the addition of new traffic to the system is a change in the timing of major capacity improvments to the existing network. Most of the literature deals well with the relationship between vehicle weight and size and the resulting cost structure, saying little about the causes of new capacity. One would expect the relationship between traffic volumes and capacity improvements to be an integral part of any incremental cost analysis.

However, on the basis of what has been said above with regard to other cost elements, the approach that was adopted is relatively straightforward. The need for new capacity can be readily identified. Once they have been identified, it is possible to allocate the new capacity costs specifically to the class of vehicle which necessitated their incurrance.

Summary

The literature review, in accordance with the objectives of the study, has focused on cost assignment rather than cost allocation. The literature reveals a preference to assign costs to those classes of vehicle which necessitate their incurrance. Such costs should be identified on a case-by-case basis. There appears to be little basis upon which to generalize.

The literature also generally agrees that the cost of new pavement and pavement repair and rehabilitation should be based on the characteristics of the vehicles using the facilities. Pavement thickness and width and a variety of other costs can be so assigned.

The literature is quiet on the question of additional capacity. It seems clear that the same principles ought to apply - costs should be assigned according to the class(es) requiring the earlier capacity improvements.

METHODOLOGY

The study upon which the present paper is based sought to estimate the incremental costs and revenues associated with the introduction of certain bulk commodity movements onto the New Brunswick highway system. The methodology used in the study to develop estimates of incremental costs and revenues is explained in the following paragraphs.

Incremental Costs

Incremental costs were classified in five categories.

These were build-sooner costs, strengthening costs, operational and maintenance costs, new link construction costs, and costs to users.

Build Sooner Costs For Re-surfacing

The first category of costs that is Build Sooner Costs was considered in two parts: the effect of the movements on structural aspects of the pavement and secondly the effect of the movements on the capacity. The structural analysis proceeded to determine the cycle time for pavement resurfacing with the new commodity traffic in place compared with the cycle which would occur in the absence of such traffic. It was decided that the Ontario Flexible Pavement Design Method would be used to develop a pavement deterioration forecast for the various highway links and commodity movements under study.

A critical component of the traffic impact on pavement deterioration is the repetition of axle loadings. The loading impact of a particular vehicle configuration is expressed in terms of an equivalent single 18,000 lb. axle load (ESAL). The Road Comfort Index (RCI) is the control variable in the analysis, providing the decision rule as to when resurfacing should occur.

Since the purpose of this analysis was to determine the build sooner period, the primary function of the analysis was to forecast future RCI values under normal growth conditions. The analysis was then repeated with the study

traffic added to this base load. Traffic volume and classification date as well as structural date of the existing pavements were made available to the study team.

It must be stressed that this approach assumes that pavement resurfacing projects would be undertaken as soon as the minimum desirable RCI threshold is reached. In reality, the actual timing of projects will depend upon many factors, the RCI being but one. The economic justification of each project in comparison with other candidate projects given the usual budget constraints can be equally or more important. The procedure for converting these build sooner periods into build sooner costs is described later in this section.

Build Sooner Costs For Capacity Improvements

The capacity analysis is similiar in many respects to the above. In this case, the build sooner period is defined by the time period a specific capacity improvement is brought forward because of the case traffic. A highway capacity analysis was conducted under normal traffic growth conditions and then with the study traffic loaded onto the base. The decision threshold for a capacity improvement is the maximum service volume of the highway section under study generally at level of service C. The capacity analysis was completed using techniques contained in the Highway Capacity Manual (HCM) developed by the U.S. Highway Research Board.

The practical capacity of a roadway section was calculated at the selected level of service. This was done by reducing the theoretical maximum capacity under ideal conditions (2000 vehicles/hour) through the application of adjustment factors presented in the HCM. These factors attempt to quantify the impact of certain conditions which tend to lower roadway capacity.

Data regarding the physical characteristics of the roadway necessary for this analysis were made available to the study team by the NBDOT. It should be noted that the truck adjustment factors in the HCM are assumed to be valid for trucks within a certain operating performance range - i.e. power to mass ratio. A number of parameters affect the truck adjustment factor. The length of grade, magnitude of grade, type of terrain (level, rolling, mountainious), and the percentage of trucks in the traffic flow all affect the number of passenger car equivalents (PCE) of trucks on any given stretch of highway. The PCE is simply the equivalent number of passenger cars to one truck under existing physical and traffic flow conditions. Clearly as the length and magnitude of the grade increases, the number of PCE's per truck will also increase. It is also important to note that as the PCE's and/or percent of trucks increase, the truck adjustment factor decreases. In other words, the increment of truck traffic due to the commodity movement not only increases the traffic, but it also reduces capacity due to a lower truck adjustment factor.

Once the capacity of each section of highway was established at a selected level of service, it was then possible to project the number of years required to reach capacity under both traffic scenarios. The growth rate assumptions applied to obtain forecasts of future traffic volumes were provided by NBDOT planners. In accordance with instructions from the client, the commodity tonnage projections assume zero year-to-year growth.

Once the build sooner period was established, it was necessary to identify the type of capacity improvement required A range of alternatives exists: improved vertical and horizontal alignment, increased land and shoulder width, provision of climbing lanes and twinning the highway. The methodology is based on the assumption that each of the capacity projects identified would be implemented once the critical capacity threshold has been reached. It is, of course, conceivable that some of the projects identified would either not be undertaken or perhaps delayed at the expense of level of service.

Analysis of Build Sooner Costs

The purpose of the build sooner costs anlaysis is to determine the financial impact of having to invest in highway resurfacing and highway capacity improvements sooner than would be the case if the commodity was not transported by truck on public highways. The first step is to determine the timing of the improvement in the absence of the study traffic. Its cost is then estimated in real terms, and

reduced to its present value through the application of an appropriate discount rate. The process is then repeated with the study traffic in place. The difference in these two present value figures is the incremental cost to government of having the study traffic use the highway facility in question.

The final step in the analysis involves converting the build sooner costs into an equivalent annual cost over the life cycle of the improvement using the appropriate capital recovery factor. For each link, sensitivity analysis was done using real discount rates of 3, 4, and 5 percent. The assumption underlying the choice of real discount rate of this magnitude was that a spread of 3-5 percent between the yield on the long term government bonds and the inflation rate would exist throughout the time horizon of this study.

Highway Strengthening Costs

Highway strengthening costs relate to the structural load bearing capacity of both pavement and bridge structures. The objective here is to detemine whether stronger pavement and/or bridges are needed due to the presence of the additional commodity movements.

The optimal truck configurations used in the analysis all satisfy existing vehicle weight and dimension regulations prescribed under the New Brunswick Motor Vehicle Act. Furthermore, for those links which are subject to spring weight restrictions, adjustments to the payload were made

during the period when the weight restrictions would be in force. This adjustment affects both the number of ESAL's per truck during the period and the fleet size required to haul the estimated annual tonnage.

Since only legal truck configurations were used, it can be concluded that the highway strengthening costs are zero. However, in making this conclusion, it must be recognized that highway construction authorities are always faced with a trade-off between pavement strength and life cycle. Clearly, for a given traffic scenario, a higher pavement design strength will yeild a longer life cycle. The economic trade-off is between the higher capital costs of additional pavement thickness and the costs associated with selecting a lower strength pavement. These costs arise from the fact that resurfacing is required more frequently.

It should be noted that the general practice of the NBDOT is to build to a standard design strength based on the classification of the highway. If a large increment of traffic is loaded onto a highway, the NBDOT will generally not increase the standard of the highway. To the extent that this policy is followed in the future, the conclusion stated at the beginning of the section (that highway strengthening costs are zero for all commodity movements in this study) remains valid. The impact of an increment of heavy commodity traffic on the structural aspects of highway costs is therefore limited to its effect on the rate of pavement deterioration.

Operational and Maintenance Costs

Two categories of operational and maintenance (O&M) costs could be affected by a sudden increase in truck traffic. Additional ordinary maintenance of pavement surfaces (eg. patching, crackfilling, etc.) could be required between resurfacing periods because of the increased number of repetitions of axle loadings. Furthermore, policing costs may also increase as these are related to traffic volumes.

It was not considered appropriate to attempt an in-depth analysis of the relationship between truck traffic and ordinary maintenance due to a lack of sufficient data. The NBDOT has embarked upon a three-year data collection program in an attempt to establish a reliable data base on maintenance costs on selected routes. However, only one year of data are currently available. Regression analysis on this data did not produce statistically significant results which could then be used to predict the impact of the commodity traffic on maintenance costs. However, it was believed that the data could be used to indicate the order of magnitude of annual maintenance costs for each link. The commodity movement's share of these costs would then be some fraction of the total.

The average maintenance cost for the five districts in the first year of the NBDOT study was calculated to be $1000 per mile. This costs excludes items unrelated to pavement maintenance such as snow removal. This figure was used to obtain a crude estimate of total traffic-related maintenance costs for each link. A fraction of this cost

was then assigned to the commodity movement on the basis of the percentage of total vehicles in the traffic stream represented by the commodity trucks.

Incremental policing costs were estimated using a staffing formula provided by the New Brunswick Headquarters of the RCMP. Aggregate planning for vehicles and staff is based on a formula of 1 officer per 16 million vehicle miles on the highway to be patrolled. The aggregate requirements are then adjusted for each detachment based on local conditions.

It was considered that the RCMP formula would suffice as an indicator of the order of magnitude of incremental policing costs that could be expected due to the addition of the commodity traffic. One further point should be made. In certain instances, despite the fact that the total vehicle miles of travel by study traffic was large, no policing costs were included in the cost estimates. This was done because the total travel was divided among a number of policing jurisdictions, with no one of them having a sufficient increment to justify staff expansion.

New Link Construction Costs

It is possible that some commodity movements would require the construction of new infrastructure in order for the trucking operation to be feasible. The Denison Mines potash movement from Cassidy Lake to Saint John is one such movement. If the potash were to be transported

by truck, the existing highway from the mine to Route 1 would have to be upgraded and some improvements would be required in the City of Saint John to provide suitable access to the potash terminal. Approximate cost estimates for any new infrastructure were developed relying on previous studies where possible and the total amount of new infrastructure costs was assigned to the commodity movement.

Costs to Users

An attempt was made to quantify the costs of the commodity movement to other highway users. Three main categories of costs were considered. First of all, the cost of additional accidents was considered. However, the predictability of accidents on specific highway sections and their associated costs was considered to be an imprecise venture. Therefore no financial cost was assigned to this element. The delay time was also estimated for the existing highway traffic. However the times were very small as compared to the total trip time of the user and it was again difficult to justify fixing a value to this time. The costs to other users of the highway was therefore not considered in terms of its financial implications.

Estimation of Incremental Revenues

The first step in the estimation of the incremental revenues arising from the trucking of commodity movements was the determination of the fleet size required to transport the forecasted tonnages. The fleet size was calculated

using the estimated truck payload and an appropriate cycle time (loading/unloading time plus trip time). The total number of trucks required was then multiplied by the appropriate license and registration fees to determine the total annual revenues that would be generated from these sources.

The fuel tax revenue was derived by using an average fuel consumption rate of 5 miles per gallon and an estimate of the total annual vehicle miles resulting from the commodity movement. The latter element is a function of the number of vehicle-trips and trip length. Once the total fuel consumption was determined, the fuel tax revenue was calculated using a tax rate of $0.414 per gallon.

Summary

Five general categories of incremental costs were identified for possible inclusion in the study. One of these, costs to users, was subsequently deleted because of conceptual and measurement difficulties. Three categories of user fee revenue were identified and included in the study. A number of analytical techniques were developed or modified to permit estimation of the incremental costs associated with the loading of the study traffic on the highway network.

The balance of the paper discusses the results of the incremental cost/revenue analysis.

RESULTS OF ANALYSIS

This section of the paper presents a summary of the

results of the analysis as determined through the study. A summary of the incremental costs by category for each of the commodity movement studies is presented in Table 4.0. It should be noted that these costs are based on a real discount rate of 4%. Substantial differences among links can be observed. In large part, these are a function of the initial conditions. In other words, an important part of the differences among links was accounted for by the initial volume to capacity ratio, the nature of the terrain involved, and the proximity of the normal upgrading which would occur even in the absence of the study traffic. The need to construct new links is an extremely important factor.

In 5 of the 7 cases examined,there were no link costs. Only the two potash movements require the construction of a new link. These are heaviest in the case of potash 2, for this movement involves a large-scale highway investment which would not otherwise be undertaken. Consequently, the movement must bear the all of the costs. Furthermore, the new link would have to be built before the movement was possible. Consequently, all costs of the construction can be allocated to the study movement.

In 5 of the 7 cases examined, the build sooner resurfacing costs were far more significant than were the capacity costs. In the case of the potash movements, this reflects the fact that capacity problems of traffic are imminent on the link, and that the expansion would occur with or

TABLE 4.0

Incremental Annual Costs by Cost Element - Various Bulk Commodity Movements

('000 1983 $)

Movement	Build Sooner		O&M	New Link	TOTAL[1]
	Re-Surface	Capacity Rel.			
Potash 1	110	39	7	92	251
Potash 2	195	7	8	892	1102
Potash Both	292	42	13	892	1239
Woodchips 1	24	91	4	0	120
Coal	225	46	7	0	380
Concentrates	81	6	2	0	89
Petroleum	6	74	1	0	132
Woodchips 2	40	5	2	0	47

NOTES:
1. Cols. may not add to total because of rounding.
2. Discount rate is 4%.
3. Accident and delay time costs are excluded.
4. Concentrates costs exclude roadbed costs for Route 430.
5. Potash 1 - Potash Company of America - Penobsquis to Saint John.
6. Dennison Mines - Cassidy Lake to Saint John.

without the study traffic. In Northwest New Brunswick, the situation is different. In the case of woodchips 1 and the petroleum movements, the additional traffic leads to capacity improvements which would only be made in the more distant future without the additional traffic loading. In explaining variations among the links, the initial conditions appear to be the most important variable. This suggests, in turn, that firm warrants cannot be established, and that each case must be examined on the basis of its own merits.

A few words are, finally, necessary concerning the incremental operations and maintenance expenditures attributable to the study traffic. As explained earlier in the paper, these were estimated using available macro-indicators. Because of this approach, they tend to vary more or less directly with the length of the link when policing costs are excluded. Despite their lack of precision, they do provide an acceptable appreciation of the relative magnitude of such costs in comparison with other incremental costs. As the table clearly demonstrates, they form an extremely small percentage of the incremental costs occassioned by the loading of the study traffic.

A comparison of the incremental costs and revenues attributable to the study traffic appear in Table 4.1 In both cases, both the total incremental costs and those per vehicle mile are presented.

In the cases of four of the seven movements considered,

TABLE 4.1

Annual Incremental Costs and Revenues, Vehicle Miles Travelled and Loss/Surplus Per Mile on Selected Bulk Commodity Movements in New Brunswick

(1983 $)

Commodity	Inc. Cost (000)	In. Rev. (000)	Inc. Loss/Sur. (000)	VMT (million)	Loss/Sur per VMT (cents)
Potash 1	251	201	50	2.30	2.17
Potash 2	1102	308	794	3.50	22.66
Potash Both	1239	509	730	5.80	12.59
Woodchips 1	120	55	65	0.51	12.75
Coal	308	495	(187)	5.70	(3.28)
Concentrates	89	247	(158)	2.80	(5.64)
Petroleum	132	90	42	0.94	4.47
Woodchips 2	47	92	(45)	0.95	(4.74)

NOTES: 1. Potash 1 and 2 are aggregated because they use part of the same link. Woodchips 1 and 2 do not.
2. A bracketed figure indicates a surplus of revenues over incremental costs.
3. A discount rate of 4 per cent was employed.

the incremental costs outweigh the incremental revenues given the users fee structure presently in place in New Brunswick. Only three movements, coal, concentrates and woodchips 2 produce revenues above the incremental costs incurred. In the case of the other movements, the extent of cost recovery ranges from a low of 28.0 per cent to the high of 78.5 per cent.

It is also possible to consider the cost and revenue comparison from the point of view of the loss and surplus per vehicle mile travelled. From this perspective, the concentrates movement produces the best result, yielding a surplus over incremental costs of 5.64 cents per vehicle mile travelled. At the other extreme, one finds the potash 2 movement which incurs a loss (that is to say an indirect or hidden subsidy were the movement to be initiated) of 22.66 cents per vehicle mile travelled. Finally, it might be noted that when these data are converted into loss/surplus figures per ton mile, all except the potash 2 movement have a surplus/loss result of less than one cent per ton mile.

Perhaps the most interesting observation of the analysis so far is the ability of the revenue "to more or less cover the incremental costs of the movements when major capital expenditures are not involved". Where additional traffic is being loaded onto existing highways, the costs and revenues appear to be in the same order of magnitude. However, where new highways are built for the movement, if these highways are built at public expense, the truck shipment

is being subsidized by the public.

A final consideration is the sensitivity of the loss/surplus calculations to variations in the rate of discount. Three calculations were performed, involving real discount rates of 3, 4, and 5 per cent. These data are presented in Table 4.2. As the discount rate is increased, the incremental losses tend to rise while the incremental surpluses tend to fall. However, even with the variation in the rate employed in the study, no surplus movement was converted into a loss movement. The reverse is also true. Nor does it appear that the variations in the discount rate change the statement above to the effect that with the exception of the potash 2 movement, all results yield a loss/surplus per ton mile of less than one cent.

The higher discount rates do produce higher costs. While this may well seem to be counterintuitive, it must be remembered that all build sooner costs are estimates from the difference in present values of an investment made at two different points in future time. The difference increases even though the absolute magnitudes of the present values fall as the rate is increased. It should also be noted that the capital recovery factor increases as does the discount rate resulting in higher costs.

CONCLUSION

The objective of this research was to determine to what extent incremental public costs resulting from the

TABLE 4.2

Sensitivity of Loss/Surplus Calculations to Changes in the Discount Rate

Movement	Incremental Loss/Surplus			Loss/Surplus per VMT		
	3%	4%	5%	3%	4%	5%
Potash 1	12	50	84	0.52	2.17	3.65
Potash 2	701	794	889	20.03	22.66	25.40
Potash Both	611	730	839	10.53	12.59	14.47
Woodchips 1	39	65	89	7.65	12.75	17.45
Coal	(236)	(187)	(147)	(4.14)	(3.28)	(2.58)
Concentrates	(173)	(158)	(148)	(6.18)	(5.64)	(5.29)
Petroleum	16	42	64	1.70	4.47	6.81
Woodchips 2	(55)	(45)	(36)	(5.79)	(4.74)	(3.79)

NOTES: 1. Potash 1 and 2 are combined because of use of common link. Woodchips 1 and 2 use entirely different links.

2. A bracketed figure indicates an excess of incremental revenues over incremental costs.

transportation of bulk commodities by truck are recovered from user fees generated by this traffic. It must be emphasized again that the study foccused upon incremental public costs, and the user fees associated with specific movements. The methodology was one of cost assignment, not cost allocation. The questions of the assignment of the historical costs of the highway system, and of the allocation of the inevitably large residual of common costs when such an assignment process is used were beyond the scope of the present study.

The results of this research suggest that in those cases where a commodity movement by truck could be accommodated on the existing highway facilities, incremental annual costs and incremental annual revenues would generally be of the same order of magnitude. This finding considers the fact that it is not possible to develop highly precise estimates of incremental costs. On the other hand, in situations where major investments in new highway infrastructure would be required before the commodity can move by truck, it is highly probable that, given the existing level of user fees, incremental costs would exceed incremental revenues by a substantial margin. This, of course, assumes that such facilities would be constructed using public funds. It further assumes that such facilities would not normally be constructed were the commodity movement not to be handled by truck transport. In this latter scenario, it seems reasonable to conclude that the truckers would enjoy the benefits of a substantial public subsidy.

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AN ASSESSMENT OF THE REGIONAL DEVELOPMENT EFFECTS OF HIGHWAY INVESTMENT

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ABSTRACT

This research examines the effectiveness of major highway improvements as policy instruments in enhancing economic development. The study area selected is the Province of New Brunswick, and the study period is 1952-1982.

Most of the previous research into the secondary effects of highway improvements deals with one specific highway segment and does not consider the effects of improvements to the remainder of the highway network. This research develops a technique which appears to be capable of estimating the secondary effects of all improvements to the highway infrastructure. This technique, which is based on a time-series approach, identifies the impact of highway investment on per capita earnings. Models are developed for each of the five economic regions of the study area.

The results of this work suggest that, under certain conditions, highway investment does have the potential to encourage regional development. However, the magnitude of this development is relatively small. The results also provide preliminary evidence of the hypothesis of saturation and shift from development functions. After a period of time highway investment

becomes incapable of enhancing further economic development and acts as a personal asset and means of increasing mobility.

INTRODUCTION

Following the Second World War all areas of Canada did not benefit equally from the growth the economy experienced. Although Ontario, Alberta and British Columbia enjoyed a period of continued growth. Eastern Canada - particularly the Atlantic Provinces has experienced less than average levels of income and higher than average unemployment rates.

Regional disparities are also present at the intra-provincial level. As an example, in New Brunswick the southern urbanized part of the province generally has performed better economically than has the northern part of the province.

It is generally believed that in order to reduce regional disparities government action is required. In 1957, the Gordon Commission on Canada's Economic Prospects indicated that an improved highway network would encourage regional development. The Commission concluded that the government should:

> Improve transportation facilities of the area (Atlantic Provinces) with a view to facilitating and encouraging economic growth within the region.

This argument has been prevalent in the justification of most, if not all of the future Federal-Provincial agreements providing Federal funds to assist

regional highway improvements. In recent years, however, the validity of this argument has come under question. It has been suggested that the construction of highway infrastructure does little to encourage regional development. This issue serves as the general subject of the research presented in this paper.

PREVIOUS STUDIES

This section reviews the available methodologies for the evaluation of the relationship between highway systems and socio-economic changes which are usually referred to as secondary benefits resulting from highway improvement. The methodologies can be classified into four groups: input output analysis, location factor preference models, intervention analysis and socio-economic interaction models.

The subject of highway impact analysis has received considerable attention from transportation planners and economists; however, most of the studies focussed either on the theoretical aspects of impact analysis or some benefits not directly related to economic development such as increases in land value. Lang and Wohl (1960) discussed economic impact studies and suggested that:

> The process of identifying the changes in economic activity (including expansion, consolidation, and/or relocation) resulting from highway improvements is extremely complicated. Determining the magnitude of such changes is even more difficult.

It is thus important to review the available literature on highway impact analysis in order to determine the advantages and disadvantages of each technique which will lead to the development of a suitable methodology for this study.

INPUT-OUTPUT ANALYSIS

Input-output analysis is the most sophisticated form of transportation impact analysis and the most infrequently used. This is due to its dependance on extensive data collection and the manipulation of that data. Input-output analysis is a process which depicts the inter-relationships of a region's economic activity over a given time period.

The first step of an input-output analysis is the construction of a transactions table. This table shows the input-output relationships for the sectors of the economy in monetary terms. The next step is to derive a technical coefficient matrix from the transactions table. The technical coefficients are than used to predict the consequences of a change in final demand in the region under investigation. Gamble et al. (1966) suggest that the most intriguing use of an input-output model is its ability to predict within a regional economy a given change in any part of the system. They called this use "impact analysis".

Pitfield (1981) noticed that many studies are not based on survey data for a particular region but base the technical coefficients matrix on national coefficients

leading to a considerable error. Furthermore, technical coefficients are not constant and are subject to change over time. This makes it necessary to forecast changes in the technical coefficients over the time period used in the study. According to Pitfield (1981) there has been no successful application of input-output analysis in the assessment of the economic impacts of transportation investment.

LOCATION FACTOR PREFERENCE MODELS

These models are concerned with the question of whether the public investment for improvement in transportation can be expected to attract new industry to the region. Throughout these studies plant location analysis has been used as a proxy to evaluate the relationship between regional economic development and transportation.

This approach was first used by Greenhut (1956) who asked industrialists in Alabama to select the plant location factors from a given series that they considered important in choosing their location. The technique was carried further by Logan (1970) who attempted to determine the relative importance of each plant location factor.

A recent study by the University of New Brunswick Transportation Group (Wilson et al., 1982) examined the transportation costs and service level and economic development to determine whether public expenditure on transportation infrastructure and freight rate subsidies

can be expected to stimulate industrial development in a region by making the region more attractive to potential firms. The study found that three factors - the proximity of the plant to the products market, the proximity of raw materials to the plant site, and the residence of the owner located near the plant site, were considered by industrial firms in Atlantic Canada to be more important than the accessibility of the plant to highways.

A major disadvantage of the methodology based on location factor indices is that the procedure has a high dependance on the subjective judgements of industry personnel. Even if it was possible to measure the developmental changes in a particular region after the construction of a major highway, it would be highly unlikely to obtain reasonable estimates of the benefits attributable to the highway investment based solely on perceived location factors. The use of these models should be limited to determining the impact that transportation rates and services levels have on industrial firms considering location in a particular region.

INTERVENTION ANALYSIS

Intervention analysis techniques estimate the effect of improvements to the highway system by comparing the behaviour of a 'trend variable' after the improvements were completed to the expected behaviour of the trend

variable in the hypothetical 'no change' situation. The difference in the actual trend and the 'no change' trend is attributable to the highway improvements.

Intervention techniques have been used to determine the regional effects of constructing major U.S. highways. Bardwell and Merry (1960) examined the effect on the retailing industry of constructing a bypass around Brighton, Colorado. They compared the trend in retail tax collected in Brighton after the bypass opened to the expected trend in retail tax collected had the bypass not been constructed.

In determining the regional effects of Virginia's Interstate system, Walton (1970) estimated the 'no change' situation in a different manner. Using regression techniques, Walton (1970) established the trend in employment personal income, and taxes collected prior to the opening of the Interstate. This trend was projected into the period when the Interstate was open. Based on differences between the actual level and the projected level of employment, personal income, and taxes collected, it was concluded that the investment in Virginia's Interstate system plus interest was recoveral in six and one quarter years.

The major weakness of this approach is that it assumes that the investment in highways was the only variable which accounted for the changes in regional development. The influence of economic factors is assumed to be accounted for in the estimate of the

'no change' trend.

SOCIO-ECONOMIC INTERACTION MODELS

Socio-economic interaction models generally use multiple regression analysis to identify the relationship between socio-economic development and transportation, the most important component being highways. Sorguc and Sener (1976) developed a relationship between socio-economic development and transportation in Turkey.

Eight indices were constructed to represent the component of socio-economic development with the transportation index represented by the area of land per kilometer of road. Several relationships were developed between the composite index of socio-economic development and the development indicies. Sorguc and Sener (1976) suggested that the relationships showed that the indicies of transportation, education and demography were important. Furthermore, a Spearman rank correlation was carried out which showed that a strong relationship existed between socio-cultural development and transportation, and also between commercial and financial development and transportation. It should be noted however, that the study was based on cross-sectional data for 67 provinces in Turkey, so the results do not show the developmental effects of specific highway programs.

Using both descriptive statistics and regression models, Briggs (1980) empirically examined the

relationship between the location of the Interstate highway system and migration and employment changes between 1950 and 1975 in all non-metropolitan counties of the United States.

The results showed that counties with interstates had higher growth rates over the study period, but the presence of the highway system was not an assurance of development for an individual county. Tourism was the industry most closely related to Interstate development, but the most noteable feature was the weak role of manufacturing and wholesaling.

From the literature review presented in this section it appears that socio-economic interaction models have the capability of explaining the relationship between socio-economic development and improvements in the highway system. However, the two studies referred to (Sorguc and Sener, 1976; Briggs, 1980) were of national scope and did not address specific highway investments. For the purpose of this research, several modifications to the available techniques were completed to make them applicable for the assessment of the impact of highway investment in New Brunswick.

RESEARCH METHODOLOGY

The Observation Unit

The observation unit is the geographical area which theoretically should benefit from an investment in highway infrastructure. It should have three characteristics

in order to be compatable with this research. First, adequate socio-economic data must be available for the observation unit throughout the duration of the study. Second, it should contain areas with similar economic characteristics so that the effect of highway improvement should then be uniform throughout the observation unit. Finally, it should include all areas which should be affected by highway investment to avoid overestimation of the effect of highway investment.

For the purpose of this research, the basic observation unit is the economic region. Following the Second World War, Canada was divided into a series of 68 economic regions. These regions were sub-provincial units with similar characteristics which could be used for estimating the impact of changing economic conditions. New Brunswick was divided into five economic regions, with the boundaries falling on county lines. Each region is identified by the major city within the region.

Although most of the socio-economic and highway data are recorded as a provincial total, some of the socio-economic data and all of the highway data can be disaggregated to the regional level. These disaggregated data will be used in the analysis.

Analytical Technique

In order to assess the impact of investment in highway infrastructure a model was developed for each economic region. Each model will attempt to identify

the variance in a region's economy which can be explained by investment in the region's highways. The model will also estimate the magnitude of the effect of highway investment. The model takes the form

$$Y_t = a + bX_t + r$$

where:

Y_t is the economic indicator which measures the performance of a region's economy at time t,

X_t is the highway development variable which is a measure of the investment in a region's highways,

r is the residual

In this model, "b" represents the magnitude of the effect highway investment has on the economic indicator. The magnitude of the effect on the regional economy of all factors except highway investment is estimated by "a".

In order to determine the significance of highway investment, the coefficient of the highway development variable will be tested by a Student's test. If the coefficient is statistically significant, it can be stated that investment in highways has an effect on regional development. The magnitude of this effect will be indicated by the sign and magnitude of the highway development coefficient.

Time Lags

The underlying theory of the model developed above is to account for the level of a regional economy at any point in time by the level of highway investment at a related point in time. The selection of the time period

between the cause (investment in highway infrastructure) and the effect (regional economic development) is critical to the analysis.

To accurately estimate the effects of highway investment, the proper lag period between highway investment and economic development should be used when entering the highway development variable into the model. In this study the correct lag period will be determined by altering the model to include a range of lags.

The model adjusted for different lag periods will become:

$$Y_t = a + b_{(t+m)}X_{(t+m)} + \cdots + b_{(b+1)}X_{(t+1)} + b_tX_t + b_{(-1)}X_{(t-1)} + \cdots + b_{(t-n)}X_{(t-n)} + r$$

where:

Y_t is the economic indicator which measures the performance of a region's economy at time "t"

$X_{(t+m)} \cdots X_{(t-n)}$ are the highway development variables from t+m to t-n

"r" is the residual

The value of $b_{(t+m)}$ to $b_{(t-n)}$ represents the magnitude of the highway development variable at a lag period from "m" to "n". In the model, the coefficient of highway investment at lag periods which do not influence the economic development of a region will not be significantly different from zero. These variables will then be eliminated from the model. If more than one year's investment in highway infrastructure appeared to be significant, the possibility of autocorrelation in the

highway development variable should be investigated.

Economic Indicator

A review of previous research on highway impact analysis revealed that employment within a given region is primarily used as the indicator of regional development.

For this research the use of employment as the dependent variable is not possible. Neither the employment by industrial classification nor the total employment is available at the New Brunswick regional level throughout the study period.

As a proxy for total regional employment, the per capita income from wages, salaries, and commissions will be used to indicate regional development. The use of per capita wages, salaries and commissions instead of per capita total income eliminates the effect of transfer payments. The inclusion of transfer payments would cause the effect of highway investment to be overestimated.

Before per capita wages, salaries, and commissions can be used as the dependant variable in the analysis, the effects of inflation must be eliminated. If the effects of inflation were not considered, the impact of investment on highways in recent years would be overestimated. Statistics Canada's all item Consumer Price Index for Saint John was used to deflate the per capita wages, salaries and commission into constant 1971 dollars.

Shift - Share Analysis

In order to accurately assess the regional development effects of highway investment the effect of the national economic forces should be removed from the analysis. Since highway investment is a regional factor, only that part of the dependant variable which is affected by regional factors should be entered into the model.

Shift-share analysis is a technique which will divide the change in socio-economic activity into two component parts. The aggregate growth component measures the change in a region's socio-economic activity if the rate of change in the region is the same as the rate of change in an analysis area (the province in this research).

The competitive component measures the performance of a region relative to the performance of the aggregate area. If the region grows at the same rate as the province, the region's competitive component will be zero. If the region grows at a faster rate than the province, the competitive component will be positive.

The competitive component is actually a measure of the economic activity of a region based on changes particular to that region. Policy decisions and dramatic changes in the economy that affect the province as a whole are accounted for by the aggregate growth component. The competitive component accounts for regional influences such as the availability of labour and raw materials, the local employment rate and the

construction of highways. The use of the competitive component as the dependant variable in the model should thus limit the scope of considerations to those having a differential impact on subject regions within an area (Herendeen, 1973).

HIGHWAY INVESTMENT IN NEW BRUNSWICK

Before identifying the historical trends of highway investment in New Brunswick it would be beneficial to establish a method of expressing the magnitude of highway investment. This will be used as the highway development variable X_t in the model developed in the previous section.

Briggs (1980) and Walton (1970) used a dummy variable to indicate the presence of a highway. Botham (1980), Peaker (1976) and Herendeen (1973) used measures of accessibility, while Sorguc and Sener (1976) used the area of land per kilometer of highway as a proxy for the magnitude of highway investment.

The use of monetary expenditure on highway construction as the highway development variable would provide many benefits not realized in the other methods.

The use of expenditure on highways as the highway development variable will consider all construction and upgrading at relative values. The magnitude of the highway development variable for the construction of a local highway would be smaller than that for the construction of an arterial highway due to the difference

in the construction costs.

Another advantage in using expenditure on highway construction as the highway development variable is that the annual improvement in the highway infrastructure can be measured. The history of highway development in New Brunswick is characterized by continuous improvements to the existing infrastructure. Unlike other variables, expenditure on highway construction has the ability to determine the magnitude of these continuous improvements.

Before the value of the investment in highway infrastructure can be used as the highway development variable, the effects of inflation must be eliminated. Since the cost of the components of highway construction rise at rates different from wages, salaries and commission, a different deflator must be used. This deflator should be based on the component costs of highway construction.

Barton (1979) recommends the use of Statistics Canada's 'Highway Construction Cost Index'. The New Brunswick index is developed based on the prices paid by the New Brunswick government in contracts awarded for highway construction.

The total expenditure on highway construction in New Brunswick appears to be directly related to the amount of funding available from the Government of Canada. Areas designated by federal assistance programs received a relatively high proportion of the construction, while capital construction in other areas did not increase as rapidly.

Since 1951 the Province of New Brunswick has entered into twenty-three federal cost sharing agreements under eight programs. These programs are the:

- Trans-Canada Highway Agreements
- Roads to Resources Program
- Atlantic Development Board Agreements (A.D.B.)
- Northeast New Brunswick Federal-Provincial Rural Development Agreements
- Department of Regional Economic Expansion Special Areas and Highways Agreements
- Agreements with the Community Improvements Corporation (C.I.C.)
- Department of Regional Economic Expansion General Development Agreements (G.D.A.)
- Canada-New Brunswick Highway Strengthening/ Improvement Agreement (M.O.T.)

The fiscal year 1951-52 was selected as the first year of the study for two reasons. Prior to 1950 the New Brunswick Department of Public Works' fiscal year of reporting extended from November 1 to October 31. In 1951 the fiscal year was changed to extend from April 1 to March 31 thus the 1951 reporting year was from November 1, 1950 to March 31, 1951. The second reason for choosing 1951-52 for the first year of the study was that the construction of the Trans-Canada Highway through New Brunswick was beginning.

Analysis

The magnitude of highway investment for each year of

the thirty-one year study period (1952-1982) was available for each region. The magnitude of the per capita wages, salaries and commissions was not available for the entire study period. In 1957, the Department of National Revenue changed their publishing format to include more statistics. Prior to 1957, the value of per capita earnings is not published at the regional level. Due to a delay in the publishing process, the 1980 calendar year is the most recent year for which statistics are available. Thus a value for per capita wages, salaries and commissions can only be determined for twenty-four years.

With twenty-three years of economic data (one year is lost in the shift-share analysis) and thirty-one years of highway investment, the maximum number of observations possible in the time series is twenty-three.

Table 1 presents the calibrated regional development models. In these models SSW denotes the competitive component of the share of per capita earnings. HILAG4 is the magnitude of highway investment four years before the increase in earnings, in constant 1971 dollars.

As outlined in Table 1, models were developed for only two economic regions: Fredericton and Saint John. No significant model was developed for the Moncton, Edmundston, or Bathurst regions.

The model developed for the Fredericton region indicates that an investment in highway construction has a positive effect on the regional economy four years

TABLE 1

REGIONAL DEVELOPMENT MODELS

REGIONAL MODEL	n	F value of model	t value of reg. coeff.	r^2
FREDERICTON				
SWS = -50.8+14.1(HILAG4÷10^6)	21	6.03	2.45	0.24
MONCTON				
No significant model				
SAINT JOHN				
SWS = -24.8+8.9(HILAG4÷10^6)	21	5.02	2.24	0.21
EDMUNDSTON				
No Significant model				
BATHURST				
No significant model				

later. The magnitude of this effect is that for every one million dollars invested in Fredericton's highway network, there is an increase in Fredericton's share of per capita earnings of 14.1 dollars. Thus as highway investment increases in the Fredericton region, the earnings of the region will rise relative to the provincial average.

The model also indicates the influence of factors other than highway construction. If no money was invested in highways, the residents of the Fredericton region would incur a relative loss in earnings of 50.8 dollars per person. Thus 3.6 million dollars of investment are required to maintain the provincial average rate of increase of earnings.

The results in the Saint John region are similar in concept but different in magnitude. In Saint John, as in Fredericton, an investment in highways has an effect on the region's earnings four years later. For every one million dollars invested in highway construction in Saint John there is a relative increase of 8.9 dollars in per capita earnings. Due to the influence of other factors an investment of 2.8 million dolalrs is required to maintain the provincial average rate of increase of earnings.

These numbers should not be accepted as exact figures, but should be considered approximations. An examination of the models indicates that at least 75 percent of the variance is left unexplained in each of

the development models. If more explanatory variables were available to be included in the model, the estimated magnitudes of the effects of highway investment would change.

No significant models could be developed for three regions. This may be due to two possibilities. One possibility is that highway investment has no significant effect on the economic development of the region. However, since the investment in highways has a significant effect on the economic development of two regions, this possibility does not appear valid. The second possibility is that highway investment does have a significant effect on economic development but this effect is not noticeable due to the absence of other explanatory variables. This possibility also appears to be invalid due to the ability to develop a model for two regions using only investment in highways as an explanatory variable.

The weak relationship between highway investment and regional development and the ability to develop significant models for only two regions provides preliminary evidence for the hypothesis of saturation and the shift of highways from a development function to an agent of personal mobility. Once a region's highway network reaches a certain level of development, it becomes uncapable of creating further regional development. The construction of additional highway infrastructure then promotes other secondary benefits.

An investigation of the hypothesis of saturation

and shift was examined in the last phase of this research. The results will be published at a later date.

CONCLUSIONS

The calibration of the models resulted in an estimate of the magnitude of the regional development effects of highway investment. In New Brunswick the lag time between investment in highway infrastructure and the resulting effect appears to be four to five years.

The models indicate the relative ability of highways to promote economic development in two separate regions.

An investment in the Fredericton region's highway infrastructure will have a larger effect on per capita earnings than will an equal investment in Saint John's highway network. However, a larger investment is required in the Fredericton region to remain growing at the provincial rate (3.6 million dollars compared to 2.8 million dollars).

The results of this analysis support the conclusions of other research into highway's role as a development tool. The models indicate that highway investment is related to increased economic development, although the effects attributable to the investment are relatively small. This may tend to indicate that highways are not important to regional development; however, there appears to be a level of investment required in each region to ensure that the region does not decline economically when compared to the province's behaviour. The level of investment depends upon the economic and highway

structure of the individual region.

Further investigation is being done on the different phases of highway development and the saturation hypothesis.

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RAILROAD DEREGULATION: THE U.S. EXPERIENCE

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Annual Meeting
Canadian Transportation Research Forum/
Transportation Research Forum
May 1984

* The views expressed in this paper are those of the author and are not necessarily endorsed by the Association of American Railroads or its member railroads.

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I. Summary

"FOR MANY DECADES, the Federal Government has regulated the prices and the conditions for entry in certain sectors of the U.S. economy. This type of regulation, often called 'economic regulation', was broadly applied to the transportation, communications, and financial sectors of the economy. Whatever historical purposes were served by economic regulation, there is an increasing consensus that much of this Federal regulation no longer serves the interests of the contemporary economy. Indeed, over the last several years a substantial part of this economic regulation has been relaxed or eliminated."

The above quote, taken from Ronald Reagan's Economic Report of the President transmitted to Congress in February 1983, succinctly characterizes the mood of the federal government as it continues to implement railroad regulatory reform, three and one-half years after passage of the Staggers Rail Act of 1980.

A 150-year old industry, U.S. railroads have operated under pervasive economic regulation since 1887. It was not until the 1970's that there was any meaningful attempt to reform the regulatory framework that was designed for a monopolistic industry, despite the fact that the railroads had long since been thrust into a competitive environment. The Railroad Revitalization and Regulatory Reform Act of 1976 (4-R Act) failed to achieve the deregulatory goals necessary for a responsive and efficient rail network. Not until the Staggers Act provided for substantial reliance upon marketplace competition as the most effective regulator of rail rates and services was relevant regulatory reform enacted.

By most measures, the U.S. rail industry was on a steep and continual decline during the past 50 years. From 1947 to 1979, total intercity freight of all modes doubled while

rail tonnage declined by one percent. Rail's market share had fallen by 50 percent over this 32-year period. During the decade of the 1970's, ten major railroad failures placed 22 percent of U.S. rail mileage under the jurisdiction of bankruptcy courts.

Although instituted during a deep and extended recession, the Staggers Act reforms have been a positive force for revitalization. Provisions which promote regulatory exemptions where warranted, contract ratemaking where desired, and rate, service, and abandonment reform throughout have assisted the railroads in weathering the recent bad economic times. They have aided in the transformation of Conrail to the point where integration into the private sector appears imminent. The industry's market share has halted its skid, there is sharp bidding for property of bankrupt carriers, and rail management is starting to compete more effectively with motor carriers and barges.

Just as important, the regulatory reform appears to be generally acceptable to carriers and shippers alike. Although not all are totally satisfied with all aspects of the new process, as more becomes known about the effects of U.S. railroad regulatory reform, more of the issues can be resolved for both carriers and shippers (Canadian as well as U.S.).

II. Pre-Deregulation History

A. Legislation and Regulation

By virtue of their unique position in American economic history, railroads became the first American industry to undergo comprehensive federal economic

regulation. And, until most recently, the railroads were probably the most closely regulated industry in the U.S. Their growth fostered by technological advances and by federal, state, and local governments in the 1800's, railroads quickly became the predominant mode of transportation and one of the largest and most powerful domestic industries. However, not long after the birth of the American railroad industry, events reversed popular public sentiment from support of railroad development to suspicion of and opposition to railroad practices. After a 40-year period (1830-1870) of active, national promotion of railroads, legislation during the following 50 years (1870-1920) was largely premised on the need to control or curb potential unfair business practices.

While legislation from 1920 forward tended to reflect a moderation of the critical view of railroads, it was not until the 1970's that a positive attitude emerged. This legislative metamorphosis is discussed below to provide an appropriate perspective of the current, new-found status of the railroad industry.

Federal assistance to all modes of transportation has represented a minimal portion of total federal assistance to all industries, and railroad-related promotion, in turn, has accounted for a minor share of all transportation aid. However, governmental financing of the surveying of western lands in the early 1800's, and the land grant programs were important factors in development of the railroads, opening the West for expansion, and restrictive railroad legislation enacted thereafter.

The land grant program featured contractual provisions

which guaranteed repayment for the value of the land by means of providing reduced rates for freight and passenger transportation to the federal government. Thus, the government achieved a dual goal of settling new territories and realizing a return sufficient to equal its investment of land. 1/

Railroad mileage grew rapidly from the first 22 miles in 1830. In just 40 years over 50,000 miles had been built. The decade of the 1880's saw the greatest expansion of the railway network with over 70,000 miles added during that single 10-year period. Rapid extension of the railway infrastructure continued to a 1920 peak of over one quarter of a million miles.

However, there were multiple forces at work during these years of phenomenal growth which created an unfavorable environment for rail enterprise. These forces included opposition from canal and turnpike proponents; the overexpansion of railroad facilities and consequent failures; the infusion of an undesirable human element into the business of railroad construction and promotion; the agricultural depression and ensuing agrarian revolt of the 1870's; and, later, confrontations between rail owners and rail workers. These and other factors brought about a distinct change in public opinion toward railroads by the 1870's.

Thus, starting with the state-enacted Granger Laws of the 1870's, which attempted to set standards for rate

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1/Study of Federal Aid to Rail Transportation, U.S. Department of Transportation, 1977.

equalization and to prescribe maximum rates, there was a proliferation of laws passed during the subsequent 50 years which had the central objective of regulating and controlling potential monopolistic abuses by the nation's rail carriers. The centerpiece of railroad regulatory legislation -- the Interstate Commerce Act -- was enacted in 1887.

This Act, and subsequent amendments thereto, established the basic regulatory framework for railroads by creating the Interstate Commerce Commission (ICC) and giving it enforcement powers, requiring tariff publication, and setting rate standards designed to prohibit rate discrimination. Subsequent legislation over the next 33 years greatly strengthened the regulatory process and formed the foundation of transportation regulation until at least 1976.

However, with enactment of the Transportation Act of 1920, while still conveying to the ICC authority over rail construction and abandonment, mergers and consolidations, and further rate areas, the idea that railroads must be permitted to earn a reasonable return on their investment first emerged.

Effectively, this law promoted the initial probing of the ICC into the arena of rationalization/restructuring of the U.S. rail system. In consideration of appropriate rate levels the Commission was to consider not only the public interest, but also carrier need. Thus, in addition to tightening regulation in areas of railroad service and capitalization and the issuance of complex procedures for

the settlement of labor disputes [2/], the Transportation Act of 1920 established the federal responsibility of ensuring the adequacy of the rail system it regulated.

Other legislation enacted through 1970 [3/] constituted various blends of stricter and more comprehensive economic regulation versus a recognition of the steadily mounting competitive forces posed by other transportation modes. Realization of the erosion and, in the more recent years, virtual disappearance of characteristics attributable to a monopolistic railroad industry eventually led to the shaping of new legislation.

Major railroad legislation during the past 12 years is of two types: 1) that relating primarily to Conrail and 2) that relating to the national rail network. The first category contains the 3-R Act (Regional Rail Reorganization Act of 1973) and NERSA (Northeast Rail Service Act of 1981). The purpose of the 3-R Act was to restore adequate and efficient rail service to the northeastern and midwestern regions of the U.S. The legislation created the United States Railway Association to oversee the establishment and operation of Conrail.

2/Labor provisions of the Transportation Act of 1920 were later replaced by the Railway Labor Act of 1926 and subsequent amendments.

3/Including, but not limited to, the Emergency Rail Transportation Act (1933), Transportation Act of 1940, Railroad Modification Act (1948), Transportation Act of 1958, Department of Transportation Act (1966), Rail Passenger Service Act of 1970. The Reed-Bullwinkle Act (1948) allowed railroads to practice rate-making through a rate bureau arrangement by exempting such activity from anti-trust statutes.

Finding that the 3-R Act had failed to create a self-sustaining and adequate railroad system in the Northeast and Midwest, Congress legislated NERSA. This law was designed to assist Conrail in an "orderly return" to the private sector by divestiture of commuter service responsibilities, expedition of abandonment proceedings, and reduction of labor expenses.

The second type of recent rail legislation includes the 4-R Act and the Staggers Rail Act of 1980. The goal of the 4-R Act was to provide the means by which the U.S. railway system could be physically, operationally, and financially rejuvinated so that it could remain a viable transportation mode in the private sector.

Treatment under the 4-R Act of new concepts such as revenue adequacy standards and market dominance, and the old issues of abandonments, mergers and consolidations, and procedural and ratemaking reform gave rise to hopeful expectations. Nonetheless, the 4-R Act did not achieve its purpose principally because of the broad discretion given the ICC in implementing the ratemaking and regulatory reform provisions. 4/ Typically narrow and restrictive, Commission interpretations of the 1976 legislation did not result in significantly lessened regulatory oversight.

It is because of the basic lack of success of the 4-R Act that the more comprehensive and less discretionary

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4/See Evaluation of the Ratemaking Provisions of the 4-R Act, Final Report No. RR-132, August 3, 1979, prepared by Ecosometrics, Incorporated under contract by the U.S. Department of Transportation.

Staggers Act was passed in 1980. While broader in scope, the Staggers Act carries the same general purpose as the 4-R Act: namely, to permit railroads the natural flexibility necessary to compete effectively in the transportation marketplace. The paramount difference between the two pieces of legislation, and the main reason for their differences in success, is their design. The Staggers Act is more specific and non-discretionary, whereas the 4-R Act remanded much of the Congressional intent to be interpreted by the ICC.

B. Rail Industry Condition

Veiled in strict regulatory constraints controlling ratemaking, service, capitalization, accounting, abandonment, merger, and investment decisions decade after decade, the railroad industry found it impossible to adequately respond to changing market conditions. And the changes have been significant. Burgeoning motor carrier and barge industries have received productivity increases in the form of government-funded rights-of-way. Rail's principal competitors (barge and certain motor carrier sectors) have enjoyed little or no regulation. The shift in the general economy from a manufacturing to a service orientation tends to dampen transportation demand in general, while most directly affecting smokestack industries from which rail in particular, derives much of its traffic.

More recently, the importance of energy conservation and other factors are affecting industrial output through the downsizing of manufactured products, such as automobiles, and homes, which in turn, diminishes the

demand for iron ore, steel, lumber, etc., and the associated demand for rail transportation. Similarly, the heightened foreign competition in U.S. domestic and export markets, especially in automobiles, steel, coal, and grain, is having detrimental impacts on the rail industry's traffic base.

More apparent is the enhanced competitive position of the motor carrier industry. The number of ICC-regulated trucking firms alone has increased 82 percent from 1972-1983, and over 110,000 operating authorities have been granted since 1976. The percentage of non-union (lower wage) intercity drivers has increased steadily and was 83 percent in 1982. Intercity truck fuel efficiency has also risen substantially and the size and weight (and therefore cubic capacity) of the truck trailers has been constantly increasing as more and more states have raised the legal limits. With the greater size and weight standards adopted nationally under the Surface Transportation Assistance Act of 1982, this trend is likely to accelerate.

With such a sharp contrast in the level of regulation accorded competing modes and such significant transformations occurring in the transport market, unnecessary regulatory shackles were a decided competitive disadvantage for the railroads. While not the sole reason for the serious competitive problems experienced by the rail industry, 5/ ubiquitous regulation was certainly a

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5/Since 1979, tons carried, and in most cases ton-miles, have declined for each of the intercity freight modes.

major contributor to the general decline of the railroad industry during much of this century.

U.S. Class I [6/] railroad mileage, which peaked in 1916 with 364,137 miles of track (231,674 miles of road), declined to 355,227 track miles in 1947. With continued rationalization of the duplicative rail net, the mileage was further reduced to 277,240 miles of track (169,927 road miles) as of 1979. The abandonment process, however, was much slower than the industry needed to eliminate essentially unused and unprofitable trackage.

Rail employment also followed the same trend. Reaching the high point of 1.7 million in 1929, Class I employment had been reduced to 483,000 as of 1979. However, as will be discussed in Section IV.A., the remaining number of employees is a substantial financial burden in view of their high rate of compensation.

In 1947 (earliest comparable data) the railroads moved 56 percent of all U.S. intercity tonnage. From 1947 to 1979 (the year before the Staggers Act), total intercity freight doubled while rail tonnage declined by one percent -- resulting in a steady drop in rail market share to 27 percent in 1979. Essentially the same trend has occurred with ton-miles, in that rail, which accounted for 74 percent in 1930 and 65 percent in 1947, had plummeted to a 1979 level of 36 percent. Morever, the rail industry had

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6/Class I roads are those which earned over $82 million in freight revenue in 1982. Together, they move about 98 percent of all rail freight, operate 94 percent of all rail mileage, and account for 92 percent of all rail employees.

dropped to a 32 percent market share of intercity freight revenues by 1979.

From 1970 through 1979, ten large carriers, comprising 22 percent of U.S. rail mileage, filed for bankruptcy.

The cumbersome and slow evidentiary process by which railroads could increase rates to recoup inflationary cost increases prior to the Staggers Act resulted in unwarranted and extensive administrative burdens and enormous levels of unrecoverable costs. These "regulatory lag" costs resulted in an annual average revenue loss of over $1 billion.

In this regulatory environment and with the shift in traffic mix, the railroads have experienced an alarming progressive decline in "real" railroad freight revenue per ton-mile -- down 25 percent from 1972 to 1979. An annual Citibank survey reveals that Class I railroads typically earn one of the lowest rates of return on shareholders' equity (ROE) of any major U.S. industry.

Return on net investment has likewise been substandard throughout the recent past. The ICC has determined that the criterion for railroad revenue adequacy is a rate of return equal to the ICC-determined cost of capital. Over the five years that the Commission has been issuing a cost of capital determination, the railroad ROI has never been more than one-third of what is deemed adequate. Even in the face of such depressed financial returns, the industry has consistently invested more for capital expenditures than it has earned. Maintenance of modern plant and equipment is a critical aspect of effective rail operation, and borrowing on the future is a circumstance

which cannot continue to persist if the industry is to grow and flourish.

III. Deregulation: Staggers Act Provisions and Their Application

The findings of the Staggers Act indicate the inability of past regulatory practice to keep pace with realities of the transportation marketplace and cite regulation's complicity in shaping the then-current state of the rail industry. Congress found that:

- many of the government regulations affecting railroads, once essential to prevent an abuse of monopolistic power, are unnecessary and inefficient,
- most U.S. transportation is competitive, and
- greater reliance on the marketplace is essential to preserve a viable energy-efficient and economic railroad industry.

The goals of the Act are to: 1) assist in rehabilitating the rail system to meet commerce and defense needs, 2) reform federal regulatory policy, and 3) retain a private sector rail industry, while balancing the needs of carriers, shippers, and the public. In the three and one-half years since the implementation of the Staggers Act, there is ample evidence that the partial deregulation of the rail industry has been beneficial to both carriers and shippers. A later section will present a summary of the Act's affects. This section reviews some of the more important provisions of the Staggers Act and related deregulatory trends while commenting on the extent of their adoption and usage.

A. Rail Transportation Contracts

One of the most significant provisions of the Staggers Act (Section 208) authorizes railroads to enter into contracts with shippers. The contract provision gives railroads and shippers nearly complete freedom to negotiate mutually-agreeable rates and terms of service with minimal regulatory requirements similar to other businesses throughout the country.

Before 1978, the ICC had held rail transportation contracts to be illegal. Even though the ICC issued a policy statement in November 1978 encouraging the use of contracts, very few contracts were filed under the new policy for a number of reasons: the unfamiliarity of all parties with contracting for rail service, the continuing uncertainty about the legality of rail contracts, the requirement that the terms of the contract be fully disclosed in tariff form, and the potential for lengthy ICC proceedings to review the proposed provisions.

The Staggers Act removed the regulatory impediments to the development of contracts. The Act required that rail contracts be filed with the ICC, but provided that only the essential terms (as defined by the ICC) have to be disclosed publicly. Also, the Act restricted the ICC's role in reviewing contracts, and established a strict timetable for their review and approval.

Contracts may now take effect on one day's notice, although the ICC retains jurisdiction for up to 30 days to decide whether to investigate (with a decision to be rendered within 30 days after the date an investigation commences). The primary grounds for complaint (which must

be registered within 18 days from the date the contract is filed) is that a shipper will be individually harmed because a contract will prevent a railroad from meeting its common carrier obligation.

The ICC's interpretation of the Staggers Act has made contracting for rail service essentially like any other business contract. Shippers and railroads may negotiate terms tailored to their specific needs and implement the arrangement expeditiously, without disclosing confidential data; a circumstance that is attractive to both shippers and railroads. The use of contracts has grown rapidly: an average of nearly 700 contracts were filed each month in 1983, compared with 50 per month in 1981. By the end of 1983, contracts had been filed by 147 railroads, including all Class I carriers. Contracts have covered a broad range of commodities as shown below:

Commodity Group	Percent of Contracts Filed
Bulk Products, Chemicals, Minerals, etc.	24.6%
Forest Products, Lumber, Paper	18.0
Grain/Grain Products	14.6
Foodstuffs	12.9
Iron and Steel, Metals, Scrap	11.2
Coal	4.4
Auto, Parts, Machinery, Implements	3.2
Other - Service and Miscellaneous Commodities	11.1
Total	100.0%

Source: Interstate Commerce Commission, Report On Railroad Contract Rates Authorized By Section 208 Of The Staggers Rail Act Of 1980, March 13, 1984.

In response to an ICC survey, 11 Class I roads (that account for 85 percent of all contracts) reported that contract revenues accounted for 12 to 34 percent of total revenues, with a mean of 27 percent. A survey of 11 shortline railroads that had filed contracts found that most

were receiving between 50 and 95 percent of their total revenues from contract service. Thus, the Staggers Act provision legalizing contracts is reshaping the way that railroads market their service -- with the emphasis on agreements with shippers in the competitive marketplace, rather than on rates and terms of service regulated by the ICC.

B. Exemptions From ICC Regulation

Another major change in railroad regulation has resulted from the ICC's authority to grant exemptions from regulation. This power, originally conferred by the 4-R Act, was broadened by the Staggers Act (Section 213). The ICC has used its authority under this provision to grant nearly total exemptions for major segments of rail traffic: boxcars, export coal, and TOFC/COFC. It has also been used in numerous cases to remove specific regulations affecting a transaction.

The Staggers Act provides that the ICC shall grant an exemption from regulation when it finds that:

(1) regulation is not necessary to carry out the rail transportation policy of 49 U.S.C. 10101a; and

(2) either (A) the service is of limited scope, or (B) regulation is not needed to protect shippers from an abuse of market power. (49 U.S.C. 10505)

The Staggers Act has enabled the Commission to grant broad exemptions where regulation is not necessary (whereas the 4R Act applied the "limited scope" requirement to all exemptions).

The ICC's implementation of its exemption authority has reflected the fact that the three parts of the statutory standard are interrelated. The ICC has justified the more significant exemptions upon a finding that vigorous competition exists. This finding has allowed the Commission to conclude that competition, not regulation, will best serve the rail transportation policy, and that the availability of alternatives (e.g. - inter- and intra-modal competition, product and geographic competition) protects shippers from an abuse of market power. When the proposed exemption has been of limited scope, the ICC has used this fact to support the other required finding -- that regulation is not needed to carry out the rail transportation policy.

The Rail Transportation Policy contains fifteen broad policy goals, such as:

> "(4) to ensure the development and continuation of a sound rail transportation system with effective competition among rail carriers and with other modes, to meet the needs of the public and the national defense" [49 U.S.C. 10101a(4)]

While the Commission is required only to make the negative finding that regulation is not necessary, it usually points to the elements of the policy that it believes will be enhanced by the exemption.

As shown below, the ICC has used its authority to eliminate virtually all regulation of approximately 21 percent of the railroad's traffic (on a 1981 tonnage basis).

RAIL TRAFFIC EXEMPTED FROM ICC REGULATION

Commodity/Service	Tonnage (Millions of Short Tons)	Percent of Total Rail Tonnage
Miscellaneous Agricultural Products	8.3	.6%
Fresh Fish	a/	a/
Export Coal	111.3	8.3
Food and Kindred Products	4.9	.4
Tobacco Products	.1	a/
Textile Mill Products	a/	a/
Boxcar Traffic	130.0	9.6
TOFC/COFC Traffic	30.4	2.3
TOTAL	285.0	21.2%

a/ Less than 0.05.

These exemptions have removed ICC regulation of rates, service, and car service for this large segment of rail traffic. The ICC has retained the standard accounting and reporting requirements for the traffic it exempted. Regulations affecting the railroads' liability for lost and damaged freight, and their obligation to protect the interests of their employees, continue to apply.

C. Revenue Adequacy, Cost of Capital

The requirement that the ICC determine an adequate revenue standard for rail carriers was established under the 4-R Act of 1976. The objective was to determine what revenue levels were adequate "under honest, economical, and efficient management" to cover total operating expenses and provide a return on capital investment. The revenue adequacy determinations made pursuant to the 4-R Act (Ex Parte No. 338) used three criteria: return on investment, financial ratios, and funds flow analysis;

with the last two elements used as indicators of the minimum levels for adequacy.

The Staggers Act did not change the 4-R Act provisions, but did mandate that: 1) the ICC initiate and conclude a new proceeding to establish railroad revenue adequacy standards within 180 days after passage of the Staggers Act and, 2) revenue adequacy be made a determinant under various provisions of the Staggers Act such as rate reasonableness and certain rate increases, for example.

In its rulemaking prescribed by the Staggers Act (Ex Parte No. 393), the ICC concluded (and the courts upheld) that a return on investment equal to the current cost of capital is the only true measure of revenue adequacy. And it further stated that this standard alone was "the minimum rate necessary to attract and maintain capital in the railroad, or any other industry."

The Commission has made cost of capital and revenue adequacy determinations each year since 1978. The industry-wide cost of capital calculation includes separate assessments of the approximate 40/60 split between debt and equity funding. This is then compared to the individual Class I carriers' return on investment. Only a few of the smaller Class I carriers have ever been found to be revenue adequate in any one year. The most recent cost of capital is 17.7 percent for 1982; against which no carrier was found to have adequate revenues. In fact, not a single carrier had a 1982 return on investment greater than one-half the adequate revenue level.

D. Intrastate Regulation

Provisions in the 4-R Act were designed to circumvent previous problems with intrastate rail rate processing. These procedures perpetuated the ICC's authority to prescribe an intrastate rate for transport -- but only after 1) the rail carrier(s) had properly filed its request with the appropriate state agency, and 2) the state authority has not acted finally on the change within 120 days of filing. If, after the 120-day period had elapsed without a decision being rendered by the state, or if a decision was rendered which denied all or part of the proposed rate action, the railroad(s) could seek full ICC approval on the basis of unreasonable discrimination or burden against interstate or foreign commerce. But the ICC could act on these cases only after holding a full hearing.

This dual system of railroad rate regulation was a source of problems for a significant portion (intrastate traffic was approximately 12 percent of freight revenue and about 30 percent of revenue tons and carloads in 1982) of the railroads' traffic. 7/ Conflicting regulatory precepts and substantial delays and expense were encountered by the railroads in seeking state approval and in appealing to the ICC. Because there is no recognizable distinction between intrastate and interstate traffic or shippers, Congress viewed this system as unnecessarily

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7/For details see A Case For Uniform Regulation of Railroad Freight Rates, Craig F. Rockey, ICC Practioner's Journal, November/December 1980.

burdensome to the railroads and affected changes in the Staggers Act.

Section 214 of the Staggers Act provides that a state authority may exercise jurisdiction over intrastate rail transportation only if the ICC has certified its regulatory procedures and standards. The certification is made only after the Commission has ascertained that the state's "standards and procedures are in accordance with the standards and procedures applicable to regulation of rail carriers by the Commission..."

Under Ex Parte No. 388 the ICC has promulgated rules to certify states. The certification process has been slow and extremely complex. After more than three years, only one state (Virginia) is fully certified, four others are almost permanently 8/ certified, and 28 have provisional certification and are in various stages of the approval process. Nine states, formerly parties to the certification process, have decided to disband state regulation and have requested the ICC to regulate their intrastate rail rates. These states basically viewed their regulatory function under the Staggers Act provisions as nothing more than administration of ICC law, and therefore opted to reduce state expenditures by eliminating the staff necessary to perform these duties.

The eight remaining states (Alaska, Hawaii, Arizona, Maine, Massachusetts, Rhode Island, South Dakota, and Vermont) have decided that the regulation of intrastate

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8/Permanent (full) certification is required to be renewed every five years.

rail traffic within their boundaries by any agency is unnecessary. Along with intrastate rate regulation by either the ICC or the state (using ICC standards), the ICC has determined that the intent of the Staggers Act is to provide the states a third choice -- that of no intrastate regulation of rail rates, whatsoever. These eight states have taken that option.

E. Interstate Rate Regulation

Perhaps the most extensive changes in regulation provided by the Staggers Act are in the provisions on ratemaking. The Rail Transportation Policy established by the Act clearly states the Congressional intent that rail rates should be governed by the marketplace, not by regulation. The first element of the policy is "to allow, to the maximum extent possible, competition and the demand for services to establish reasonable rates ..." [49 U.S.C. 10101a(1)].

This general policy was reflected throughout the Staggers Act's ratemaking provisions. The Act has enhanced competition among railroads by effectively ending collective ratemaking through railroad rate bureaus and has reduced maximum rate regulation. It has also given railroads more freedom to unilaterally alter joint rates with other carriers. In addition to the granting of exemptions from regulation, some deregulation of intrastate traffic, and the opportunity to contract (all discussed above), the Staggers Act has removed rate regulation from a sizeable portion of the railroads' traffic.

The discussion of the system of rate regulation that follows is divided as shown below:

1. Rate Bureaus, Anti-Trust, Direct Connector
2. Savings Clause
3. Maximum Rate Regulation
   - Market Dominance
   - Thresholds, Cost Recovery Percentage
   - Rail Cost Adjustment Factor
   - Zone of Rate Flexibility
   - Coal Rate Guidelines
4. Minimum Rate Regulation
5. Interline Traffic Provisions

1. Rate Bureaus, Anti-Trust, Direct Connector. The Staggers Act placed major restrictions on the activity of railroad rate bureaus, through which railroads had set rates collectively since their authorization in 1948. The Staggers Act removed antitrust immunity for discussions or votes on single line rates, and required that only those carriers that could "practicably participate" in an interline movement could be allowed to discuss or vote on general rate increases for the movement.

Effective January 1, 1984, the "direct connector" standard removed the general rate increase exception by providing that only the carriers actually involved in a particular route could participate in setting the rate.

2. Savings Clause. Section 229 of the Staggers Act provided a final 180-day opportunity to challenge rates that were in effect at the time the Act was passed. The burden of proof in these proceedings is on the complainant. The 864 complaints filed under this provision are being processed by the ICC under Ex Parte No. 421 in bifurcated proceedings: first stage is market dominance determination, second stage involves rate reasonableness.

As of January 3, 1984, 757 of the cases have been concluded. The remaining 107, which include interstate and intrastate traffic, are in various stages of finalization.

3. Maximum Rate Regulation. The Staggers Act contained a number of provisions that have greatly reduced the ICC's role in regulating maximum rate levels. The most significant changes have involved the application of market dominance standards, new procedures for recovering inflation-related cost increases, and the ICC's issuance of guidelines for determining the reasonableness of coal rates.

Market Dominance

The market dominance concept, originated by the 4-R Act, eliminates ICC jurisdication over maximum rate levels except where there is "an absence of effective competition." Under the 4-R Act provisions, the ICC determined in Ex Parte No. 320 that a carrier was presumed to have market dominance if: 1) the carrier handled 70 percent or more of the traffic of goods involved within the prior year (the "market share" presumption), 2) the rail rate yielded revenue exceeding 160 percent of the railroad's variable cost of service (the "cost" presumption), and 3) the shipper had made a substantial investment in rail-related plant or equipment which effectively precluded the use of alternative transportation (the "substantial investment" presumption). The "market share" presumption was rebuttable only by evidence of direct carrier competition for the disputed movement.

The Staggers Act modified the market dominance test. Under the new criteria, market dominance cannot be found to exist unless the revenue-to-variable cost (RVC) ratio of the subject traffic is above a given threshold level. Furthermore, a finding that the rate is above the RVC threshold level "does not establish a presumption" of market dominance.

If the rate is determined to be above the threshold (carrier's burden to prove otherwise in a complaint case), the Commission invokes an examination of "qualitative" issues on a case-by-case basis. These issues include the existence of intermodal, intramodal, product, and geographic competition, and the legislative intent that carriers earn adequate revenue. As of February 1984, there have been no market dominance cases decided solely on a finding of product or geographic competition.

Thresholds, Cost Recovery Percentage (CRP)

The RVC thresholds mandated by the Staggers Act and below which a rate cannot be found to have market dominance are as follows:

160%	- October 1 1980 - September 30, 1981
165%	- October 1, 1981 - September 30, 1982
170%	- October 1, 1982 - September 30, 1983
175% or CRP (whichever is less)	- October 1, 1983 - September 30, 1984
CRP	- Each 12-month period beginning October 1, 1984

The above schedule includes the stipulation that the threshold shall never be greater than 180 percent nor less than 170 percent.

The CRP (Cost Recovery Percentage) is defined as the RVC level at which railroad revenue would equal the

railroads' fixed and variable costs (at the embedded cost of debt), if all rates with higher RVC ratios were reduced until they were at the CRP level. This extremely complex determination is made annually by the ICC. With the current CRP level at 342.5 percent the effective threshold is 175 percent. Latest estimates show that approximately 85 percent of all non-exempt rail tonnage and carloads and 77 percent of the industry's revenues are generated by traffic below the 175 percent threshold.

Rail Cost Adjustment Factor (RCAF)

One of the most harmful processes of the pre-Staggers regulation was the means by which inflation-justified rate increases were approved (or disapproved). As explained earlier, not only were the procedures unresponsive to cost increases in a timely fashion, their mechanics guaranteed less than full recovery. As a substitution for this process, Section 203 of the Staggers Act mandated a quarterly measurement of railroad-related inflation with carriers free to increase rates by a corresponding amount without challenge.

The Act stipulates that the inflation measurement, called the Rail Cost Adjustment Factor (RCAF), must be published quarterly by the ICC. A rulemaking proceeding (Ex Parte 290 (Sub No. 2)) was initiated in November 1980 by the ICC to consider the appropriate means by which to meet the Staggers Act requirements. A modified version of the Association of American Railroads' Price Index, which had been maintained in various forms since 1933, was adopted as the basis for the RCAF determinations.

This modified index, known as the Interim Midquarter Index, consists of separate components for labor, fuel, and materials and supplies. The remaining 30 percent of all rail costs are currently being measured by the U.S. Department of Labor's Producer Price Index until the ICC completes its study of how best to track the inflation associated with the six components which make up the "other" cost category. Also under review at this point is the issue concerning the appropriateness of a productivity adjustment to the RCAF calculation.

Using a one-quarter forecast of the Interim Midquarter Index, filed by the AAR no later than 20 days before the end of each calendar quarter, the ICC publishes a RCAF ten days before the close of the quarter. The railroads may then adjust their rates during the ensuing calendar quarter by up to the cummulative RCAF.

Stringent documentation standards are placed on both the AAR and individual railroads concerning all facets of the RCAF process. Detailed guidelines, forms, and procedures are reviewed periodically by the ICC, and formal audits are performed by both the ICC and an independent accounting firm engaged by the railroad industry.

The RCAF procedure has functioned efficiently during the first three and one-half years of rail regulation under the Staggers Act and has offered railroads and the shipping community a dependable and equitable method by which to account for inflationary pressures. Since October 1980, the RCAF has risen 24 percent to the first quarter 1984 level, with six of the quarterly

determinations providing no capability for rate increases. U.S. Department of Labor statistics show that rail rates during this same period have increased by virtually the same amount.

Zone of Rate Flexibility

The Staggers Act also provides a zone of rate flexibility, which allows railroads to increase rates by as much as 6 percent per year for the first four years, with certain limitations. After the initial four year period, carriers not earning adequate revenues may increase rates by up to 4 percent per year.

Coal Rate Guidelines

Another development concerning maximum rate regulation has been the issuance of coal rate guidelines, which define the process the ICC will use to determine a reasonable maximum rate for coal traffic where the railroad(s) is found to have market dominance. For nearly 10 years the ICC has had before it a series of individual coal rate cases for which it has attempted to formulate a standard procedure. The proceeding to issue nationwide guidelines developed from an investigation of western coal rates begun in 1978.

The ICC has proposed to follow what it calls a "constrained market pricing" approach, under which four constraints would be placed on railroad coal rates:

> First, a coal shipper could not be charged more than the "stand-alone cost" of serving its traffic. Second, captive shippers would not be required to bear the cost of obvious management inefficiencies. Third, carriers would generally not be permitted to increase their rates on captive coal traffic by more than 15 percent in a single year (after allowing for inflation). Fourth, until

a rail carrier achieves revenue adequacy, it would be free to adjust its rates unless it violates one of the three constraints previously listed. [Ex Parte No. 347 (Sub-No. 1)]

The ICC defined stand-alone costs to any shipper (or shipper group) as "the cost of serving that shipper alone, as if it were isolated from the railroads' other customers." The ICC elaborated as follows:

> The objective is to establish the minimum long-run average cost for the capacity of rail plant and equipment required by the stand-alone shipper, not necessarily the existing plant.

The ICC believes (and the rail industry agrees) that this approach -- although it has been harshly critized by coal and utility interests, and it has been the focus of a bitter debate at the ICC -- synthesizes the best and most useful economic theory of rail pricing within the agency's statutory responsibilities.

4. Minimum Rate Regulation. Before enactment of the 4-R Act, minimum rate regulation had at times served to hold up rail rates to average cost levels to protect the "inherent advantages" of competing modes. The 4-R Act established a standard that the rate must contribute to the going concern value of the railroad, and provided that rates that exceeded variable costs would be presumed to contribute.

The Staggers Act strengthened this standard by placing the burden of proof on the protestant, and by providing that a rate which exceeds variable costs is conclusively presumed to contribute to going concern value.

In 1981, the ICC decided that any rate which exceeded "directly variable costs" -- the costs that vary directly with the specific movement -- would be found legal. This

standard (developed under Ex Parte No. 355), which provides the railroads considerable freedom to price competitively with other modes, has allowed the railroads, for instance, to offer special "backhaul" rates to attempt to balance traffic flows.

5. Interline Traffic Provisions. The Staggers Act revised certain aspects of rulemaking for interline traffic, and the ICC revised its interpretation of other aspects to provide railroads increased flexibility. The Act authorized railroads to surcharge or cancel joint rates on which their portion of the revenue (their division) did not cover at least 110 percent of the variable cost of the movement over their line. The Act also provided for the surcharging of uneconomic light density lines. The railroads implemented more than 200 surcharges during 1981 and 1982. 9/

A more significant development has involved broad cancellations of joint rates covering a group of commodities or routes (e.g., Conrail's grain rate restructuring). These have been processed under public interest standards which were in effect prior to the Staggers Act. The ICC has allowed a number of such cancellations to take effect, but two major cases have been remanded by the courts for a more detailed analysis of evidence pertaining to each affected route.

In some instances, generally in retaliation for the

9/Ex Parte No. 427 Joint Rates Study, An ICC Report to Congress, November 12, 1982. These surcharges applied to approximately 100,000 carloads in 1981 alone.

cancellation of joint rates, railroads have sought to eliminate reciprocal switching agreements or increase charges to compensatory levels. Shippers have objected to changes, and have petitioned the ICC to institute a proceeding to establish rules under which it would require reciprocal switching in order to enhance competition. The ICC has denied these requests, but is continuing to examine the issue.

F. Costing, Accounting

The various Staggers Act provisions promulgated to reduce the level of regulatory oversight by the federal government have generated an increased reliance upon accurate rail costing. As a result of the 4-R Act mandate to issue new "regulations and procedures prescribing a uniform cost and revenue accounting and reporting system" for rail carriers, a revised Uniform System of Accounts (USOA) was released by the ICC on January 1, 1978.

However, since the new USOA was not compatible with the prevailing regulatory costing system (Rail Form A), the ICC undertook development of a new and improved regulatory costing methodology for use with the new USOA. A contract was let by the ICC on June 30, 1976, with two large accounting firms to develop what has become known as URCS (Uniform Rail Costing System). After approximately eight years of development, testing, installing, etc., URCS appears to be close to adoption by the ICC. In fact, it has already received limited use before the ICC in rate proceedings.

The Staggers Act contains a provision creating a Railroad Accounting Principles Board, the purpose of which

is to establish the most efficient method of generating accurate costs associated with particular railroad functions. This Board was to be comprised of seven members from different sectors of the economy and to have a life of three years. Its standards were to be implemented by the ICC. One million dollars was authorized for each of the three years, but the necessary appropriations were never made and the Board has, therefore, not been formed.

G. Abandonments, Feeder Railroad Development Program

The 4-R Act and subsequent ICC regulations require railroads to prepare, publish, and file with the ICC current diagram maps of their entire rail system identifying the relative susceptability of each line segment to abandonment. While this requirement still exists, Section 402 of the Staggers Act provides for a more expedited abandonment process and ICC implementation of abandonment procedures has substantially eased the costly burden of long-term operation of unprofitable line segments.

If no protest is filed within 30 days of an abandonment filing, ICC approval must be issued within 15 days. If protests are submitted, the Commission must render a decision within 75 to 330 days of the abandonment filing, depending upon whether the Commission decides to investigate and if appeals are made to the interim investigatory decision.

The ICC may postpone action on an abandonment proposal if another entity (or individual) is willing to subsidize the line with the appropriate level of funds. However,

the line may be abandoned and purchased by another party when: (1) neither the railroad nor the protestant asks the ICC to determine the conditions and amount of compensation within 30 days after a subsidy offer is made, and (2) the offerer agrees to purchase (not subsidize) the line for at least fair market value. The purchaser must maintain the line for at least two years and cannot transfer it to any party other than the selling road within five years of purchase.

In addition to the above, the feeder railroad development program contained in Section 401 of the Staggers Act provides further impetus for abandonment of light-density lines. Under this section, and subject to specific conditions as to traffic volumes, the ICC, after finding that the present railroad service is inadequate, can require a railroad to sell a line to a person (or entity) who is financially responsible.

As a consequence of the liberalized abandonment procedures and the purchase provisions of the Staggers Act and a 1981 amendment to the 3-R Act (Section 1156 (a), Title III) which requires the ICC to approve Conrail abandonment applications within 90 days in the absence of a financial offer, abandonments have increased since the Staggers Act became effective. Over the 1969-1980 period, an annual average of 118 applications were granted, equating to an approval of 78 percent of those filed. During 1981 through 1983, 90 percent of the average 241 proposals made each year were granted (217).

In terms of mileage, a yearly average of 1,951 miles were abandoned during the 12-year pre-Staggers period. An

annual average of 3,480 miles were abandoned during the three years ending with 1983. The average mileage involved per application remained fairly constant; 16.0 in the post-Staggers period vs. 16.5 in the pre-Staggers years.

H. Mergers

Mergers, operating agreements, financial control through stock purchases, formation of holding companies, and other forms of consolidations, intended to make the railroad parties more efficient and competitive, have been commonplace throughout the history of U.S. railroads. 10/ The consolidation process was often slow and uncertain. For example, the BN merger of the Great Northern, Northern Pacific, and Chicago, Burlington & Quincy was initiated in 1961, and took 9 years to work its way through ICC and court approval procedures. Consolidation proposals for Rock Island, submitted by Chicago & Northwestern in 1963, and by Union Pacific in 1964, were not decided until late 1974 -- only months before Rock Island filed for bankruptcy.

The 4-R and Staggers Acts have contributed to a substantial restructuring of the rail industry during the past few years, involving most of the major U.S. carriers. These mergers have included: (1) Burlington Northern - St. Louis San Francisco (November 1980), (2) Chessie System - Seaboard Coast Line (November 1980),

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10/In fact, during the 1920-1940 period, the federal government initiated various plans to mandate a consolidation of U.S. railroads.

(3) Norfolk and Western - Southern (June 1982), (4) Union Pacific - Missouri Pacific - Western Pacific (December 1982), and (5) Boston & Maine - Delaware & Hudson - Maine Central (January 1984). Still under consideration are Santa Fe - Southern Pacific - St. Louis Southwestern, and acquisition of the Milwaukee Road for which four potential buyers are currently vying.

The basic standards under which the most recent consolidations were considered pre-date the 4-R and Staggers Acts. Certain 4-R Act merger provisions were designed to encourage consolidations that would rationalize and improve the nation's rail system. These provisions include a maximum 31-month decision period for merger proposals involving two or more Class I roads, which has greatly expedited merger proceedings. Staggers Act provisions largely provided for expedited handling of the proceedings and reduced the substantive standards for mergers not involving two Class I railroads. The ICC's modified interpretation of the law gives greater emphasis to net national benefits anticipated from a merger, and less to negative impacts on individual carriers (as long as essential service will continue).

The Staggers Act retained the "public interest" standard in major consolidations, but added a new factor to be considered: the effect of the transaction on competition. The other four factors that, at a minimum, must be considered are: (1) the adequacy of transportation to the public, (2) the public interest in including (or failing to include) other rail carriers, (3) the total fixed charges that result, and (4) the interests of the

railroads' employees. (49 U.S.C. 11344) For minor consolidations, the Staggers Act (1) substituted an antitrust-style standard in place of the "public interest" standard used for major consolidations, and (2) shortened the time allowed for ICC review.

The Norfolk Southern Corporation's acquisition of control of Norfolk and Western, Southern, and related railroads provides an example of the ICC's handling of a major consolidation. In this instance, the ICC found that it would not adversely affect the adequacy of transportation to the public, nor would it lessen competition. The Commission also found that the failure to include other roads would have no ill effects, and that the interests of labor could be protected by imposition of standard labor protection agreements.

I. Entry

The Staggers Act promotes entry into the rail industry by several means. Section 401 sets out the feeder development program with the ICC overseeing the sale (voluntary and forced) of rail properties. The Commission has certain powers with regard to the establishment of joint rates and labor protection under these provisions. Section 221 prohibits the refusal by an existing carrier for a new line or extension to cross its line. Labor protective agreements can also be imposed by the Commission in these instances. Section 223 mandates that the ICC may require rail carriers to enter into reciprocal switching agreements where they are found to be "in the public interest" and where they "are necessary to provide competitive rail service." Employee protective

arrangements may also be required under this section.

IV. Experience Since Regulation

A. Effect on Rail Industry

The principal purposes of the Staggers Act are to bring regulatory theory into step with competitive fact and to insure that railroads be given the opportunity to earn adequate revenue in order to survive and flourish as private entities in a competitive world. During its first years the Staggers Act reform has not worked miracles, but it has worked. And it has confirmed the basic premise that railroads do exist in a highly competitive environment. Managerial freedom has allowed railroads to keep costs in line with revenues and vice versa. Competition has served as an adequate substitute for regulation in constraining prices.

The spate of bankruptcies which occurred during the 1970's has not continued after the Staggers Act, even in the presence of the deepest and longest recession since the Great Depression. In direct contrast and with assistance from both NERSA and the Staggers Act, Conrail has been revitalized to the point where its long-sought integration back into the private sector may soon be a reality. Similar favorable signs are also apparent in the bidding for Milwaukee and Rock Island assets and the formation of Guilford Industries from three weakened northeastern carriers.

Regulatory exemptions appear to have been prudent decisions. The latest data show that the traffic which has been exempted is lower-rated than the non-exempted traffic. Specifically, 12 percent of the exempted traffic

has revenue-to-variable-cost ratios equal to or above the current statutory threshold of 175 percent, whereas the average for the non-exempted traffic is 16 percent. Moreover, the TOFC/COFC exemption has resulted in traffic growth rates of about 20 percent per year since the Staggers Act. Furthermore, export coal deregulation has not caused rail rates to climb.

The pervasive use of rate and service contracts permits both railroads and shippers to organize and control the future. Such emphasis on stability underscores the belief of many that contracting is one of the most important new freedoms. Innumerable combinations of volume, rate, and service agreements are available under contracting. Innovative provisions, such as car and facility utilization, equipment purchases, improved service, and trackage rehabilitation, have been consumated.

The initiation of what is believed to be the longest non-coal unit train movement is also credited to the Staggers Act. Starting in Florida, these three-carrier shipments are delivered to the Port Maitland, Ontario, destination by the Toronto, Hamilton and Buffalo. It was also by use of a long-term contract that Chicago & North Western and Union Pacific were able to outbid the proposed ETSI slurry pipeline for a minimum 10 million tons of Powder River coal to be delivered to Arkansas Power and Light Company. In its March 13, 1984, report on railroad contract rates, the ICC reports that "contracting has intensified intramodal competition and has also been successful in attracting traffic from other modes." The Commission also predicts an annual five to ten percent

growth in contract traffic over the coming years.

Despite the ratemaking alternatives under Staggers, railroads have taken only a portion of the authorized increases since 1980. Competition and other market conditions have forced the industry to increase rates to levels that are only commensurate with inflationary trends. In fact, during 1983, railroads did not take even the full measure of rate flexibility available under the Staggers provisions. Indeed, rate reductions resulting from contract negotiations as well as non-contract rates have not been uncommon. Overall, rail rates have increased an annual average of 6.2 percent over the three years subsequent to the Staggers Act, while having increased at an annual rate of 15 percent during the three prior years.

Measuring the industry's financial success attributable to deregulation would be difficult during stable periods, but virtually impossible during a severe recession. Nonetheless, it is worth noting that rail's market share of intercity freight traffic has essentially remained constant since deregulation and that the boost to rail earnings during the 1980-1982 deregulatory period has moved railroads up from the very bottom in Citibank's industry-by-industry comparison of return on shareholders' equity.

Rail traffic levels, in general, started to rebound during the last half of 1983, and are continuing into 1984, but it is unlikely that some of the basic commodities will ever regain their prominence. And the production of coal, which is the railroad's single most

important commodity at 41 percent of total tonnage, is now forecast to increase at a rate less than that over the last 10 years. Furthermore, the commodities which hold the greatest potential for future growth are those which generate the lowest revenue per ton-mile.

While the freedoms granted under the Staggers Act are essential to effective management under such volatile market conditions, regulatory reform is only one of the essential ingredients in retaining existing markets and opening new ones. Also essential are such things as continued strong capital investment, comprehensive maintenance programs, and ongoing research and development on issues such as fuel economy, equipment configurations, and rolling stock utilization. And of vital importance to the health and competitiveness of the rail industry are labor productivity improvements.

Labor expenditures are the single most important component of U.S. railroad expenses -- comprising 50 percent of all Class I expenses in 1982. Average annual railroad compensation (wages & fringes) has increased by 204 percent from 1972-1983 -- a level far exceeding national inflation and compensation increases in other industries. In 1983, the $41,000 average annual compensation ($32,000 in wages and $9,000 in fringes) paid rail employees was over 50 percent greater than that earned in the trucking industry. 11/

11/As a point of reference with Canadian labor costs, the 1981 average wages and salaries (excluding fringe benefits) for U.S. Class I railroads was 33 percent higher than the average rate paid CP employees (in U.S. dollars).

As previously cited, the Staggers Act regulatory reform provides the opportunity to be more responsive to shipper needs/market conditions. But marketing prowess is nothing without the capability to be price competitive. Now that a reasonable degree of maneuverability has been granted rail management under deregulation, the key ingredient to a successful railroad future is through increased labor productivity. Without it, Staggers Act flexibility will be comprised.

B. Acceptance

On balance, the Staggers Act reforms were endorsed by affected parties as sound legislation and the experience to date under these provisions has generally been accepted as recognition that competition and marketplace forces are the best regulator of railroad service. The present Administration embraces railroad deregulation as overdue. An August 1982 U.S. Department of Agriculture study -- An Assessment of Impact on Agriculture of the Staggers Rail Act and Motor Carrier Act of 1980 -- revealed that "...there has been intense competition between and within transportation modes to move traffic; shippers -- even some of those previously thought of by many as "captive shippers" -- have benefited from such competition."

The ICC, in its March 13, 1984, Report on Contract Rates, concludes "...that, for the most part, contracting was mutually beneficial to railroads and shippers." The Commission states that most shippers from which it gathered data indicated that they have benefited from contracting through reduced rates and that contracting has been successful in diverting traffic from other modes to

rail. Most of these shippers also viewed the confidentiality of contract terms as a positive factor in fruitful negotiations.

This overall acceptance of railroad regulatory reform is echoed by the National Industrial Transportation League. In an April 29, 1983, circular, this association, which represents 1,600 shippers, shippers' associations, boards of trade, chambers of commerce, and other entities, supports the reduction of federal economic regulation and asserts that "the League supported the Staggers Rail Act of 1980, and is generally pleased by its implementation."

Railroad companies, likewise, continue to support economic deregulation and welcome the ability to have normal relations with their shippers. The sentiments of many in the industry are voiced by Charles Marshall, Conrail Vice President of Marketing, in his recent statement: "Too often in the past, we were faced with the urgencies of litigation. Our approach was to sneak up, catch them off guard, and jump them by surprise. And we weren't surprising our competitors. Our customers were the target. No other industry on earth had that kind of relationship with its customers."

Change has been rapid during the three and one-half years since regulatory reform has been instituted. Acceptance of the greater reliance on market forces has been dominant. But after almost 100 years of smothering regulation, complete and immediate change and full acceptance cannot be expected. Change of this magnitude requires time before the old ways can be fully cast aside and new methods put in place and refined. There is much

searching and testing yet necessary to develop the innovative environment in which the benefits of the new flexibility are maximized for both railroads and shippers.

Until this happens, it is evident that the changes will not be welcomed by everyone. There have been and will continue to be some pains involved for both shippers and carriers as the partial deregulation of the railroads is carried out. Overall, however, the Staggers Act and its implementation appear to be positive steps toward a revitalization of the rail industry.

V. Canadian Perspective

There are more similarities than differences between Canada and the U.S. concerning the history of railroad regulation and deregulation. The rail industries of both countries have experienced early (1800's) and long-term comprehensive regulation. Like the U.S., Canada has a patchwork history of rail policy determinations, including such noteworthy entrants as: The 1938 Transportation Act, the Turgeon Commissions (1951, 1955), the MacPherson Commission (1961), and the resulting 1967 National Transportation Act. Each of the countries have both federal and state/provincial authorities, and in each case monopolistic regulation of rail carriers continued long after competition from other modes was strong.

There are also some fundamental differences in the rail industries of the two countries and in the environments within which they operate. These differences include the ability to engage in multi-modal operations, the prescription of statutory rates (e.g. - Crows Nest Pass and Maritime), and the extent of the use of railroads

for national policy and regional development. Perhaps one of the most fundamental divergencies is the industry consist; with Canada having only two major entities, one of which is a Crown Corporation.

Nevertheless, Canadian rail deregulation was a formidable influence on the U.S. regulatory reform enacted 13 years later. U.S. deregulation has not been as complete in some areas as in Canada, and is possibly more comprehensive in others. While a thorough assessment of the Staggers Act effects is not yet possible, considerable attention by Canadian shippers and carriers is being directed to potential changes in traditional route/rate/ratemaking arrangements regarding U.S.-Canadian traffic (international traffic accounts for approximately 18 percent of total Canadian rail tonnage). Another area of interest is the impact of the elimination of U.S. anti-trust immunity on the compliance of Canadian and U.S. railroads with the laws of the other country.

As within the U.S., any change of magnitude will bring some dislocations from the traditional patterns. The Canadian Transport Commission and Transport Canada are reportedly studying the effects of U.S. railroad regulatory reform and the Minister of Transport announced in February 1984, that further "liberalization" of the Canadian railway sector should be considered. These types of issues will be resolved as their ramifications become more clearly defined.

LESSONS FROM CANADIAN IMPACTS OF RECENT U.S. TRANSPORTATION POLICIES

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ABSTRACT

This paper describes selected impacts on Canada resulting from recent U.S. transportation policies and highlights observations as lessons of possible interest to Canadian transportation researchers and policy makers. Following a description of the importance and extent of transborder transportation, policy facets that impact Canadian interests including selected modal and intermodal impacts (both positive and negative) are discussed and policy-related inferences are noted.

INTRODUCTION

During the decade of the 1970s, transportation regulators and policy makers in the U.S.A. assessed the effectiveness of their regulatory policies and practices. As a consequence, a number of deregulatory policy reforms were implemented. Following the Airline Deregulation Act of 1978 and the International Air Transportation Competition Act of 1979, policy changes were implemented for truck and rail transportation (in 1980). The Bus Regulatory Reform Act was signed into law in the Fall of 1982. These policy reforms in essence are intended to enhance the scope of competition. A number of regulatory policy changes in respect of marine transportation have

been proposed as well. While their intent is far from deregulating the industry, these are expected to have significant effects on the maritime transportation industry. Also, in 1982, the Surface Transportation Assistance Act was signed into law.

The above named policy reforms in the U.S.A. have affected and are likely to continue to impact, directly and indirectly, Canadian carriers, shippers, and consumers. Reasons include: a high degree of integration of Canada-U.S. transportation systems for crossborder as well as long haul international traffic lanes, the deregulatory nature of most U.S. policy reforms, the extra-territorial reach of U.S. anti-trust legislation, and the generally protectionist attitude of political interests. The scope of Canadian impacts is substantial owing to a high level of trade between the two countries and the substantial volume of passenger and freight traffic moving across the border.[1]

TRANSBORDER TRANSPORTATION

Transborder transportation is of much importance to Canada for economic (i.e., trade) and other (i.e., social, cultural, and recreational) reasons. Table 1 summarizes major points. A majority of Canada's import and export trade is with the U.S.A.[2] The level of air passenger travel makes it the world's busiest binational air transportation link. Air cargo is carried mostly in passenger aircraft cargo holds, although the rising demand for all cargo and high priority small shipment services is becoming significant.

Crossborder truck transportation, estimated to be $1 billion business, plays a major role in serving Canada-U.S.A. trade. In 1979, 45% of Canadian exports to the U.S.A. were transported by truck while rail accounted for 29.7%. Transportation of imports is believed to be

Table 1

The Importance to Canada of Transborder Transportation

- Economic Interdependence
  - Trade -- U.S.A. is Canada's number one trading partner
    66% of Canada's export trade ($55 b in 1981)[a*]
    69% of Canada's import trade ($54 b in 1981)[a]
- Social, Cultural, Recreational Linkages
- Transportation -- an integral part of Canada-U.S.A. economic interdependence
  - Air -- World's busiest binational passenger system (more than 10m passenger trips/year),[b] growing air cargo and high priority small shipment service
  - Truck Transportation -- serves about 45% of Canadian exports to the U.S.A.;[c] $1 b business;[d] 10% of Canadian truckers' operating revenues;[e] 14 b tonnes transported by for-hire companies (1.9 b tonnes container component)[e]
  - Railway -- 30% of Canadian export trade; 30-33% of CN's and CP's total traffic is transborder traffic (only 5% for U.S. carriers); 25-30% of Canadian railway revenue is derived from international traffic.[f]
  - Marine and Intermodal Transportation -- considerable interaction in respect of third countries' traffic; Net Canadian surplus of container diversion.

a - Reference 2 c - Reference 4 e - Reference 6

b - Reference 3 d - Reference 5 f - Reference 8

* Over $70 b in 1983.

similar to exports although firm data are not available. Revenues of trucking firms derived from transborder service amount to about 10% of total operating revenues (17% for carriers domiciled in Ontario, 8% for Quebec, 7% for carriers domiciled in other parts of Canada).[6]

Railways carry about 30% of Canadian export trade and an estimated 30-33% of CN's and CP's total traffic is to and from the U.S.A. On the other hand, such traffic for U.S. railroads is relatively small -- about 5% of their total movement.[8] About one billion dollars, which is twenty-five to thirty percent of Canadian railway revenue, is derived from international traffic.[9]

There is considerable interaction between marine transportation industries of the two countries in respect of third countries' (international) traffic lanes. In recent years, a substantial amount of U.S. container traffic has been diverted to Canadian ports on the East Coast (nearly 64,000 TEU in the period of January-September, 1981). On the West Coast, however, Canadian container traffic is diverted to U.S. ports (about 39,000 between January and September, 1981). In total, there has been a net Canadian surplus of containers.[10] Prior to 1979, there was a net Canadian deficit of container flow across the border for international transportation.

Available information on intermodal container traffic originating from or destined to an overseas point but crossing the Canada-U.S.A. border suggests that it is transported mostly by trucks. Only 17% of this tarrific is transported by rail.[6]

RECENT U.S. TRANSPORTATION POLICY INITIATIVES

The following U.S. policy initiatives through structural changes in key policy facets have already impacted Canada (positively and

negatively) or have the potential to impact Canadian interests in the future.

- The Airline Deregulation Act of 1978
- The International Air Transportation Competition Act of 1979
- The Motor Carrier Act of 1980
- The Surface Transportation Assistance Act of 1982
- The Staggers Rail Act of 1980

Policy reforms in respect of marine and intermodal transportation could also potentially impact Canadian interests.

The two Acts that deregulated air transportation, named above, did not bring about "total deregulation". Also, economic regulation is not completely phased out in spite of the planned phasing-out of the CAB.

The Motor Carrier Act of 1980 consists of a large number of elements (i.e., provisions). Notable among these are liberalized entry and rate setting which imply substantially reduced economic regulation. Another motor-carrier related recent legislation that could potentially affect Canadian interests is the 1982 U.S. Surface Transportation Assistance Act. For U.S. carriers, this Act implies a modified highway use tax allocation.

The Staggers Rail Act of 1980, which deregulated railway carriers in the U.S.A., was intended to achieve objectives similar to those realized in Canada through the formation of CNR and the passage of the National Transportation Act. There are however considerable differences of detail and context (of policy implementation) between the Canadian experience and U.S. aspirations.

Two bills have been under consideration in order to improve the economic condition and efficiency of U.S. maritime industry. Another concern was the diversion of U.S. container traffic to Canadian ports.

These bills, namely the proposed Shipping Act of 1981 (the "Gorton Bill") and the proposed House of Representative Bill (the "Biaggi Bill"), taken together, aim to: strengthen the conference system (i.e., open membership), improve comity with other nations, recognize and properly regulate intermodalism, require filing of tariffs with the Federal Maritime Commission (FMC), disallow refunding practices, and authorize the FMC to disapprove rates of foreign state-controlled lines that are found to be predatory.

Recently, the Interstate Commerce Commission (ICC) has been implementing the policy of intermodal promotion and minimum regulation (e.g., exemption of TOFC and COFC movements by railway companies from regulation, repealing rules that had limited railroads to transport freight primarily by rail except in "special circumstances" and thus making it possible for railroads and their affiliates to seek unrestricted motor carrier authority). Further intermodal transportation developments are expected in the U.S.A. A new bill (S48) by Senator Packwood proposed to shift duties of three major transportation regulatory agencies to a new National Transportation Commission, and would permit intermodal ownership. The Reagan Administration also indicated an interest in developing its own transportation legislation with intermodal provisions. It is likely that during the 1980s the residual U.S. rail and trucking regulations will be phased out and intermodal transportation will become the prime responsibility of the new regulatory agency or agencies.

IMPACTS ON CANADA

Canadian impacts of recent U.S. transportation policy initiatives are described here and summarized in Table 2.

Deregulation of air transportation in the U.S.A. has affected

Canada's negotiations with U.S. on routes, rate control, and entry or licencing. Agreement on new bilateral arrangements was hampered due to differences in regulatory approaches of the two countries. From the Canadian carriers' viewpoint, U.S. authorities have been attempting to gain a favourable position for U.S. carriers through the open market approach. Such (open market-oriented) policies, it is feared by Canadian carriers, would cause Canadian air transportation industry to be adversely affected by the larger U.S. industry. Examples of proposals that have generated controversy include: the case of all cargo Flying Tiger Line service and relaxed transborder competition in respect of rates and routes.

Canadian consumers are affected as well (both positively and negatively) by the air transportation deregulation policy in the U.S.A. Canadians travelling to the U.S.A. and U.K. have benefited so far from reduced fares caused (directly or indirectly) by policy reforms. Canadian users of air cargo services are also beneficiaries to low rates in the U.S.A. Other impacts of U.S. airline deregulation policy on Canadian consumers relate to increasing uncertainty (owing to continuous shifting of route structure and fares), and air transportation network connectivity losses caused by structural changes in the system. These include loss of productive time in travel planning as well as in making flight connections during the course of the journey. As for prospects of low fares in the future, according to one theory, deregulation increases the long term market power of large consolidated carriers.

Truck transportation issues relate to the Motor Carrier Act of 1980 and the Surface Transportation Assistance Act of 1982. These issues could be categorized as registration for permits to carry freight, taxation, vehicle weights and sizes, and shipping standards.

Table 2

Canadian Impacts of U.S. Regulatory Reforms

Air Transportation

- Effects on bilateral negotiations (in respect of routes, market entry, rate control).
- Diversion of some Canada-U.K./Europe traffic to U.S. carriers.
- Consumer benefits (low air fares, low cargo rates).
- Increasing uncertainty faced by consumers (owing to lack of stability in fares and route structure).
- Network connectivity losses caused by structural changes in the U.S. system -- resulting in loss of time.
- Fears of long term market power of large consolidated carriers.

Truck Transportation

- The registration issue; possibility of future (renewed) retaliation by the U.S. authorities.
- Increasing presence of U.S. truckers in Southern Ontario (e.g., through business takeovers).
- Increase in competitive pressures and mergers.
- Efficiency gains resulting from elimination of restrictions in existing permits (in respect of origins, destinations, ports of entry).
- Direct benefits to consumers -- reduced rates, improved cross border service.
- Adverse financial effects on U.S. trucking subsidiaries of Canadian trucking companies.
- As a result of the Surface Transportation Assistance Act, re-evaluation of all reciprocity agreements.

Table 2 (Continued)

Canadian Impacts of U.S. Regulatory Reforms

Rail Transportation

- Less leverage in negotiating international rates.
- The emergence of "superrailroads" in the U.S. would impact the viability of U.S. subsidiaries of CN and CP.
- Canadian railway affected owing to: route cancellation, the liability issue, extra-territorial reach of U.S. antitrust laws, rate filing issue, box car deregulation, use of preferred gateways and surcharges on traffic.
- Low rates in the U.S.A. for TOFC and COFC caused Southern Ontario shippers to use rail terminals in the U.S.A.
- Effects of periodic nature of rates for agricultural commodities.
- Impacts of new opportunities in railroad pricing in the U.S.A. -- reduced transportation costs of imports from the U.S.A., increased movements of coal and container traffic through St. Lawrence.

Maritime and Intermodal Transportation

- Cargo diversion experience.
- Causes of diversion.
- Opportunities offered by intermodal transportation developments.
- Impacts of U.S. actions.

The issue of registration, which grew out of registration policy differences in the two countries, has been well publicized and will not be discussed here. However, the potential effects of current understanding in this area are of much interest.

Following a number of notable events including a temporary ban on applications of Canadian trucking firms, on November 30, 1982, Canada (provincial and federal governments) and the U.S.A. agreed to a policy of accommodation of each other's interests. It was also agreed that future truck transportation issues will be resolved through a newly created bilateral consulting agency consisting of Canadian and U.S. government representatives.

As a part of the recent agreement on cross border trucking, Canada gave an implicit pledge to allow reasonable opportunities for U.S. investors when screening foreign ownership applications. Another observation of the trucking dispute is that the ICC leaves open the possibility of future action against Canadian trucking firms wishing to register in the United States since it does not completely agree with Canadian licencing practices.

Specific impacts or potential impacts on Canada resulting from U.S. truck transportation deregulation policies include the following:

1. Any hardline attempts by FIRA on U.S. bids to business takeovers or excessive restrictions from provincial transport boards (on granting permits to carriers for service in Canada) could result in renewed retaliation by the U.S. regulators.
2. Canadian jurisdictions are expected to extend the benefits of existing and/or reformed regulations to U.S. truckers. Such moves would intensify competitive pressures which in turn could lead to mergers in order to benefit from economies of scale and compete with U.S. carriers. Under existing or reformed policies

in respect of trucking, U.S. trucking interests are likely to increase their presence in the Southern Ontario -- a highly desirable market in Canada.

3. Deregulation policy in the U.S. removed restrictions in existing permits which specified Canadian destinations or origins to be served or which designated ports of entry. Removal of these restrictions resulted in efficiency gains.
4. Direct benefits have accrued to Canadian consumers in the form of reduced rates and improved service (e.g., reduced delays at the border due to through service by carriers licenced in both countries).
5. In some instances, the financial viability of U.S. trucking subsidiaries of Canadian trucking companies has been adversely affected due to competitive pressure by deregulation of the industry.

As for the Surface Transportation Assistance Act of 1982, it is likely to result in the re-evaluation of all reciprocity agreements of the states with the provinces. The basic motives include the prospects of generating more revenue through the new increased highway use tax and also to satisfy the U.S. federal government that all eligible road users are paying their allocation. According to well informed sources, for the first time, substantial supervision by states of the payment of highway use tax by Canadian motor carriers is expected.

The consequences of the Staggers Act, as these relate to Canadian interests, are listed below.

1. Canadian railways and shippers have less leverage (and will continue to do so) in negotiating international rates since it is likely that they will be dealing with a single U.S. carrier (evolving

as a result of merger activity).

2. The emergence of "super railroads" will impact the viability of U.S. subsidiaries of CN and CP Rail.

3. Other provisions of the Staggers Act that have the potential to impact Canadian interests include:

   (a) Authorization for U.S. railroads to cancell segments of routes used for transborder transportation (while Canadian railways do not have similar authority),

   (b) Exemption for U.S. railroads from the liability questions arising from shippers of transborder traffic (while Canadian railways are not exempt in this respect),

   (c) Authorization for U.S. railroads to concentrate traffic through preferred gateways and to surcharge traffic on highly travelled routes,

   (d) Deregulation of TOFC (piggyback) traffic which has lowered rates in the U.S.A., and caused greater use of shippers in Southern Ontario of trucking to rail terminals in the U.S.A., and

   (e) Periodic nature of rates for agricultural commodities have caused low export grain rates quoted by U.S. railroads, which could in turn undercut marine shipments via the St. Lawrence Seaway and Canadian elevators.

4. Extra-territorial reach of U.S. Antitrust laws, in spite of ICC's granting to CN and CP the status of "one integrated enterprise", has reduced the ability to conduct joint rate-setting for international traffic. This special provision does not apply in cases where the U.S. railroad is a subsidiary of a Canadian carrier.

5. Elimination of rate filing requirements for the U.S. carriers and

the legality of rate contracts has created much difficulty for Canadian carriers. According to Canadian regulations, Canadian carriers can collect only those tariffs which have been filed with the CTC. Canadian railways cannot legally bill a customer for an international movement which has been surcharged south of the border by the U.S. line.

6. The deregulation of box car traffic adversely affects Canadian rail carriers. A substantial portion of CN's and CP's internal traffic, especially the traffic that interlines with Conrail is affected. In 1981, 30% of the box cars transported by CNR and CPRail to the U.S.A. (which totalled 30,000) were interlined with Conrail.[8]

7. Available information suggests that some segments of Canadian economy are benefiting from railroad deregulation (i.e., new opportunities in railroad pricing) -- e.g., reduced transportation costs on some inputs from U.S. suppliers, and increased movements of U.S.-originating container and coal traffic through the St. Lawrence.

The interaction of Canadian and U.S. maritime transportation industries has been attracting much attention from technical and political interests. The diversion of U.S. cargo through Canadian East Coast ports has been the cause of much concern in the U.S.A. Factors that have played a role in cargo diversion include: door-to-door service and tariffs (offered through Canadian ports) which are found attractive to large volume users, inefficiencies of the U.S. ports, rising tolls at U.S. Great Lakes' ports (indirectly causing cargo diversion to Montreal), and movement of containers facilitated by the dramatic growth of U.S. motor carrier services.

The proposed U.S. (shipping) legislation, if passed would enable

the exercise of extraterritorial jurisdiction by the United States by affecting U.S. container traffic using Canadian ports. Canadian interests would also be adversely affected should punitive action be taken by the U.S.A. on the West Coast in response to the competitive efforts of the port of Vancouver (i.e., improved service and price reduction) aimed at stopping the diversion of Canadian container traffic to West Coast ports in the U.S.A.

Finally, developments in intermodal transportation policies in the U.S.A. have the potential to impact Canada. Intermodalism has opened up new transportation options and routes for shippers of international traffic. In the context of long distance trans-oceanic transportation, intermodal services give inland shippers (in Canada and the U.S.A.) a large number of alternative ports for their shipments. As previously noted, Canadian ports on the East Coast have provided an efficient alternative for many U.S. shippers. On the West Coast, owing to inefficiencies associated with the Port of Vancouver, the reverse has been the case. Intermodalism has also offered opportunities of developing coordinated as well as competitive services that incorporate surface (land) and marine transportation (e.g., minibridges, land bridges). Intermodal transportation policy developments in the U.S.A. are expected to render Canadian alternatives less attractive to U.S. shippers.

LESSONS OF POSSIBLE INTEREST TO CANADA

Air Transportation

Although merits of regulatory reforms are recognized by many policy experts, U.S. style of deregulation is generally regarded as inappropriate for Canada. This research provides additional reasons for avoiding completely open market policy for air transportation.

While there is merit in showing flexibility in bilateral negotiations, Canadian policy stance in the form of reforms rather than deregulation should be stressed.

In the context of transborder transportation, reasons against U.S. style deregulation include: physical location relative to the U.S.A., smaller air transportation industry relative to that in the U.S.A., Canada's geography and the nature of the domestic air transportation market, uncertainties evolving from continuous shifting of route structure and fares, and concerns for long term market power of large consolidated carriers which may result from deregulation policy.

Truck Transportation

Policy inferences in respect of truck transportation are listed below.

1. Canada should improve comity with the U.S.A. in trucking affairs in order to avoid future problems.
2. While interests of Canadian trucking industry are not identical to those of its American counterpart, mutual gains are achievable through bilateral agreements on permits to service traffic provided that Canada-U.S.A. trade is not adversely affected. A related observation is that American style deregulation in terms of ease of entry (for Canadian and U.S. carriers) is inappropriate for Canada since:
   (a) the U.S. trucking firms enjoy a major economic advantage owing to their geographic proximity to the Canadian markets
   (b) the U.S. trucking system consists of large trucking companies, and it is also considerably more developed (in technical terms such as computer-communication applications) and extensive than the Canadian system due to geographic and demographic reasons, and

(c) the U.S. system is efficient and enjoys economies of scale owing to its network structure and large fleets serving large number of customers.

3. The competitive position of the Canadian trucking industry should be enhanced through all possible policy-induced means and incentives so that it can compete in the new transportation and economic era of the 1980s.

Railway Transportation

In this case, opportunities for Canadian action are rather limited. Canadian interests could seek to modify certain provisions of the Staggers Act or their interpretation, although past attempts have been successful only to a limited extent. In most impact areas as noted earlier in this paper, Canadian interests have to adjust to the U.S. policy changes. Such adjustments in the event of real hardships would involve changes to Canadian railway-related policies and/or procedures in respect of international traffic (e.g., compatibility in rate filing requirements for trans-border movements, exemption from the liability question, route cancellation authority).

Maritime Transportation

U.S. transportation interests have considerable misconception about Canadian transportation system and institutions. In order to avert future misunderstanding and actions based on poor information, it is necessary that U.S. transportation regulators, legislators and marine transportation interests are sensitized to the Canadian perspective of the issues and facts are provided.

On the physical facility side, every attempt should be made to expedite technical and capacity improvements in the Canadian marine

transportation system (e.g., the port of Vancouver) since an efficient and competitive system is required for serving Canada's trade needs in the 1980s and years beyond.

Intermodal Transportation

Regulatory reforms in the U.S.A. are expected to enhance the competitive position of intermodal transportation. Rates are expected to decline and service is likely to improve. The current Canadian advantage (i.e., efficient and innovatively priced intermodal system and port facilities in Eastern Canada) that facilitated the diversion of U.S. cargo to the East Coast ports is likely to gradually diminish. The proposed sea-land service through Halifax is expected to face tough competition from U.S. systems. On the West Coast, substantial port and intermodal system modernization type of improvements are required in order to become competitive with U.S. systems.

Information presented in this paper suggests that unless Canadian intermodal and modal services match the efficiency improvements that are expected in the U.S.A., Canadian container traffic is likely to be attracted to the U.S.A. for long haul international transportation.

ACKNOWLEDGEMENTS

This paper is based on research sponsored by Transport Canada's University Programs. The author served as the head of a research group which included A. M. Maslove, J. McPherson and A. I. Wallace. Also information was contributed by the Research Branch of the Canadian Transport Commission. The author sincerely acknowledges assistance received from all contributors. The views expressed herein and conclusions reached are those of the author.

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Management Strategies under Deregulation: The Case of the British Columbia Forest Industry

by Trevor D. Heaver and Sylvie Lefebvre

The deregulation of the railway industry in the U.S. in 1980 has had profound effects in that country and in Canada. Assessment of the effects are important to Canadians. Understanding the reasons for changes since deregulation is a first step to forecasting future developments in the absence of further regulatory changes. The experience gained with the working of transport markets in the U.S. is relevant to the development of Canadian policies. For example, the experience in the U.S. may provide some insights into the working of railway markets in which collective pricing practices are severely constrained.

Much information is required on market conditions and practices before forecasts of future conditions and recommendations for policy development can be made. The research for this paper has been undertaken to contribute information on railway pricing on lumber from the Pacific Northwest into various U.S. markets[1].

The paper reviews briefly some of the production and marketing characteristics of the B.C. lumber industry and the transportation arrangements of the industry prior to the 1980 Staggers Act. The effects of the Staggers Act on the structure of the railway industry and on the permissible conduct of shippers and carriers are reviewed. The development of railway rates and services subsequent to the Staggers Act are described in the context of the competitive conditions faced by shippers and carriers. Explanations are offered to account for the observed patterns of change in rates. Some

implications of the American experience for Canadian transportation policies are suggested.

British Columbia Lumber Production and Transportation.

In 1982, B.C. produced 9,945 million board feet of lumber which represented 63% of the total Canadian production[2]. The provincial lumber production was distributed 30% in the Coast region and 32, 23, and 15% in the northern, southern and central Interior regions respectively[3]. The industry has a number of large companies. In 1975, the two largest firms -- MacMillan Bloedel and B.C. Forest Products -- together controlled 13.6% of provincial lumber manufacturing capacity and these, together with five other companies controlled 36.4% of the total[4]. Sawmilling capacity is concentrated in fewer firms in the Coast region than in the Interior region. In the Coast region, 6 out of 71 firms controlled 50% of the capacity. In the Interior, 18 out of 179 firms controlled 50% of the capacity. These data show that the structure of the railway market is characterized by a large number of firms dealing with the railways. The influence of the large firms in the railway market is even less than that implied by the statistics because of the substantial use of water transport for U.S. and overseas markets by the large coastal producers.

The largest market for B.C. lumber is the U.S. In 1982, 50% of all B.C. shipments went to the U.S., 28% remained in Canada and the remainder was shipped offshore[5]. (The importance of the U.S. market is underestimated slightly by the shipment of some lumber to Eastern Canada where it is handled through "reload centres" for distribution south of the border.) In 1981, exports from B.C. to the U.S. accounted for about 17% of that country's consumption.

Other major supply regions were the U.S. Pacific Northwest, 41%; the Southern U.S. pine region, 20%; and eastern Canada, 11%[6]. The penetration achieved by B.C. lumber in the U.S. market varies by region. Table 1 shows that, in 1981, the sales of B.C. lumber in the U.S. were more evenly distributed between the regions than the sales from any other origin. The least quantity was sold in the U.S. Northeast, 12.1%; the greatest amount was sold in the U.S. Southeast, 24.2%. However, B.C. lumber enjoys widely varied shares of the regional markets; in 1981 it had 41% of the market in the Southeast, 10.9% of the market in the U.S. West.

The modes of transportation used, in 1980, for shipments from the major supply regions to the U.S. submarkets are shown in Table 2. Shipments from the Southern pine region to all parts of the U.S. are by primarily truck. Certain other routes are also dominated by trucking: it dominates from Eastern Canada to all regions except the Southwest; trucking also dominates both from B.C. and the Pacific Northwest to the Western United States. Water transport is significant from B.C. into the West, Northeast and, to a lesser extent, the Southeast regions of the U.S.

The data on market shares by producer region and modal split are indicative of the market and intermodal competitive forces which the railways face. The influence of these forces must be kept in mind when the pricing actions of the railways are examined. The Staggers Act affected the opportunities of the railways to respond to existing competition. It did not just stimulate intramodal competition.

The Staggers Act and Rates on Lumber in 1980

The main purpose of the Staggers Act was to ease the regulatory burden on the U.S. railroad industry so that carriers would be more likely to achieve revenue adequacy. However, while the Act provided greater freedom to the railways it also placed some important new constraints on them.

Individual railways are given greater freedom to set rates and to apply a surcharge to any joint rate that does not yield a 110% of variable cost or they may cancel the application of the joint rate. Contract rates are now allowed. Although all contracts must be filed with the ICC, only a summary, which does not include rate information, is made public.

However, as a result of the Staggers Act, railways are no longer immune from antitrust litigations in the U.S. Collective ratemaking through rate bureaus is severely restricted. Rate bureaus may not discuss single-line rates nor is there to be any discussion or voting on interline rates unless the rail carriers participate in the movement. Discussion on joint-line rates is limited to carriers forming part of the route. General rate increases continued to be set on a collective basis until January, 1984.

The structure of the U.S. railway industry has been affected significantly by the reduction in substantive standards for approval of end-to-end mergers. The result has been an acceleration of mergers which have greatly extended the areas to which individual lines can provide single-line movements. The Burlington Northern (BN) system, was extended significantly by mergers. However, for the BN the major merger occurred in 1970, well before the Staggers Act.

The BN can provide single-line access from the Pacific Northwest many locations throughout the central U.S. from the Canadian border to Galveston, Texas and Mobile, Alabama.

Prior to 1980, lumber shipments by rail from B.C. and the U.S. Pacific Northwest to U.S. markets moved at rates published by the Trans-Continental Freight Bureau (TCFB). The TCFB rates were and are based on four origin groups or blanket zones covering large geographical areas. The coast zone stretches from Medford, Oregon to Prince Rupert. The interior zone extends through the center of the Province; the inland zone covers the southeast of the Province. The level of rates decreases from the coast to the interior and to the inland zone. The rates applicable from B.C. Railway (BCR) origins are higher by so-called arbitrary rates above those existing in Vancouver and Prince George. The TCFB rates are quoted to six U.S. destination groups. The origin and destination groupings were originally established to permit producers to compete in large areas and to give customers in those markets a wide choice among suppliers. The zones provided a stable framework within which to deal with the difficult problem of equality of access to markets for competing suppliers when rates are value-of-service, not cost, determined.

The location of origin and destination regions is related to important rate-making factors. The less the distance between origins and destinations, the less the railway costs and the greater the trucking competition. Table 3 shows that, for Southwestern and Southern markets, mills in the northern Interior region of B.C. have a locational disadvantage compared with mills in southern B.C. and

the Pacific Northwest. However, the northern mills have no disadvantage in respect of the Northeast market area. For example, while Prince George is 621 miles further from Dallas than is Portland, it is 34 miles closer to Chicago.

The structure of the railway network is important to the commercial significance of distance. Shippers originating traffic on a line able to offer a single-line rate, for example, the BN to Dallas, are at an advantage compared with shippers requiring a joint rate, for example, those using CN to Dallas.

The TCFB rates had been uniform within the zones for many years; the disadvantage of Northern B.C. was not reflected in rates to the Southwest until April, 1980. The rates from the Coast were at one time lower than those from the Interior because of water competition. Even though the rates from the Coast zone were increased as water competition became less significant, especially from U.S. origins, the rates continued to be uniform until 1980.

During 1980, two events occurred. First, the Canadian lines insisted on the importance of increasing the rates on lumber traffic to protect the profitability of the traffic to them, especially into the Southwest which they served through relatively long interline routes. Second, U.S. lines sought ways to combat the effects of trucking competition and to encourage better utilization of their equipment, problems not present in Canada to the same extent. The result was the application of increases in TCFB rates to the Southwest for Canadian origins only and the application of an open incentive rate structure on rates from U.S. origins only. The Canadian railways subsequently joined in the incentive rates to locations other than the Southwest and South.

Table 4 shows the rates which applied to Dallas and Chicago from various origins in December 31, 1980. The rates to Dallas are higher within the zones from B.C. than from the U.S. The rates to Chicago are the same in each zone for B.C. and U.S. origins. The rates are all in U.S. dollars; charges from Canadian origins are calculated on 60% of the exchange premium, selected twice monthly.

Events since 1980

The TCFB rates have continued to exist beyond the Staggers Act and have been subject to general rate increases. However, whereas all lumber moved under those rates prior to 1980, now only a portion of lumber moves under them. A significant development has been the publication of tariffs by individual carriers at lower rates than those existing in the TCFB.

In 1980, BN prepared to respond to growing trucking competition. The competition had become more significant with the deregulation of the trucking industry and the downturn in the economy. Response to it became easier with the passage of the Staggers Act.

About September 1980, BN commenced studies of the trucking rate structure and the railway's cost levels into truck competitive markets. Over a ten month period, the railway developed a competitive rate structure and marketing strategy. It published tariff BN 4494 in August 1981; this tariff, with revisions, is still in effect today.

Tariff BN 4494 included incentive rates on loadings of 110,000 pounds and 120,000 pounds and established much lower rates than the TCFB level on lumber moving under single-line rates on the BN system. The rate reductions apply to the truck competitive North Central and Southwest regions served directly by BN. The latter

region is, also, a strong growth region for lumber demand. The tariff does not apply on lumber moving to the South Atlantic or Northeast regions which the BN does not service directly and for which trucking competition is of less significance. To those regions the TCFB rates still apply. The tariff reductions apply to all points served by BN in the Pacific Northwest and B.C.

The BN also signed contracts offering lower rates than those published in BN 4494. A number of these confidential contracts have been signed with U.S. lumber brokers and producers. Some of the lumber brokers are handling B.C. lumber.

The rate action by BN introduced a new significant element of intramodal competition for the CN, CP and BCR, in spite of the small share of the market formerly held by BN. Table 5 shows the market share in carloads enjoyed by the five carriers in 1980. The BN's new rate structure prompted competitive actions by the other carriers.

The carrier most affected was CP because of its southern location. Lumber mills not located on the BN had the option of trucking relatively short distances to that carrier.

Both the CN and CP prepared competitive tariffs which initially focussed on the Texas and Oklahoma markets. The CN introduced a new joint tariff in October, 1981 in conjunction with the Missouri-Kansas-Texas Railroad Company (MKT) and the BCR. Subsequently, other U.S. carriers joined the tariff and a wider range of destination points was included. CP Rail issued a new competitive tariff in November, 1981 in conjunction with BN because of their numerous connections. Other destinations and carriers were added to the CP tariff subsequently.

The CN and CP tariffs were based on the carriers' individual assessments of the level of rate needed to achieve a desired competitive status in particular markets. The rates were based generally on the BN rate plus the estimated trucking costs. Because of CP's more southerly location, it was forced to estimate and follow those costs carefully.

The rates in effect August/September 1983 are shown in Table 6. The rates are quoted in American dollars but not all of the rates are subject to the international currency adjustment factor for Canadian traffic. The low level of the BN rates shown for Vancouver and Sumas compensates for Canadian shippers paying the full exchange charge on these rates, not 60% of the exchange as is usual on transborder traffic.

The introduction of the reduced BN rates has been most significant on routes for which the TCFB scale in B.C. had been raised above the U.S. scale in 1980. This is illustrated by the rates to Dallas, shown in Table 6. The effect on rates to the Northeast has been less pronounced, as illustrated by the rates to Chicago. The TCFB rates still apply to the U.S. Southeast, which BN does not serve directly.

The CN and CP tariffs were produced without significant negotiation with individual shippers. Subsequent to publication of the tariffs, "negotiations" have taken place between individual carriers and shippers to adjust the rates where they seemed not to meet the competition. The "negotiation" process has taken on more of the aspects of "bidding" than "negotiation", a development viewed favourably by shippers. Where both the CN and CP have been present, for example, in the Okanagan, "negotiations" have occurred as

shippers have attempted to play off one carrier against the other. (The relatively high rate filed by CN out of Vancouver to Dallas, is because the CN has very little traffic available to it in Vancouver for which it has a prior-existing service disadvantage.)

The effects on the rate structure within the Province differ by destination. The pattern in rates to Dallas has changed from the north-south zones present in 1980, to location-specific rates. The rates are least in B.C. communities served directly by BN, for example, Nelson; they are slightly higher in southern towns from which trucking to the BN would be necessary, for example Cranbrook; they get progressively higher from more northerly locations. However, the differential in rates between Prince George and Terrace has stayed at ten cents. Maintenance of the old differential has been promoted by the northwest mills seeking off-shore markets in view of their growing disadvantage in the U.S. market compared with southern and central B.C. producers.

Less significant changes have occurred in the freight rate structure to Chicago, a market to which the Canadian and U.S. zone rates were the same in 1980. Nevertheless, CP has had to respond to significantly reduced rates from inland points. It has done this by the use of agreed charge rates to a reload centre in Windsor and joint rates with the Sooline to a reload centre in Minneapolis.

A further significant development is the use of contracts involving volume allowances. The amount paid per car varies widely but it may be $200. As these confidential discounts are illegal under the Railway Act, they only affect the routing of Canadian traffic through arrangements made with U.S. carriers. Contracts have been signed by U.S. buyers and wholesalers who then seek to

control the routing of freight. They may or may not share the freight allowance with shippers. Canadian producers and wholesalers have, also, been active in the negotiation of contracts with intermediate carriers in the U.S. The contracts usually involve volume-related allowances which may be based on the use of one carrier for a part of a route or a series of carriers in a route. The volume allowances may be related to the use of a distribution centre.

The Canadian equivalent of the volume allowance contract is in volume related competitive commodity rates. For example, CPW 4045 offers a reduced rate to a Minneapolis reload centre for shippers moving at least 400 cars a year of which not less than 150 cars originate on CP. The cars so shipped may be from a number of mills and may be for shipper produced or purchased lumber. Although volume-related rates and special tariffs to reload centres are published, the Canadian carriers have been quiet about their existence.

The use of reload centres was increasing prior to the Staggers Act. However, that Act provided a great stimulus to their use as carriers tried to exert more control over the routing of traffic. By the expansion of Eastern Canadian reload centres, CN and CP have been successful in circumventing the routing closures of Conrail which deprived the Canadian carriers of long hauls.

Results and Assessment of the Railway Competition

The pricing actions of the railways since the Staggers Act have been associated with evolving strategies for the carriers and shippers. Those strategies are reviewed here. Finally, the implications of the U.S. experience for Canadian policy are considered.

Effects and nature of railway strategies. The most obvious result of the rate competition introduced by BN is a significant reduction in the freight bill on B.C. lumber. How rates would have varied in the absence of deregulation is purely speculative. What is significant for the shippers is that the freight bill is less than it would have been otherwise.

The main reductions in published rates on lumber were introduced by BN to U.S. markets for which trucking competition was important and to which BN has a single-line haul. Consequently, tariffs lower than the TCFB rates have been published selectively; they are most important to the U.S. Southwest; the TCFB rates still apply to the Southeast. The change in rates has affected old rate relationships. However, the major deviation from the TCFB scale is in rates to the Southwest for which the TCFB rates no longer conformed with railway cost and competitive conditions. The old "rate parity" was no longer viable.

The introduction of truck-competitive rates by the BN would have been legal prior to the Staggers Act, but under the previous environment the railway was reluctant and slow to take independent action. A number of factors contributed to this. First, the company had limited capability for highly selective and responsive pricing. The marketing organization was not well developed. Second, the combination of collective processes involving parallel railways and the negotiation of joint rates involving interline arrangements made it difficult for an individual carrier to persuade others of the need to respond to localized competitive conditions. Consequently, carriers flagged out of rate increases infrequently. When such action was taken, it might be associated with strong

controversy among carriers whose division would be affected, and opposition from shipper groups whose relative market position deteriorated. These conditions may account for a delayed response by BN to growing truck competition in the U.S. However, that competition became more compelling with the deregulation of the trucking industry and the downturn in the economy. Response to it became possible on passage of the Staggers Act.

The Act made contracts legal and encouraged the railways to focus on their individual market shares and marketing strategies. The pricing policies of the railways are still in formative stages as the railways attempt to define their major market shares and territories. Pricing competition among the carriers can be expected to be more aggressive during this phase than it will be later.

Three elements are important in the intramodal competition. First, there are confidential contracts which may offer reduced rate or volumerelated discounts. These arrangements are illegal under the Railway Act but are entered into by U.S. receivers and Canadian shippers with U.S. railways. The confidential contracts leave carriers and shippers uncertain about the freight charges of competitors. In this competition, the CN and CP are at a disadvantage because of the requirement that their tariffs be published. However, CP has been active in the development of volume-related rates which, while published, are "hard to find". The BCR is not subject to the Railway Act but it continues to follow Canadian pricing practices.

Second, the carriers are imposing routing restrictions on traffic. The restrictions may be linked with the application of a published tariff, the use of a reload centre or a contract arrangement. When routings involve joint rates, carriers may renegotiate

rate divisions. The CN and CP have been active in the development of reload centres and appear to have been involved in the renegotiation of divisions. Presumably such arrangements provide them with an opportunity to offset their disadvantage in being excluded from confidential contracts.

Third, carriers have encouraged volume shipments to reload centres. The routings used may protect the carriers' long haul but they may also enable improved car utilization.

The results of the railway strategies on market shares and profitability are uncertain. The BN argues that it has been successful in gaining traffic from trucking in the U.S. but that overall its market share of B.C. traffic has declined. It has gained traffic in southeastern B.C. both from direct rail shipment and trucking to its U.S. facilities. However, it has lost traffic off the BCR as that railway now routes more traffic over the CN at Prince George, even though a BN tariff applies on the BCR.

Canadian carriers have suffered a revenue loss on lumber traffic. First, the rail share of the total lumber market has declined. Table 7 shows the market split of shipments to the U.S. by origin region from 1980 to 1983. The increased share of the market served by trucking is most notable. Unfortunately, it is not known how much of this is to the BN and how much is direct to truck-competitive markets. Second, the level of rates is less than previously applied to the U.S. Southwest and is "held down" by competition to other locations. The rate reductions in southern B.C. have reduced but not stopped trucking to the BN. Third, the CN, CP and BN argue that as originating carriers they suffer from routing restrictions that reduce their long hauls to some markets.

Shipper strategies. Prior to the Staggers Act, Canadian shippers engaged in limited negotiation of U.S. rates which were subject to general rate increases. Negotiation of the general scale of rates is still limited, but negotiation of special terms and conditions is common. Those negotiations are most often with U.S. carriers and generally involve the larger Canadian shippers. The negotiations focus on the routing of traffic which has now become a management tool rather than a "clerical function".

The management of traffic routing to reduce transportation costs introduces new elements into the marketing of lumber. Previously, with access by shippers to the railway network at individual carload rates which did not vary by route, shippers would sell lumber on the basis of the net mill return in different markets on a short-run (daily) basis. Volume related freight contracts raise new short- and long-run questions for marketing management. First, short-run shifts in sales may conflict with transportation efficiency if they affect volume-related discounts. Therefore, a new liason is required between sales and transportation. Second, flexibility between markets may be less than in the past because serving markets is associated with special transportation contracts. To shift between markets successfully may require new contracts to be established. Third, because volume related discounts are available, a greater advantage accrues to large marketing organizations than was formerly the case. This may encourage producers to become more active as lumber wholesalers in order to control traffic volume.

Implications for Canadian policy. Canadians are interested in the lessons that can be learned from the U.S. experience about intramodal competition. Drawing such influences is difficult be-

cause of contrasts between the Canadian and U.S. conditions and because of the changing conditions found in the U.S.

The changes introduced by the BN in lumber transportation reflect release from a long period of rigid regulation. Corporate reorganization was undertaken to enable response to previously existing intermodal competition. Competitive pricing by BN has focussed on single-line traffic as carriers have tried to establish their market share in the new environment. An important part of the competitive strategy is to gain the traffic of large shippers.

The change which could be expected in Canada if collective pricing were ended would likely be less than that seen in the U.S. The pricing freedom given to the railways in 1967 resulted in the railways adapting to intermodal competitive conditions. The need to establish market shares would not be driven in Canada by the restructuring of railway ownership as it has been in the U.S. However, features of the competition evident in the U.S. could be expected to develop in Canada. In maintaining or attracting market share, competitive strategy of the railways would likely focus on shippers controlling large volumes of traffic. To date the negotiation of rates has focussed on intermodal and market competition and on limited amounts of intramodal competition, generally service competition. In this environment, shipper size per se has had limited effects on rail rates. The U.S. experience indicates that shipper size would become more important. Tying down the traffic of large shippers can become an important consideration in rate negotiations when intramodal competition is active. The desirability of more intramodal competition and the immediate benefits to large shippers must be judged in light of several factors. They include,

the desirability of more competition to induce efficiency, the revenue adequacy of carriers and the long-run effects of greater benefits accruing to large than small firms.

Notes:

1. Field work was undertaken by Sylvie Lefebvre as a part of her MBA graduating paper. The research was made possible by a Transport Canada Universities Programme Fellowship.

2. British Columbia Forest Industry, Statistical Tables, Council of Forest Industries of B.C. (COFI), Vancouver, April 1983.

3. Statistics Canada, Catalogue 35-003, Volume 36 No. 1 to 12, January to December 1982.

4. Timber Rights and Forest Policy in British Columbia, Report of the Royal Commission on Forest Resources, Peter H. Pearse, Commissioner, Victoria, 1976, p. 11.

5. COFI, op. cit.

6. Statement of Mr. John M. Trask, filed on behalf of Canadian Softwood Lumber Committee, Before the U.S. International Trade Commission, In Connection With Study of Softwood Lumber Imports From Canada, Under Investigation No. 332-134, March 1982.

Table 1
U.S. Lumber Consumption by Region and by Origin, 1981
(Million Board Feet)

Market	Origin						
	B.C.	Prairies	Eastern Canada	U.S. PNW	Southern Pine	Other U.S.	Total
Northeast							
MFB	636	14	1443	527	301	537	3458
%	12.1	2	45	4.3	5.1	19.3	11.5
Southeast							
MFB	1275	103	328	431	929	43	3109
%	24.2	18	10.3	3.5	15.7	1.6	10.4
North Central							
MFB	1270	340	1290	1551	961	1001	6413
%	24.1	60	40.3	12.7	16.2	36	21.4
U.S. South							
MFB	917	88	102	1278	3728	167	6280
%	17.4	16	3.2	10.4	63	6	20.9
U.S. West							
MFB	1168	21	40	8493	-	1032	10754
%	22.2	4	1.2	69.1	-	37.1	35.8
Total							
MFB	5266	566	3203	12280	5919	2780	30014
%	100	100	100	100	100	100	100
Origin as a % of total U.S. consumption	17.5	1.9	10.7	40.9	19.7	9.3	100

Source: Statement of Mr. John M. Trask, Filed on Behalf of Canadian Softwood Lumber Committee, Before The U.S. International Trade Commission, in Connection With Study of Softwood Lumber Imports From Canada, Under Investigation No. 332-134, March 1982.

Table 2
Modal Split for Shipments to Various U.S. Regions, 1980
(Million Board Feet)

		B.C.	Eastern Canada	PNW	Southern Pine
Northeast	Road	12	1708	113	870
	Rail	1190	222	1098	362
	Water	446	--	--	--
	Total	1649	1930	1211	1232
Southeast	Road	3	76	23	1529
	Rail	1201	47	439	340
	Water	109	--	3	--
	Total	1313	124	464	1869
North Central	Road	33	283	587	564
	Rail	1395	87	901	280
	Water	—	--	--	--
	Total	1428	370	1488	844
Southwest	Road	14	19	198	2131
	Rail	674	720	899	324
	Water	15	15	--	--
	Total	704	754	1098	2456
West	Road	516	14	5818	—
	Rail	487	7	2875	—
	Water	229	—	396	—
	Total	1233	21	9089	—
Total (a)	Road	578	2100	6739	5094
	Rail	4947	1083	6212	1306
	Water	799	15	399	—
	Total	6327	3199	13350	6401

(a) May not add due to rounding.

Source: Consolidation of Material Presented to the International Trade Commission Regarding Enquiry Into Importation of Canadian Softwood Lumber, by Canadian Softwood Committee, February 1982.

Table 3
Railway Mileages Between Selected Cities(a)

	Dallas	Chicago
Vancouver	2364	2148
Cranbrook	2048	1649
Prince George(b)	2768	2105
Portland	2147	2139
Spokane	1988	1797
Comparative Distances		
Vancouver minus Pr. George	+ 404	+ 43
Vancouver minus Portland	+ 217	+ 9
Pr. George minus Portland	+ 621	- 34
Pr. George minus Cranbrook	+ 720	+ 456

Notes:

(a) Mileages are "commonly used", not necessarily short-line mileages.
(b) Terrace is 373 miles further from U.S. markets by rail than Prince George.

Source: Submission of the Council of Forest Industries of British Columbia to the International Trade Commission, 1982.

Table 4
Transcontinental Freight Bureau Rates,
December 31, 1980
(based on 110,000 lbs. shipments)

Origin	Dallas (a)	Chicago (b)
Vancouver	481	400
Terrace	481	400
Nelson	468	386
Cranbrook	468	386
Kamloops	471	397
Prince George	471	397
Portland	415	400
Sumas	415	400
Spokane	400	386
Wenatchee	405	397

Notes: (a) TCFB 4518.
(b) TCFB 4520.

Table 5
Share of B.C. Lumber Carloads by Carrier, 1980

Carrier	Carloads (1980)	Percentage
Canadian National (CN)	35,016	37.74
Canadian Pacific (CP)	19,528	21.05
British Columbia Railway (BCR)	30,721	33.11
British Columbia Hydro (BCHR)	4,643	5.00
Burlington Northern (BN)	2,877	3.10
	92,785	100.00

Source: Council of Forest Industries of British Columbia.

Table 6
Lumber Rates, in U.S. Dollars, from
Various Origins to Dallas and Chicago, 1983

	Dallas				Chicago			
	TCFB[a]	BN[b]	CP[c]	CN[d]	TCFB[a]	BN[b]	CP[e]	CN[d]
Vancouver	550	400[g]	461	494	438	412	438	428
Terrace	550	-	-	514	438	-	-	428
Nelson	536	375	385	-	416	358	416	-
Cranbrook	536	-	438	-	416	-	416	-
Kamloops	540	-	471	469	435	-	435	426
Pr. George	540	501[f]	-	504	435	-	-	426
Portland	435	410[g]	-	-	438	412[g]	-	-
Sumas	435	402[g]	-	-	438	412[g]	-	-
Spokane	416	375[g]	-	-	416	358[g]	-	-
Wenatchee	421	375[g]	-	-	435	379[g]	-	-

Notes:

a. TCFB Tariff 4518, effective August, 1983.
b. BN Tariff 4494, effective August, 1983.
c. CP Tariff 4025, effective September, 1983.
d. CN Tariff 4171, effective September, 1983.
e. CP only has TCFB rates to Chicago. CP prefers to serve the Chicago market area from reload centres in Windsor or Minneapolis.
f. BN Tariff 4495. In spite of the participation of the BCR in this tariff, the BCR prefers to exercise routing over Prince George.
g. No currency adjustment applies to these rates.

Table 7
Modal Split of Shipments to the U.S.
From Various B.C. Regions for 1980 to 1983
(in Percentage)

		1980	1981	1982	1983[a]
Coast	Truck	7	7.6	11	14
	Rail	30	29.1	27	24
	Water	63	63.3	62	62
	Total	100	100	100	100
Central Interior	Truck	1.6	2.5	3.8	6
	Rail	98.4	97.5	96.2	94
	Total	100	100	100	100
Northern Interior	Truck	.5	.5	2	1.5
	Rail	99.5	99.5	98	98.5
	Total	100	100	100	100
Southern Interior	Truck	10	16.3	14	13
	Rail	90	83.7	86	87
	Total	100	100	100	100

Note:

a. Excludes November and December 1983.

Source: Statistics Canada, Catalogue 35-003, Monthly Publication, Vol. 34, 35, 36, and 37.

ISSUES IN TRANSPORTATION/DISTRIBUTION FOR THE SMALL/NEW EXPORTER

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INTRODUCTION

The Ontario Ministry of Transportation and Communications (MTC) provides assistance to small business firms which are experiencing transportation/distribution problems. This is accomplished through the Ministry's Physical Distribution Consulting Services (PDCS) program which is administered by the Goods Distribution Systems Office (GDSO). All of the staff members associated with this program have a private sector background and practical experience in transportation. Generally, complaints or requests for assistance related to transportation/distribution are channelled into MTC from the Small Business Division of the Ministry of Industry and Trade.

***The views and conclusions presented in this paper are those of the authors and do not necessarily reflect those of the Ministry.**

The primary objective of the PDCS program is to reduce physical distribution costs, thereby enabling firms to become more competitive in existing markets or to penetrate new ones. This activity covers investigating the many aspects of physical distribution and movement by all transportation modes. The return for Ontario in providing this service comes from enabling business in the province to grow and, in turn, to protect and create jobs.

Since 1983, the provincial Ministry of Industry and Trade has been aggressively encouraging Ontario firms to export. The ultimate goal is to double total exports by 1987.Consequently, PDCS staff consultants have responded to an increased number of requests for transportation/distribution advice directly related to export trade. From these encounters, there is evidence to suggest that significant barriers to trade are institutionalized within the transportation system.

This paper is intended to illustrate the transportation difficulties faced by small shippers in Ontario who are seeking to export their goods to foreign markets, particularly the United States. However, the views and

conclusions presented are those of the authors and do not necessarily reflect those of the Ministry.

The issues which will be discussed in the context of this paper have appeared repeatedly during the investigation of complaints from the small business community. As such, it is possible to cite actual cases in order to lend strength to the arguments that will be made.

STUDY POPULATION

The small shippers included in the sample typically employ fewer than 30 employees. Exhibit I provides a profile of this study in terms of organization size. Annual expenditures for transportation are generally less than $75,000, although 25 percent of the sample exceeded that level. Some firms have freight accounts approaching the one million dollar level. None of these firms employ an individual whose sole responsibility is transportation/distribution. The person who makes the decisions related to transportation/ distribution matters invariably controls three or four segments of the company operations or, on occasion, is a shop employee assigned the duty of shipping and receiving.

The study is based on a sample population of 73 firms involved in the manufacture of a wide

range of products, such as clothing, furniture, floor drains and Christmas tree ornaments. Sixty-five percent of the firms are located in the Toronto-St. Catharines corridor; the remainder are in small communities in southern Ontario, such as Orillia, Parry Sound and Kingston. This adds a unique dimension to the study which makes it possible, despite the limited sample size, to observe the relative importance of transportation/ distribution cost issues between metropolitan and rural shippers.

METHODOLOGY

As previously stated, PDCS staff consultants review the shipping practices of small shippers through on-site observation and study. This includes the analysis of freight bills, packaging procedures, inventory programs and other relevant sources of information. The paid freight bills of any firm provide an accurate historical record of both good and bad shipping practices. Opportunities for future improvements can often be quickly identified through analysis of these documents.

Using MTC's in-house expertise, freight rates can be obtained for different modes and different carriers between the origin and destination points where problems exist. Where warranted, a

comparison is made between the costs of private trucking (company-operated vehicles) and for-hire carriers. Recommendations for changes in distribution practices which provide potential dollar savings, yet maintain acceptable service levels to the firm, are identified. In each case, a written report is provided to the firm which details the consultant's findings and recommendations.

These reports were used as the primary source of data for this discussion paper. A major finding for each case was identified in terms of the relative importance to each firm's particular situation. Using this breakdown, the authors noted the most significant problems in terms of economic impact and repetition. (Exhibit II).

From these observations, conclusions about the transportation marketplace were drawn and are presented as follows.

OBSERVATIONS

In general, the small business community exhibits a limited understanding of the transportation marketplace. Freight rate structures, which ultimately determine the cost of transporting goods, are probably the least understood aspect. Similarly, the rules that

govern rates also remain a mystery. This is particularly true for international (defined as U.S.-bound) traffic.

The small shipper is, by virtue of his size, compelled to pay class rates (maximum rates). The lack of sufficient product volume necessary to obtain lower rates is the primary reason. However, most small shippers also lack the skills and knowledge necessary to negotiate successfully in the transportation marketplace. The latter shortcoming is a direct reflection on the availability of tariff information and the format in which it is presented. As well, the majority of these smaller shippers are not aware that it is possible to negotiate a commodity rate with a carrier if they have regular traffic volumes. In the sample population of 73 shippers, 11 had attempted to secure lower rates through negotiation.

The low level of market intelligence possessed by small shippers is demonstrated by several common practices. The standard complaints focus on the perceived high cost of transportation. However, in 33 percent of the cases studied, significant savings were developed by changing the practices of shippers, not by negotiating lower rates.

INFORMATION GAP

Ineffective shipping patterns emerge as a direct result of a lack of information. To illustrate, a common problem is missed consolidation opportunities. Shippers typically are unaware of the benefits of optimizing shipment size. In fact, there have been several instances of firms making separate shipments to the same consignee on the same day. In some cases, these multiple shipments are of such a small size that, by combining them, the shipper would still be paying a single minimum charge.

In the same way, small shippers often do not understand that rates are structured into weight groups, the per hundredweight charge decreasing at higher weight levels. Consequently, additional freight cost savings through consolidation are lost. The most common symptom of this is multiple shipments to the same consignee over a relatively short period of time. In 20 percent of the cases studied, freight costs were lowered by reducing the frequency of shipping without affecting required service levels. These savings were, of course, weighed against the increased cost of inventory and storage. In all instances, the maximum length of time between shipments was stretched by an extra 10 days.

For the shipper paying class rates, one of the most important influences on freight costs is the classification of the goods. Products are assigned a class according to the governing rules in the appropriate tariff. For Ontario shippers exporting by truck to the United States, the National Motor Freight Classification Tariff 100-J (N.M.F.C.) applies. By rail, the Uniform Freight Classification 6000-B (U.F.C.) is applicable.

Of the 73 shippers in the study, no more than nine had a copy of the relevant page of this tariff in their possession. In all of these cases, a carrier had provided the document. None of the remaining shippers were aware of the importance of the classification tariff or the need to accurately describe the goods on the bill of lading.

The parameters for assessing the class for a given commodity can vary within an item in NMFC based on such things as density and value per pound. To illustrate, one firm evaluated in this study ships electrical parts that, when packaged, are worth $4.07 per pound. By reducing the declared value of the product from $4.07 to $4.00 per pound, the shipper was entitled to a rate that was approximately 13 percent lower than he had previously been paying. The carrier, of course,

is only liable for the declared value of the goods in case of loss or damage. The shipper felt that reducing the carrier's liability was well worth the return in freight savings gained. It should be noted that insurance coverage obtained through a firm's corporate insurance company is generally a fraction of the price assessed by carriers.

Similar examples can be given about packaging requirements, knockdown rules and other information found in the relevant tariffs.

The intent of these examples is to illustrate the minimal level of understanding of tariffs by small shippers. The causes of this are, in the opinion of the authors, the inaccessibility and complicated nature of the tariffs themselves. These two factors contribute enormously in fostering the low level of market intelligence exhibited by most small shippers.

Through observation, it has been found that 75 percent of small shippers do not have any sort of freight rate information available within the organization. Further, these firms did not realize that tariffs were available for public scrutiny.

The implication here is that the subject shippers are purchasing transportation services without the benefit of knowing how much they will

pay or the alternatives available. In fact, that is precisely what is happening. The majority of the firms studied paid their freight bills in full without any verification of the rate that appeared on the face of the invoice.

Most small shippers believe that the only source of rate information is from the carriers themselves. In the sample for this study, all of the firms that had obtained rate information had done so by calling one or more carriers directly. Two shippers included freight costs in the delivered prices of their goods only to find out later that the quotes were incorrect, requiring them to pay a "carrier's balance due." Unfortunately, this "extra" cost was not recoverable from the shipper's customer.

The exact reasons for inaccurate rate quotes are not readily apparent. However, it seems that two explanations hold a degree of merit. First, the shipper may not realize the importance of accurately describing the goods in question. As a result, a classification error may occur. A second possibility is that the carrier's rate personnel simply made an error. Given the complex nature of tariffs today, this explanation is valid and supportable. According to Niagara Frontier Tariff Bureau (NFTB) staff, international

common carriers place the number of misrated freight bills at approximately 15 percent of the total. In one case study, the shipper's freight bills had an error rate of 30 percent.

A clear indication of the magnitude of this problem comes from the fact that an industry exists which relies on freight bill audits for their livelihood. While some of these firms assess a fee for their service, the majority of them operate solely on a commission basis, taking a percentage of overcharge claims they file against carriers on behalf of their clients.

RATE LEVELS

The complaint which surfaced in approximately 80 percent of the firms visited dealt with the high level of international freight rates. As previously discussed, the distribution costs incurred by these firms are usually inflated by ineffective shipping practices. However, even when measures are taken to streamline procedures, the absolute level of rates still appears to be excessive for 42 percent of the subjects.

When comparisons are made with U.S. or Canadian domestic rates, the international class rates published by the Niagara Frontier Tariff Bureau are found to be considerably higher on a per-mile basis.

The variances in rates are most striking when comparisons are done at international gateways. For example, rates from Toronto to distant points in the U.S., such as Atlanta, Georgia, can exceed the rate from Buffalo, New York, to the same destination by over 65 percent. The geography of the situation is not consistent with the rate structure. This is not an isolated case, but is typical of the international class rates applying between Ontario and the United States. Exhibit III provides a number of representative comparisons.

To appreciate the impact that this situation is having on international traffic, it is necessary to know how much freight is moving under class rates.

Staff of the Niagara Frontier Tariff Bureau have stated that, according to their "Continuing Traffic Study", class-rated traffic to and from Canada produces approximately 60 percent of their member carriers' revenue. The majority of this movement is LTL (less-than-truckload) traffic.

The absence of acceptable levels of transportation rates has important implications for new exporters. The most significant effect is that shippers, by default, have quoted prices F.O.B. origin as opposed to a delivered price.

This puts the firm at a disadvantage vis-a-vis local competition in the target market. By abdicating the responsibility for transportation, the shipper imposes the burden on his customer, a burden that many U.S. buyers are not willing to assume. Some firms have been frightened by the rate quotes they received and the impact this has on their selling prices. These firms have mistakenly believed they could ignore the transportation element of their business by simply changing the delivery point of their product (i.e., from F.O.B. destination to F.O.B. origin).

However, an American buyer, faced with the choice of purchasing a product from a domestic source or buying the same product on an F.O.B. Canadian origin basis, will lean strongly towards the American supplier in the majority of cases. The buyer will be inclined not to invest the additional time to find out what the transportation charges are, nor will he want to get involved with payment of U.S. customs duty and clearance procedures. Experience has shown that Canadian firms which have not assumed responsibility for transportation costs and U.S. customs have experienced greater difficulties in penetrating the United States market than those who have quoted a simple delivered price.

PRIVATE TRUCKING

Some shippers who realize the importance of selling on a delivered price basis have looked for alternatives to paying international class rates. The most popular alternative, now practiced by 20 percent of the firms in this study, is consolidation of LTL lots at the plant site and use of their own private truck to a U.S. gateway city. There the freight is delivered to a U.S. common carrier terminal or distribution warehouse. The traffic then moves to the consignee under the U.S. domestic rate structure. The cost of operating a vehicle to the border, plus the U.S. freight rates to the ultimate destination (including full U.S. exchange), was less than the NFTB rates by an average of 25 percent in the subject cases.

In one situation, a shipper who was able to schedule his inbound and outbound movements effectively, rented a truck and reduced his transportation cost by over 60 percent against the best rate he could obtain from an international common carrier.

However, the option of private trucking is not available to everyone. Occasional shippers with little volume cannot economically rent a truck to move several hundred pounds. Some of

these firms use shipper agents who consolidate LTL shipments into truckload (T/L) quantities and offer lower rates. Others have joined a shippers' co-operative that provides some relief. A number of shippers break down their shipments into small lots of 75 pounds or less in order to utilize ground parcel service. This allows them to take advantage of the low level of rates provided by the small shipment specialists. In addition, the volume of traffic which shippers are tendering to air carriers is growing.

IMPLICATIONS

All of the above indicate that shippers, in growing numbers, are individually taking steps to circumvent the general commodity trucking industry's international class rate structure.

Investigation of complaints has led the authors to conclude that LTL rate levels between Ontario and points in the United States are having a significant negative impact on export development for many small shippers.

This is despite recent rate discount programs implemented by NFTB carriers competing for international traffic. In effect, the discount programs have not served to eliminate the proportional difference between international rates and domestic United States rates because the latter rates have also been discounted.

Over the years, the absolute rate levels (international) of the NFTB have grown relative to the rate levels of other tariff bureaux. This trend still continues. At a recent NFTB meeting, the member carriers collectively agreed to file for a rate increase of 10 percent on LTL traffic and six percent on T/L traffic, producing a revenue impact of approximately eight percent. The effective date of this increase is May 14, 1984. This contrasts with nine other tariff bureaux in the U.S. Five bureaux filed for increases producing revenue impacts of 3.9 percent, two at 4.9 percent, one at five percent and another at six percent. The overall impact of the increase is compounded further by the fact the NFTB rates were at a higher level initially. It must also be pointed out that the N.F.T.B. rates, which apply domestically between points in the U.S., were only subject to a 3.9 percent increase.

A paradox exists in the traffic flow between Canada and the United States. Staff of the Niagara Frontier Tariff Bureau have stated that, of every three loaded trailers which come into Canada, two of these trailers return to the U.S. empty. On the other hand, we have Canadian exporters who are doing everything possible to

find alternatives to using NFTB carriers because they find their rate levels too high. A solution to this enigma must be found where both shippers and carriers can emerge as winners.

Perhaps there are legitimate reasons why the international rate structure is higher than domestic rate levels. Carriers often state that Canadian customs procedures delay the smooth and efficient flow of traffic. Union contracts which require multiple drivers to handle a single load have also been blamed for increasing carrier costs. The practice of interlining and its impact on rates has been questioned. Most Canadian LTL carriers are obliged to interline at the U.S. border. Very few carriers have the authority or the terminal network to provide extensive LTL service to the U.S. Some carriers that do have this capability have reduced LTL rates substantially, one carrier by 35 percent. The latter point indicates there may be a rate division problem between domestic and U.S. carriers.

It has also been suggested that the absolute rate level disparity is historical in nature. When the railways were still in the LCL (less-than-carload) business, the international truck carriers established their prices at a comparable

level which was higher than domestic truck rates. This relationship still remains, even though the rail service no longer exists.

Today, the for-hire industry faces its stiffest competition from private trucking. Many international carriers appear to ignore this fact.

Large shippers are generally capable of looking after their own interests. However, small business must have access to a cost effective for-hire transportation industry if they are to compete effectively in U.S. markets. Considering the excess capacity which the NFTB members now have and their apparent need to attract more southbound freight, it appears they are in a position to lower their rates thereby increasing the potential to attract larger traffic volumes and, consequently, increase their revenuse.

The impact of transportation costs on the success of any business enterprise is greater today than ever. If problems exist, either regulatory or commercial, we should address them for the common good of both carriers and shippers, bearing in mind the overall economic consequences for Canadian trade.

SUMMARY

Members of the small business community in Ontario are citing transportation costs as a major barrier to entry into the U.S. market.

In the opinion of the authors, there is no doubt that a significant number of small shippers are paying excessive amounts for transportation service. There are several contributing factors that have fostered this situation:

1. Objective freight rate information is unnecessarily complex and inaccessible to the small shipper.

Tariff structures are such that it is virtually impossible for the untrained shipper to determine what transportation costs will be.

Failure to understand tariffs results in shipping practices that impose an unacceptable cost burden on the shipper.

2. Although private trucking to U.S. gateway points enables some shippers to defeat the high international freight rate structure, it remains a "bandaid" treatment at best. In fact, it is likely that the diversion of traffic to private truck is contributing to the current economic hardships faced by many common carriers while only partially solving the cost problems faced by shippers.

3. The absolute level of class rates between points in Ontario and points in the United States is inhibiting Ontario's export development programs.

The authors feel that a substantial general reduction of rate levels, perhaps supported by efficiency and productivity improvement, is necessary to divert the freight from private trucks back to for-hire carriers.

In conclusion, the relative importance of transportation costs in determining international competitiveness should not be over-emphasized. Reducing transportation cost alone will not necessarily create export opportunities. These costs should be looked at in the total context of what creates the ability to export successfully: the quality of entrepreneurship, labour relations, production efficiency, marketing effectiveness and, above all, the creation of products which the export market demands. In the final analysis, it must be remembered that transportation costs are paid by the export customer. At times these can be the determining factor in the success or failure of export sales.

EXHIBIT I

SIZE OF CLIENT BY NUMBER OF EMPLOYEES

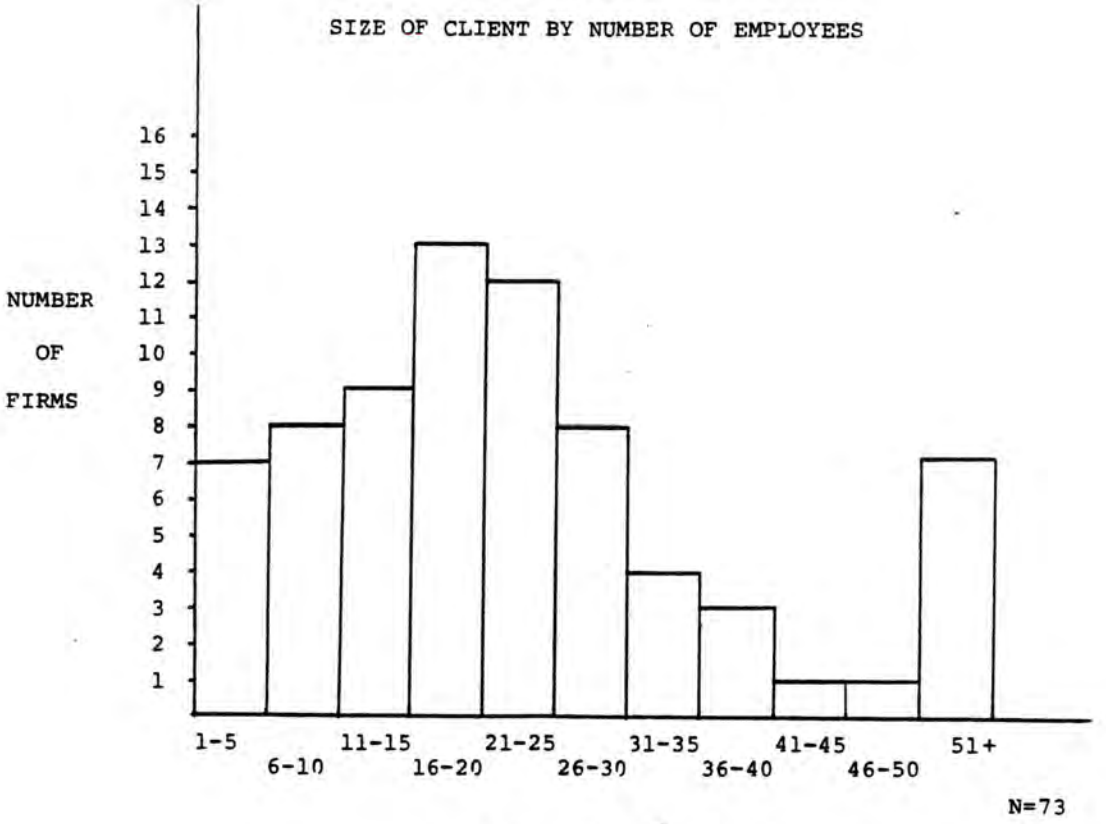


EXHIBIT II

BREAKDOWN OF CASE STUDIES
BY MAJOR PROBLEM AREAS

Problem Area	Frequency
A. Rate Levels	31
B. Information Gap	
- Substandard shipping practices resulting in excessive costs	24
- Carrier/mode selection errors	10
C. Service (delivery times, O.S.D., etc.)	8
Total Cases Studied	73

Note: While each case analysis may have revealed several problems, the authors have chosen to tabulate only the primary difficulty experienced by each shipper.

EXHIBIT III

RATE COMPARISON
INTERNATIONAL MOTOR CLASS VS U.S. DOMESTIC CLASS
01/01/84
CLASS 100, LTL SHIPMENT 2000 POUNDS

	$Rate Cwt.	$Cost Mile
Toronto, Ont. to New York City	22.77	.95
Buffalo, N.Y. to New York City	12.68	.70
Toronto, Ont. to Minneapolis,Min.	35.22	.78
Buffalo, N.Y. to Minneapolis,Min.	22.06	.48
Toronto, Ont. to Louisville, Ky.	23.06	.77
Buffalo, N.Y. to Louisville, Ky.	13.47	.50
Windsor, Ont. to Louisville, Ky.	19.82	1.07
Detroit, Mi. to Louisville, Ky.	11.48	.63
Niagara Falls,Ont. to Pittsburgh,Pa.	18.35	1.56
Niagara Falls, NY to Pittsburgh,Pa.	12.62	1.08
Hamilton, Ont. to Chicago, Ill.	21.29	.92
Rochester, N.Y. to Chicago, Ill.	14.39	.48
Windsor, Ont. to Chicago, Ill.	18.65	1.38
Detroit, Mi. to Chicago, Ill.	10.49	.78
Toronto, Ont. to Atlanta, Ga.	30.89	.66
Buffalo, N.Y. to Atlanta, Ga.	16.92	.40
Toronto to Dallas, Tx.	41.39	.60
Buffalo to Dallas, Tx.	25.87	.38
Toronto to Little Rock, Ar.	36.98	.68
Buffalo to Little Rock, Ar.	21.72	.42
Sarnia, Ont. to Gary, In.	19.23	1.28
Port Huron, Mi. to Gary, In.	11.07	.75

Note: All rates are in U.S. dollars.

(854)

"Tariffs and Transport Cost Barriers on Wheat Exports: U.S. Experience and Implications for Canada"

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ABSTRACT

The purpose of this study is to evaluate spatial equilibrium conditions for U.S. wheat exports under alternative trade restrictions and transportation costs with policy implications for Canada. A quadratic programming model is used for a comparative static analysis.

Differences between actual and equilibrium prices at each U.S. export port derived from the model indicate that some import demand requires spatial reallocation from the Gulf and Atlantic ports to the West Coast and Great Lakes ports to maximize social welfare in both the U.S. and importing countries. Incidence of tariffs and transport costs also is examined. Tariffs imposed by both the EEC and Japan/Korea are absorbed more by consumers in the importing countries than by U.S. exporters. In contrast to tariffs, changes in ocean freight-rates influence wheat price at U.S. ports more than in importing countries. Welfare losses in the U.S., therefore, are much larger resulting from transport cost increases than from tariffs imposed by individual trading partners. Policy implications for Canada, the chief competitor of wheat trade, is discussed.

INTRODUCTION

Spatial grain price differences are substantial between importing and exporting countries and also among U.S. export ports. For example, average export price of wheat (f.o.b.) was $5.92 per bushel in the Pacific Northwest ports and $5.42 per bushel in the Gulf ports in 1981 (World Wheat Statistics). The price differential could be due mainly to changes in import demand under trade restrictions such as customs tariffs in importing regions and differences in international transport costs between U.S. export ports and importing regions. Nevertheless, the question of spatial wheat price differences caused by the trade barriers has not been adequately treated in the literature, particularly relative to the importance of transport costs vis-a-vis tariffs. In contrast with a large body of literature concerning both theoretical and empirical examination of man-made trade barriers such as customs tariffs, study of international transport costs as a natural barrier to trade has been rather neglected until recently. Among other things, the exclusion of transport cost is one of the shortcomings of the Orthodox Theory of International Trade (Gray). Bryan (1974) argues that the neglect of transport cost in the theory is largely attributed to the post-war pre-occupation with the formal aspects of the Hecsker-Oblin theory of trade, as it requires the assumption of zero transport cost to be logically correct.

It must be emphasized that transport costs are an economic fact of life and hence, the protection or burden they give is an important regard, different from that of man-made barriers such as tariffs. Transport costs affect payment for the use of real resources; tariff payments do not.

The body of recent empirical literature which does exist dealing with the relative significance of tariffs and transport costs can be found in the field of international trade, transportation and agricultural economics, and is comprised by the work of Waters (1970). More recent studies are conducted by Yeats (1976, 1977) and Yeats et al. (e.g., 1976, 1977), and Furtan et al. (1979). Yeats and his collaborators, using cross sectional data, were mainly concerned with aspects of nominal and effective protection as trade barriers acting to disadvantage exports to the U.S.; Waters dealt with nominal vs. effective transport costs and tariffs from the opposite point of view, as an advantage serving to protect import-competing U.S. industries. Furtan et al., examined impacts of changes in nominal tariffs vs. transport cost on equilibrium price and quantity traded for Canadian rapeseed. Nevertheless, these studies did not examine the relative magnitude of the incidence of tariffs and transport costs.

The purposes of this study, therefore, are (1) to evaluate spatial equilibrium conditions for U.S. wheat exports under alternative nominal tariffs and transport costs, (2) to examine incidence of the two trade barriers, (3) to estimate welfare losses for U.S. wheat economy, and to discuss policy implications for Canada.

Theoretical Framework

The spatial equilibrium condition of a single commodity with tariffs and transportation costs is illustrated in Figure 1. The quantity of a commodity traded (OQ) is equal to the quantity exported (ef) and the quantity imported (gh) at the equilibrium price (OP). With the existence of tariffs and transportation costs measured by the vertical distance between import demand and export supply curves,

price differences between import and export regions are equal to the sum of the tariffs and transportation costs (distance ab in Figure 1). The tariffs and transportation costs are shared by import and export countries, depending upon the price elasticities of export supply and import demand. Tariffs and transportation costs increase price in the import country from OP to OP_1 and decrease the price in the export country from OP to OP_2. The increase in the price paid by the import country results in a decrease in the quantity of a commodity traded from OQ to OQ_1. The proportion of price change borne by the importer (PP_1) and that borne by the exporter (PP_2) can be calculated as a function of supply and demand elasticities (Kreinin) as follows:

$$(1)\quad pp_1 = \left(\frac{e_x}{|e_m| + e_x}\right) \overline{ab}$$

$$(2)\quad pp_2 = \left(\frac{|e_m|}{|e_m| + e_x}\right) \overline{ab}$$

where e_x is price elasticity of export supply and e_m is price elasticity of import demand.

In the case of several import countries trading with one export country, prices in the export country are influenced differently by tariffs and by transportation costs in comparison with a two country trade model. A customs tariff imposed by a country is applied to only the portion of total grain that country imports. Impacts of the tariff imposed by an import country on price in the export country are, therefore, dependent upon the quantity of its imports (i.e., market-share of import), compared to the total quantity traded in addition to price elasticities of export supply and import demand. In applying Equations 1 and 2 to calculate changes in prices due to a

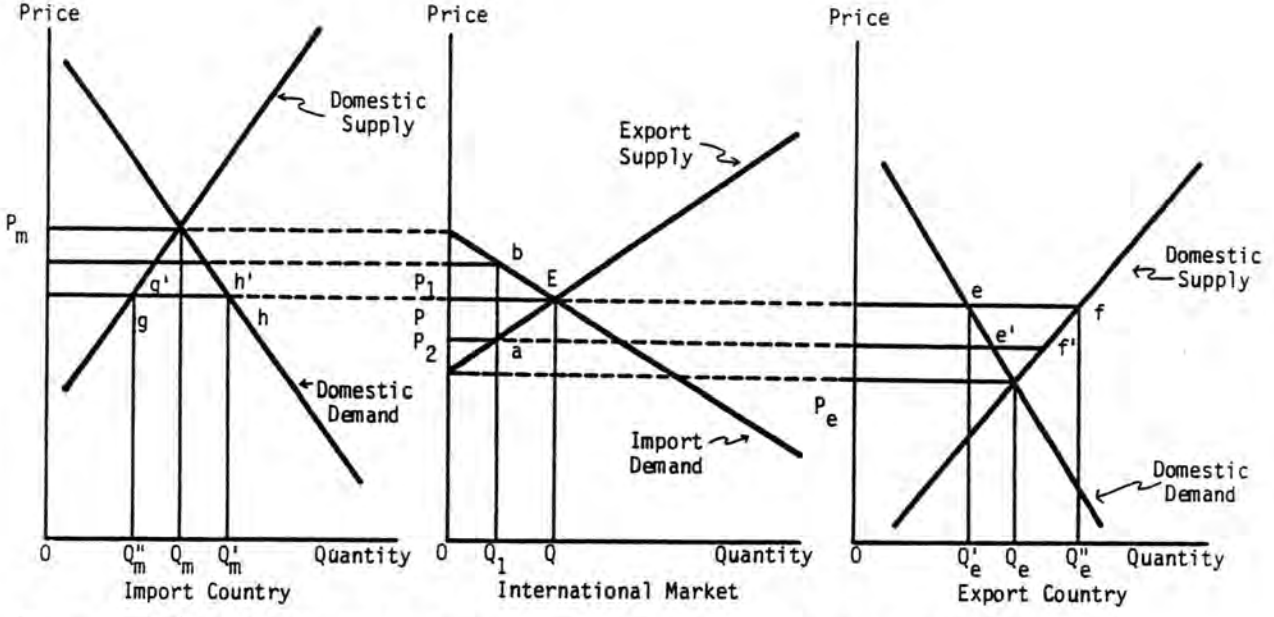


Figure 1. Spatial Equilibrium Under the Existence of Tariff and Ocean Transportation Cost

tariff imposed by an importing country within a multiregional trade case, the price elasticity of export supply associated with that country's import share should be used instead of the total supply elasticity. The price elasticity of supply of a country's imports of a given product is inversely related to its share in the world market. Assume that Q_S is the total exports of a given product and Q_d is the quantity of the commodity imported by the other countries and $Q_S - Q_d$ is the quantity of the commodity imported by the country, A, in question. Then, the price elasticity of supply of country A's imports (e_A) can be computed as follows (Kreinin):

$$(3)\quad e_A = \frac{\Delta(Q_S - Q_d)}{\Delta p}\ \frac{P}{Q_S - Q_d}$$

$$= \frac{\Delta Q_S}{\Delta P}\frac{P}{Q_S}\frac{Q_S}{Q_S - Q_d} - \frac{\Delta Q_d}{\Delta P}\frac{P}{Q_d}\ \frac{Q_d}{Q_S - Q_d}$$

$$= e_S\ \frac{Q_S}{Q_S - Q_d} - e_d\ \frac{Q_d}{Q_S - Q_d}\ .$$

where e_S is the total supply elasticity of the product and e_d is the demand elasticity from the other importing countries. This indicates that e_A can be very elastic even if e_S is inelastic. On the other hand, when transportation costs are changed, the costs should be applied to the total quantity of the commodity traded. Impacts of changes in transportation costs on prices in import and export countries are, therefore, dependent upon price elasticities of export supply and import demand, regardless of the quantities of commodity imported by each import country. Consequently, Equations 1 and 2 are applicable to the existence of transportation costs in shipping commodities from export regions to import regions while Equation 3 is applicable to a situation in which a tariff is imposed by an importing country, A.

The Quadratic Programming Model

A spatial equilibrium model for the U.S. wheat industry is developed on the basis of a quadratic programming algorithm. The model incorporates transportation and storage activities in shipping wheat from producing areas to domestic and foreign import countries. In addition, the model incorporates the estimated export supply equations in each U.S. export port. Domestic producing regions are linked to export ports through transportation activities in shipping wheat from producing regions to export ports. Similarly, import demand equations in each import region are incorporated and linked to U.S. export ports through ocean transportation activities in the model. As shown in Table 1, the objective function of the model is to maximize the net social payoff function defined by Samuelson. The social payoff function is calculated on the basis of wheat export supply equations for winter, spring, and durum wheat at each U.S. export port and import demand functions for winter, spring, and durum wheat in each import region. The net social payoff which is the objective function of the model is the social payoff less transportation costs in shipping wheat from producing regions to domestic consuming and export regions (Samuelson).

The basic structure of the model is similar to those earlier studies (e.g., Furtan et al.; Takayowa and Judge; and Shei and Thompson). However, there are two major differences between the model in this study and earlier studies cited above: firstly, this model includes domestic transportation activities associated with wheat shipments from producing regions to domestic consuming regions and export ports, and secondly, this model excludes trade activities associated with other wheat export countries. The rationale for including transportation activities in prices at U.S. export ports is

influenced not only by changes in domestic transportation but also ocean freight rates and tariff barriers. The trade activities, however, are excluded for two reasons: first, the model becomes too large to manage particularly when those trade activities associated with other wheat export countries are included in the model. Second, export prices at U.S. export ports are not largely influenced by trade activities associated with other wheat export countries due to the fact that the U.S. dominates the world wheat export market.[2]

Equations 5, 6, and 7 in Table 1 represent domestic supply, domestic demand, and storage capacity constraints, respectively. Equations 8 and 9 are introduced to meet import demand and export supply conditions in importing and exporting regions, respectively. Equation 11 indicates that price differences between importing and exporting regions must be equal or greater than the sum of import tariffs (t_n) and ocean freight-rates (C_{ghn}). Spatial equilibrium prices are determined subject to Equations 8, 9, and 11. Equation 10 represents an inventory clearing condition at U.S. export ports, indicating that the quantity of wheat received by each port from domestic producing regions must be equal to the quantity of wheat shipped to importing regions.

The model contains 49 domestic wheat producing regions, 23 domestic consuming regions, and 12 export ports (two from the Atlantic Coast, four from the Gulf, three from the West Coast, and three from the Great Lakes). Producing regions are delineated on the basis of wheat production location and domestic consuming regions on the basis of wheat processing capacities. Foreign importing regions used in this study are the EEC (Western Europe), Eastern Europe, Africa, the Middle East, South Asia, West Asia, Japan and Korea, Central America, Brazil and Venezuela, South America, and the U.S.S.R. Nine commercial

storage locations are selected mainly from the Great Plains states to capture commercial storage activities.

The study includes three different classes of wheat: winter, spring, and durum. Each wheat has unique production and consumption characteristics which make marketing activities of one wheat different from the others.

Four modes of transportation (rail, truck, barge, and ocean vessel) are included in the study. Transportation activities associated with the modes of transportation are: (1) shipments of grain from producing regions to domestic consuming regions; (2) shipments from producing regions to export ports; and (3) shipments from U.S. export ports to foreign import regions. Barge transportation activities are coordinated with rail and truck transportation through inland water ports on the Mississippi River, the Great Lakes, and the Columbia-Snake River system. Hence, the model includes 40 water access points as inland water ports on the river system.

Data

Data used for the model are demand for wheat in domestic consuming regions, supply of wheat in producing regions, and transportation costs in shipping wheat from producing regions to domestic consuming and foreign importing regions. In addition, the model incorporates export supply equations in U.S. export ports and import demand equations in importing regions. Export supply equations are derived from export supply elasticities of U.S. wheat at average export quantity and price levels.[3] Export supply elasticity of each type of wheat (e_x) is obtained from price elasticities of domestic demand (e_d) and domestic supply (e_s).[4]

Quantities of each wheat supplied, exported, and demanded are three-year average (1978-1980) of the data obtained from the Grain Market News (U.S. Department of Agriculture). Price elasticities of domestic supply and demand for each type of wheat are empirically estimated from time series data from 1961 to 1980 which is shown in Table 2. Estimated export supply elasticities are also shown in Table 2. It is assumed that the magnitude of price elasticities are the same at all U.S. exports ports. Import demand elasticities at average import quantity and price levels in each import region are also estimated,[5] which is shown in Table 3.

Domestic consumption and imports were averaged over a three-year period (1978-1980) for each of the 11 import regions. Information for domestic consumption and imports in import regions was obtained in the World Wheat Statistics (International Wheat Council). Price elasticities of domestic demand for wheat in import regions were taken from a study by Rojko et al.

Domestic demand and supply of each class of wheat used in the model are a three-year average of the data from 1978 to 1980 obtained from Wheat Situation (U.S. Department of Agriculture).

Transportation costs for rail, truck, barge, and ocean vessel are estimated on the basis of information obtained from industrial sources. The estimation procedure of the costs is detailed in a study by Koo (1982a).

The Empirical Results and Analysis

This study is based on the base and three alternative models. The base model (Model 1) is developed on the basis of estimated export supply, estimated import demand, and the 1980 ocean freight-rate structure for wheat under an assumption of free trade between

TABLE 2. PRICE ELASTICITIES OF SUPPLY AND DEMAND IN U.S.

	Winter Wheat	Spring Wheat	Durum Wheat
Domestic Supply[a]	0.099	0.218	0.132
Domestic Demand[b]	-0.259	-0.595	-0.455
Export Supply[c]	0.219	0.508	0.466

SOURCES: a. Won W. Koo (1982b).
b. Estimated by Won W. Koo.
c. Footnote 4.

TABLE 3. PRICE ELASTICITIES OF IMPORT DEMAND BY IMPORTING REGIONS

Region	Elasticity	Region	Elasticity
Western Europe	-1.97	Japan/Korea	-0.38
Eastern Europe	-1.23	Central America	-1.28
Africa	-0.41	Brazil/Venezuela	-0.31
Middle East	-0.36	South Asia	-0.33
South Asia	-0.68	U.S.S.R	-2.85
East Asia	-2.16		

SOURCE: Rojko et al.

importing and exporting regions. Alternative models[6] included in this study are: $1.00 per bushel tariff imposed by the EEC and by Japan/Korea[7] (Model 2); a 20 percent increase in ocean freight-rates (Model 3); and a 40 percent increase in ocean freight-rates (Model 4). Model 2 is developed to evaluate changes in the spatial equilibrium condition for U.S. wheat exports under customs tariffs imposed by the EEC and by Japan/Korea, while Models 3 and 4 are developed to analyze the interdependency between U.S. wheat exports and ocean freight-rates.

The models determine the equilibrium prices of U.S. export ports and import regions and the equilibrium quantities traded between the U.S. and import regions. The price determination is dependent on the estimated export supply equations of U.S. wheat, import demand equations, and changes in tariffs and transportation costs.

Impacts on Special Equilibrium Prices and Quantities Traded

Table 4 presents winter, spring, and durum wheat equilibrium prices, respectively, under alternative tariffs and ocean freight-rates. The durum wheat price is the highest among the three classes of wheat. Winter and spring wheat prices are comparable among U.S. export ports. This equilibrium price pattern is consistent with the actual average wheat prices from 1978 to 1980.

Equilibrium price of winter wheat is highest at the West Coast (Portland/Seattle), second highest at the Gulf ports, and lowest at the Great Lakes in the base model. The spatial price difference is due mainly to the demand and supply situation in each export port, domestic transportation costs in shipping wheat from producing regions to export ports and ocean transportation costs from export ports to import regions. The West Coast has a cost advantage in shipping wheat to Japan/Korea and other Asian countries, but the Gulf ports have a cost advantage in receiving winter wheat from producing regions. Consequently, Japan and other Asian countries' import demands for winter wheat at the West Coast are greater than at other U.S. export ports. This leads to higher prices at the West Coast. Wheat prices at the West Coast increase until the price difference is large enough to cover additional domestic transportation costs required in shipping wheat to the West Coast. The Great Lakes has a cost disadvantage over the Atlantic and Gulf ports in shipping wheat to most import regions.

This lowers import demand for winter wheat at the Great Lakes and results in a lower price. On the supply side, because of relatively low domestic transportation costs from producing regions to the Great Lakes, winter wheat is supplied to the Great Lakes despite the lower wheat price.

The Gulf ports have higher import demand for winter wheat from most import regions except Southeast Asia, but winter wheat prices at the Gulf ports are lower than at the West Coast because domestic transportation costs by barge to the Gulf ports are lower. Most winter wheat produced in the Southern Plains is moved to the Gulf ports for exports. The spatial equilibrium prices obtained from the base model are similar to the actual average prices at U.S. export ports except the West Coast. The actual price at the West Coast is much lower than the equilibrium price, indicating that some import demand should be shifted from the Gulf to the West Coast to maximize social welfare.

Let us turn to spring wheat. No spring wheat price is determined at the Atlantic ports because of its locational disadvantage in receiving spring wheat as spring wheat production is concentrated in the northern plains in the United States, (e.g. Dakotas, Montana, and Minnesota). Spring wheat price is highest at the West Coast and lowest at the Great Lakes in the base model. This is again due to import demand and export supply conditions related to both domestic and ocean transportation costs. The spatial equilibrium prices obtained from the base model are lower than the actual average prices at the Gulf and West Coast ports, and higher at the Great Lakes ports. The price differences indicate that some import demand for spring wheat should be shifted from the Gulf and West Coast ports to the Great Lakes ports to maximize social welfare.

Similarly, durum wheat price is not determined at the Atlantic ports. Durum wheat price is highest at the Great Lakes and lowest at the West Coast. Durum wheat is imported mainly by the EEC and Africa through the Gulf and Great Lakes ports. Most durum wheat produced in Arizona is shipped for exports to the Gulf ports. Durum wheat produced in the Dakotas and Minnesota is shipped for exports to the Great Lakes. The equilibrium prices are slightly lower than the actual price at the Gulf ports and much higher at the Great Lakes ports. This indicates that some import demand for durum wheat should be shifted from the Gulf ports to the Great Lakes ports to maximize social welfare.

The total quantity of wheat sold in domestic consuming and export market is 1,932 million bushels in the base model, which is similar to the three-year average of wheat sold, 1,939 million bushels (1978-1980). Approximately 65 percent of the wheat goes to export markets and the remainder to domestic consuming regions. Of the quantity of wheat shipped to domestic consuming regions, market shares for winter, spring, and durum wheat are 73, 21, and 6 percent of the total wheat marketed, respectively. The market shares of winter, spring, and durum wheat in export markets are 79, 15, and 6 percent of wheat exported (Table 5). The average market share from 1978 to 1980 are similar to the optimal market share obtained from the base model, indicating that U.S. wheat export markets are optimally shared by winter, spring, and durum wheat industries.

Customs tariffs imposed by the EEC and/or Japan/Korea result in substantial increases in wheat prices which leads to a decrease in the quantities of wheat imported by the regions. However, the impacts on the total quantity of U.S. wheat exports are minimal. The reduction

TABLE 4. AVERAGE ACTUAL AND EQUILIBRIUM WHEAT PRICES AT U.S. EXPORT PORTS UNDER TARIFFS AND CHANGES IN OCEAN FREIGHT-RATES

	Atlantic	Gulf	West	Great Lakes
		($/bu.)		
Winter Wheat				
Average Actual Price[a]	4.44	4.51	4.49	--[b]
Equilibrium Prices Under Model 1-4:				
1. Base	4.38	4.47	4.76	4.09
2. $1.00 Tariff in the EEC and Japan/Korea	4.26	4.34	4.63	3.96
3. 20 Percent Increase in Freight-Rate	4.17	4.28	4.62	3.82
4. 40 Percent Increase in Freight-Rate	3.96	4.09	4.49	3.56
Spring Wheat				
Average Actual Price	--	4.81	4.96	4.13
Equilibrium Prices Under Model 1-4:				
1. Base	--	4.46	4.80	4.17
2. $1.00 Tariff in the EEC and Japan/Korea	--	4.03	4.42	3.74
3. 20 Percent Increase in Freight-Rate	--	4.29	4.71	3.95
4. 40 Percent Increase in Freight-Rate	--	4.11	4.67	3.71
Durum Wheat				
Average Actual Price	--	6.09	--	5.36
Equilibrium Prices Under Model 1-4:				
1. Base	--	5.86	5.80	5.85
2. $1.00 Tariff in the EEC and Japan/Korea	--	5.33	5.26	5.30
3. 20 Percent Increase in Freight-Rate	--	5.71	5.64	5.69
4. 40 Percent Increase in Freight-Rate	--	5.55	5.47	5.54

[a]Actual average price from 1978 to 1980 (World Wheat Statistics).
[b]Not available.

in U.S. wheat exports is 17 million bushels with a $1.00 tariff per bushel of wheat in the EEC and Japan/Korea.[8]

Similarly, increases in ocean freight-rates also result in reductions in the total quantities of wheat exported from the U.S. The estimated reductions are 12 and 24 million bushels with 20 and 40 percent increases, respectively, in ocean freight-rates (Table 5).

The quantities of wheat imported by the EEC and Japan/Korea are also shown in Table 5. The total quantities of wheat imported are reduced with the existence of tariffs and increases in ocean freight-rates in both the EEC and Japan/Korea.

Incidence of Tariffs and Transportation Costs

When both EEC and Japan/Korea impose a specific tariff of $1.00 per bushel of wheat, U.S. winter wheat prices, for example, are reduced by approximately 13 cents per bushel indicating that approximately 13 percent of the tariffs are absorbed by U.S. grain industry while the remainder of the 87 percent are absorbed by consumers in importing regions although both regions' (EEC and Japan/Korea) price elasticities of import demand for U.S. winter wheat are more elastic than the elasticities of U.S. export supply. The main reason for this is that changes in quantities of winter wheat imported by either the EEC or Japan/Korea due to the tariff are not large enough to influence the U.S. export prices. When the tariff is imposed in both the EEC and Japan/ Korea, reductions in spring wheat prices are 38 cents at the West Coast and 43 cents at the Gulf and Great Lakes ports indicating that more than 50 percent of the tariff is absorbed by consumers in importing countries.

Impacts of the tariffs imposed in the EEC and/or Japan/Korea on durum wheat prices are similar to those imposed on spring wheat

TABLE 5. ACTUAL AND OPTIMAL QUANTITIES OF WHEAT TRADED UNDER TARIFFS AND CHANGES IN OCEAN FREIGHT-RATES

	Winter	Spring	Durum	Total
	(million bushels)			
Total Quantities of U.S. Wheat Export by Wheat Types				
Average Actual Exports[a]	1,001	199	68	1,268
Equilibrium Quantities Under Model 1-4:				
1. Base	1,003	194	63	1,260
2. $1.00 Tariff in the EEC and Japan/Korea	997	185	61	1,243
3. 20 Percent Increase in Freight-Rate	995	191	62	1,248
4. 40 Percent Increase in Freight-Rate	968	187	62	1,236
Quantities of Wheat Imported by the EEC and Japan/Korea				
EEC				
Average Actual Imports[b]	49.3	56.9	28.6	134.8
Equilibrium Imports Under Model 1-4:				
1. Base	45.8	51.5	29.9	125.2
2. $1.00 Tariff in EEC and Japan/Korea	29.6	37.0	22.0	88.6
3. 20 Percent Increase in Freight-Rate	43.4	49.0	26.6	119.0
4. 40 Percent Increase in Freight-Rate	41.9	45.5	26.2	113.6
Japan				
Average Actual Imports[c]	153.8	35.1	1.6	190.5
Equilibrium Imports Under Model 1-4:				
1. Base	155.2	36.8	1.5	193.5
2. $1.00 Tariff in EEC and Japan/Korea	145.0	33.0	1.4	179.4
3. 20 Percent Increase in Freight-Rate	154.8	35.7	1.4	192.0
4. 40 Percent Increase in Freight-Rate	154.4	35.6	1.5	191.5

[a]Actual average exports from 1978 to 1980 (Wheat Situation).
[b]Actual average imports from 1978 to 1980 in the EEC (Wheat Situation).
[c]Actual average imports from 1978 to 1980 in Japan/Korea (Wheat Situation).

prices. The only difference is that reductions in durum wheat prices are greater than in spring wheat prices with tariffs in the EEC. Durum wheat prices in U.S. export ports are not influenced by a tariff imposed by Japan/Korea. In contrast to tariffs, increases in ocean freight-rates result in a much larger reduction in wheat prices in all U.S. export ports than in importing regions. The reason is a tariff imposed by a country is applied to only the quantity of wheat it imports, but transportation costs are applied to the total quantity of wheat traded.

A 20 percent increase in ocean freight-rates results in about a 19 cent per bushel reduction in winter wheat prices in all U.S. export ports (Model 3 in Table 4). A further 20 percent increase in ocean freight-rates produces an additional 18 cents per bushel reduction (Model 4 in Table 4). The average ocean freight-rate for shipping wheat from U.S. export ports to import regions is about $1.05 per bushel. Therefore, 20 and 40 percent increases in ocean freight-rates cause average freight-rate increases of 21 and 42 cents per bushel. This indicates that the increases in ocean freight-rates are largely absorbed by U.S. grain industry by depressing the export price of winter wheat at U.S. export ports. The proportion of ocean freight-rates borne by U.S. grain industry is approximately 85 percent of the freight-rates.

Similarly, increases in ocean freight-rates result in reductions in spring and durum wheat prices in all export ports (Models 3 and 4 in Table 4). However, the proportion of ocean freight rates borne by U.S. grain industry for spring and durum wheat exports is smaller than for winter wheat exports. U.S. exporters absorb about 70 percent of the ocean freight-rate increases and the remainder is absorbed by the foreign importers. The proportion of ocean

freight-rates borne by U.S. exporters for spring and durum wheat is about 15 percent lower than for winter wheat. This is because export supply elasticities are greater than winter wheat. The reduction in spring wheat prices are largest at the Great Lakes ports and lowest at the West Coast ports. This indicates the proportion of ocean freight-rates borne by U.S. exporters are different at U.S. export ports due to different import demand elasticities in import regions.

Effects on Social Welfare

The social welfare losses presented in Table 6 are measured by consumers' and producers' surpluses. A specific tariff of $1.00 per bushel of wheat in the EEC and Japan/Korea results in substantial reductions in social welfare in both the U.S. and these import regions due to changes in equilibrium prices and quantity traded (see Model 2 in Table 6).

Similarly, increases in ocean freight-rates result in reductions in social welfare in both the U.S. and foreign import regions. However, the decrease in social welfare in the U.S. due to increases in ocean freight-rates is much larger than that in foreign import regions (see Models 3 and 4 in Table 6). This is because the U.S. exporters absorb a larger portion of ocean freight-rate increases than do foreign importers.

Implications for Canada

Canadian wheat comprises about 96 percent of the total Canadian exports of grain and grain products. Canada is the second largest exporter of wheat in the world market with a market share of approximately 18 percent during the study period. Wheat production, however, is confined largely to a land-locked Prairies which is

TABLE 6. ESTIMATED SOCIAL WELFARE LOSSES UNDER TARIFFS AND CHANGES IN OCEAN FREIGHT-RATES

Models	Import Regions	U.S.	Total
		(million dollars)	
1. Base	0	0	0
2. $1.00 Tariff in EEC and Japan/ Korea	180	168	348
3. 20 Percent Increase in Freight-Rate	89	162	251
4. 40 Percent Increase in Freight-Rate	177	322	499

spatially separated from the major world markets, as well as from the major domestic markets. Therefore, provision of an adequate and efficient rail transportation system is vitally important to the wheat economy. Under the circumstances, wheat prices received by the producers are inevitably influenced significantly by the two major marketing costs: domestic freight-rates to export ports (i.e., Atlantic Coast, Great Lakes, Churchill and Pacific Coast) and ocean freight-rates from Canadian ports to importing countries.

Results from the earlier section revealed that approximately 80 percent of ocean freight-rate increases for wheat shipment were borne by exporters while the remaining 20 percent is absorbed by the importing countries. The extent to which above stated results, based on the U.S. data, are relevant to Canada depends largely on such factors as price elasticities of demand and supply for the various segments of wheat market including domestic consumption, stocks, and trade. If we assume that Canada faces similar market conditions to that of the U.S., we would expect that about 80 percent of the ocean freight-rate increases will be borne by the Canadian producers while

buyers. In contrast to transport costs, more than 50 percent of the incidence of tariffs imposed by a foreign importer on Canadian wheat is absorbed by the tariff-imposing country, as it is the case with the U.S., while the remainder is to be absorbed by the Canadian wheat producers.

Regarding the incidence of domestic rail freight-rate increases, a study done by Nagy et al. based on the Canadian data has shown quite similar conclusions to the present study. When the Crow's Nest Pass Freight-Rate (i.e., widely known as the Crow rate in Canada) is replaced by the compensatory rate (e.g., Crow rate multiplied by 3.08), Nagy et al. found that wheat producers will absorb on the average between 76 percent and 96 percent of the increments in the freight-rate which amounts to 86 percent on the average. As rate increases towards compensatory rate, it is to be expected that about 86 percent of the increments will be absorbed by the grain producers in the absence of subsidy while the remainder will be borne by the foreign consumers.

A significant economic implication can be drawn jointly from the study by Nagy et al. and the present study. That is to say, uncertainties associated with farm gate price for wheat are composed of factors including two major transport costs (i.e., ocean freight-rates and domestic freight-rates), trade barriers such as tariff, and world supply and demand conditions. The world supply and demand situations dictate an equilibrium world price under free trade. The trade barriers, both natural and institutional ones, make the price deviate from the world equilibrium price between sellers and buyers. Since the transport cost is a natural barrier which affects the entire volume of export and is mostly borne by exporters, welfare implications for Canadian wheat producers are far reaching.

Transport costs, therefore, deserve more attention in research and policy formulation. The Canadian government is urged to pay more attention to the international shipping conventions, particularly on Canadian trading routes, by which ocean freight-rate is largely determined although they are outside the jurisdiction of Canadian government. Government policy on domestic transport market for wheat export under the Western Grain Transportation Act, enacted in 1983 to replace Crow rate, should ensure adequacy and efficiency for all segments of transportation from farm gate to export ports in the post-Crow era.[9]

Insofar as the burden of a tariff is shared by both the exporting and importing countries, the cost to the importing country of tariff protection will be less than the nominal rate of duty. Likewise, the cost to the exporting country will always be less than the nominal rate of duty as long as the export supply curve is less than perfectly elastic. It has an important implication for GATT negotiations for Canada concerning the choice of similar goods to gain concessional duty reduction. To be on a par with the tariff-imposing country, Canada should negotiate duty rate concessions for other goods which have not only similar commodity characteristics but also similar magnitudes of price elasticities of export supply with the good subjected to the import tariff.

Summary and Concluding Remarks

Equilibrium prices derived from the quadratic programming model are not consistent with actual average export prices in the United States, which indicates that volumes of wheat flow to the various export ports in the U.S. are not allocated in an optimum manner to maximize social welfare. There should be more import demand

for winter wheat at the West Coast and more for spring and durum wheat at the Great Lakes.

The incidence of a specific tariff of $1.00 per bushel of wheat imposed by the EEC and/or Japan/Korea is absorbed more by consumers in the import regions (i.e. more than 50 percent for spring wheat; 87 percent for winter wheat) than by the U.S. exporters. Unlike a tariff, changes in ocean freight-rates influence wheat price at U.S. ports more than in import regions. Approximately 80 percent of ocean freight-rate increases (85 percent for winter wheat and 70 percent for spring and durum wheat) is borne by U.S. exporters, resulting in substantial decreases in wheat prices at U.S. ports indicating that major sources of price uncertainty are not only trade restrictions, but also volatility in ocean freight-rates. Therefore, increases in ocean freight-rates and tariffs imposed by the EEC and/or Japan/Korea result in substantial decreases in social welfare in both the U.S. and import regions.

The extent to which the findings from the U.S. study may be relevant to the Canada's wheat economy depends largely upon the similarities or differences between the two major exporting countries such factors as price elasticities of domestic and export supply, domestic demand, import demand, and export market shares for the Canadian exports to the various trading partners. A number of earlier studies have shown that there are significant differences between the two major exporters in terms of government intervention in wheat acreage allocation and supply responses (Koo and Uhm 1983a), marketing systems (McCalla and Schmitz), rail regulations on freight-rate structure and levels for grains (Koo and Uhm 1983b), etc. These differences could be explicitly incorporated into a model for the better assessment of the subject matter. It is the authors'

suggestion, therefore, that further research should be directed to develop a quadratic programming model combining Canada and U.S. by incorporating all relevant variables in order to evaluate full impact of trade barriers vis-a-vis the competitive position between Canada and the U.S.

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Footnotes

[1]Import quota influences the price of the commodity in much the same way as does the tariff (Kreinin). Consequently, the only trade restriction considered in this study is tariff, although import countries could have other trade restrictions.

[2]In the 1980/81 crop year, for example, the U.S. exported approximately 49 percent of the total quantity of wheat traded in the world wheat market and the remainder was shared by other export countries including Canada, Argentina, and Australia (World Wheat Statistics, 1982).

[3]Suppose a linear supply equation is specified as $Q_S = \alpha_0 + \alpha_1 P_S$. The intercept ($\alpha_0$) and slope ($\alpha_1$) of the equation can be derived as follows:

$$\alpha_1 = e_S \frac{Q_S}{P_S} \text{ and } \alpha_0 = Q_S - \alpha_1 P_S$$

where e_S is price elasticity of supply equation, Q_S is a mean quantity of supply and P_S is a mean price in supply region.

[4]Export supply elasticity of wheat by types is derived from the following relationship:

$$(12) \quad e_x = \frac{Q_S}{Q_e} e_S + \frac{Q_d}{Q_e} |e_d|$$

where Q_S is the total quantity of wheat supplied, Q_e is the total quantity of wheat exported, and Q_d is the total quantity of wheat domestically consumed.

[5]Import demand elasticity (e_m) for each type of wheat is obtained from price elasticities of domestic demand (e_d) and domestic supply (e_s) in importing regions as follows:

$$(13) \quad e_m = \frac{Q_d}{Q_m} e_d + \frac{Q_S}{Q_m} e_S$$

where Q_m is the quantity of wheat imported, and other variables are previously defined. It is assumed that price elasticities of domestic supply (e_S) are completely inelastic in import regions (Shei and Thompson). Price elasticity of import demand is, therefore, calculated with the first term on the right hand side of Equation 13.

6All alternative models are based on hypothetical tariff levels and changes in ocean freight-rates because import tariffs and ocean freight-rates vary over time. In addition, it is not important whether the tariff rate assumed is on actual level because this study is a comparative static analysis.

7Import quotas influence the price of wheat in import and export regions in much the same way as tariffs. Consequently, the only trade restriction considered in this study is tariff, although Japan and Korea currently impose quotas on their wheat imports. Because Japan and Korea are geographically close and have import quotas on their wheat imports, the two countries are considered as one wheat import region.

8The effects of a $1.00 tariff in the EEC and Japan/Korea is derived from the difference between the base model and the model 4 in Table 5 (i.e., 1,260-1,243 = 17 million bushels).

9During the Crow rate era, freight-rates for export grain have been artificially kept lower than the actual cost of moving them, resulting in creating an artificial comparative advantages of Canadian wheat export against the U.S. When the Crow rate is compared with that of the U.S. export freight-rate in terms of structure and level, it was found that southern route in the U.S., which is the most inexpensive route, has similar rate structure with that of the Crow rate while U.S. rate level is about 4.3 times higher for distances of 200 miles and 2.9 times for 1,000 miles in 1979. However, when compared with the most expensive route in the U.S. (originated from Northern Plains to the Great Lakes), the U.S. rate structure is much steeper in the rate-distance scale as such rate level in the U.S. is about 4.5 times higher for 200 miles and 7.4 times higher for 1,000 miles (Koo and Uhm, 1983a). Under the new freight-rate formula, grain producers and the government will share cost increases. This will mean that the proportion of grain transport costs paid by grain producers will increase from the present 18 percent to approximately 30 percent in 1985/86 and 57 percent by 1990/91.

FUTURE CANADIAN COMPETITION FOR MIDWEST U.S. - IMPORTS & EXPORTS

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ABSTRACT

This paper concerns transborder foreign trade container traffic of Canada and the United States. There is a substantial volume of both Canadian and U.S. Foreign Trade which is routed across the border to ports in the adjoining country. These transborder routings reflect the rational workings of a free marketplace in both countries and an open border. There has been substantial growth in this traffic and there are many benefits from this freedom to route cargoes. However, there are also disruptions to accustomed practices and economic losses which are suffered by some carriers and ports.

There have been national outcries in the U.S. against such transborder routings. Some carriers and ports maintain they have suffered losses arising from unfair competition. This paper has been prepared to

illustrate the highly competitive situation surrounding this aspect of foreign trade. It results from an analysis undertaken to determine possible future reroutings of U.S. Foreign Trade from U.S. Ports to Canadian Ports, mainly Montreal.[1]

INTRODUCTION

As background to the analysis, one should be aware of the significant increase in shipping facilities and activities at Montreal in recent years. Of greatest interest is the establishment of year round liner service by several shiplines. In 1982 these lines included CP ships, Dart Container Lines, Manchester Lines[2], CAST, and late in the year, Sofati Container Line. Sofati was created by former officials of CAST who left the line when, under economic pressures, CAST decided to join the North Atlantic Conference and raise its rates. The former officials apparently recognized that the maintenance of a differential lower rate structure than that charged by the conference was important in retaining the traffic that CAST had gained, or that Sofati could, in turn, handle[3].

To state that the shipping situation in Montreal is a dynamic one is to greatly understate the magnitude of the changes that have been occurring. In

early 1983 CAST went bankrupt and was reorganized by late 1983 into CAST (1983). Late in the year, the Sofati Line was subsequently purchased by CAST (1983). Also late in the year CP Ships and Dart combined their operations into a single carrier, The Canada Line. These consolidations are "part of the general rationalization developments in North Atlantic shipping severely weakened by over-capacity and low rates".[4]

CAST has been the most aggressive of the carriers serving Canada. It is also the carrier most directly related to the topic of this paper. CAST North America was founded in 1969 and, from a start of 14,000 TEU handled in 1970, grew to a volume of 120,000 TEU in 1981. CAST was founded on the basis of attracting U.S. foreign trade through Canadian Ports,[4] by 1981, 55% of volumes transported by CAST were U.S. cargoes.[5]

A representation of the 1982 - 1983 transborder traffic situation is presented in Exhibit 1. It illustrates the relative level of both Canadian and U.S. transborder traffic in annual terms for 1981.[6]

Canadian 1983 traffic levels continued upward over 1982 and 1981 levels. U.S. traffic levels rebounded in 1983 over 1982, but 4.2% compared to 1981 levels. Also noteworthy are the comparisons between imports and

EXHIBIT 1

SUMMARY
TRANSBORDER CONTAINER MOVEMENTS
CANADIAN AND U.S. OVERSEAS TRADE
(in twenty foot equivalent units)

		East Coast	West Coast	Total
Canadian Trade via U.S. Ports				
Canadian Exports	1981	22,702	13,189	35,891
	1982	27,539	13,415	40,954
	1983	20,953	16,103	37,056
Canadian Imports	1981	15,461	40,523	55,984
	1982	18,545	41,041	59,585
	1983	19,701	47,362	67,063
Total Canadian Trade	1981	38,163	53,712	91,875
	1982	46,084	54,456	100,539
	1983	40,654	63,465	104,119
U.S. Trade via Canadian Ports				
U.S. Exports	1981	57,134	1,085	58,219
	1982	45,481	854	46,335
	1983	50,945	557	51,502
U.S. Imports	1981	68,871	602	69,473
	1982	53,760	109	53,869
	1983	69,824	1,024	70,848
Total U.S. Trade	1981	126,005	1,687	127,692
	1982	99,241	963	100,204
	1983	120,769	1,581	122,350

SOURCE: Revenue Canada

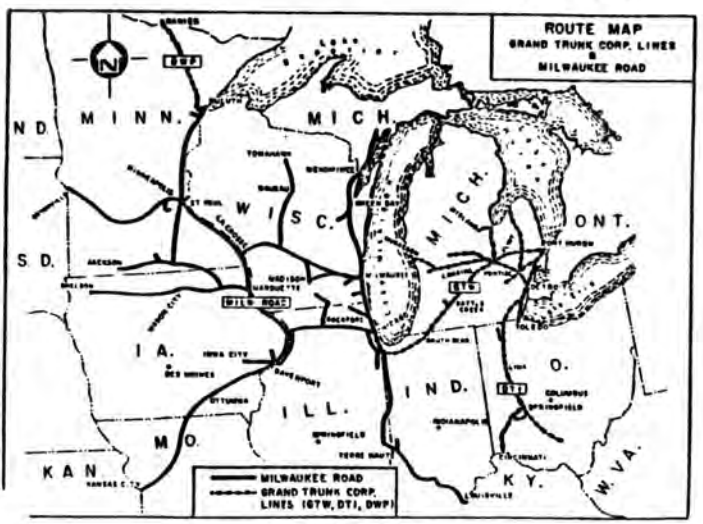
exports on the two coasts for both countries. It is obvious that both countries have more imports than exports. One should also note that the Canadian traffic is split between the east and west coast ports, and that the U.S. traffic is heavily concentrated on movement through ports on the East Coast of Canada.

Many in the U.S. have been unaware of the Canadian transborder trade through the U.S. The continued political drives for anti-diversion legislation in the U.S. in the last several years have overlooked the level and extent of Canadian traffic handled through the U.S.[7] It also is interesting to note that the Maritime Administration of the U.S. Department of Transportation annually publishes data on U.S. traffic "diverted" through Canada, but says nothing of Canadian traffic routed through the U.S.[8]

Access to the Midwestern U.S. markets is obtained by longhaul rail. Container traffic at Montreal can access both the Canadian National (CNR) and Canadian Pacific (CPR) railroads. They connect, in turn, with U.S. carriers at Sarnia, Ontario (CNR with GTW), and at Sault Ste. Marie, Ontario (CPR with the Soo Line Railroad). Both of these U.S. railroads are subsidiaries of their Canadian connections.

Recently the transborder shipment volume issue was surfaced in the proposed acquisition of the Milwaukee Railroad (MILW) by the Grand Trunk Corporation (GTC). If it were to come about, the MILW acquisition might provide coordinated single line access to Minneapolis/ St. Paul, Minnesota, and Kansas City, Missouri. The map in Exhibit 2 illustrates the potential widening of direct market access that the proposed acquisition would provide. An evaluation of the potential additional container traffic that would result from the acquisition was necessary because of the close ties of the GTC, CNR and CAST. Prior to CAST's 1983 reorganization, two factors had indicated the importance of this evaluation.

EXHIBIT 2



1. CNR had an 18% share of CAST;

2. All of CAST's rail traffic was being handled by CNR, due to credit difficulties with the CPR.[9]

FACTORS FAVORING INCREASED TRAFFIC

At the outset it appeared that a number of factors indicated possible increases in U.S. North Europe traffic routed via Montreal. Foremost of these was that CAST was an aggressive marketeer. If there was an advantage to be capitalized upon, the company would seize and run with it. They initiated the concept of a low cost door-to-door service with an all-inclusive rate. In their pricing CAST took full advantage of all the cost advantages that their concept could muster.

The currency difference was one such factor. The difference in exchange rate between the U.S. and Canadian dollars could be used to good advantage; it could add some bottom line savings for discerning shippers in the U.S.

Closer geographic locations of Montreal to North Europe lessened voyage expenses, and the sheltered

passage on the St. Lawrence River did the same. Montreal is 141 nautical miles closer to Rotterdam than is New York, and 414 nautical miles closer than Baltimore.

Favorable vessel economics have been obtained through the use of modern fuel efficient designs with lower operating expenses (low speed diesels) and, more importantly, combination bulk/container designs. With the availability of export grain moves between Montreal and other St. Lawrence River ports and Rotterdam/Antwerp, a combination vessel design can work well to minimize the cost impacts of imbalances in traffic flows. An all container design would have higher costs. CAST's con-bulker vessels carry containers and bulk or general cargo in alternate holds. Their most modern ships have a capacity of 1,450 TEU and 40,000 tons of bulk.[5]

Low cost marine terminals are yet another factor in the equation. In 1982 terms and U.S. dollars, Montreal is up to $247/Box less expensive than New York, and $22/Box less expensive than Baltimore.[10]

Efficient long-haul rail operations provide the connecting link to the markets. The container traffic is carried in dedicated container trains. And the CNR provides high capacity (100 ton) flatcars that can carry four fully loaded twenty-foot containers.[11]

FACTORS WEIGHING AGAINST INCREASED TRAFFIC

Not withstanding the foregoing list of advantages, there were several obvious factors that would tend to dampen future growth. Foremost among these was the fact that service via Montreal was restricted to North European service. Shippers want frequent, reliable, all point capability for maximum market acceptance. For example, North European service will not attract cargo routed to the Far East or Africa.

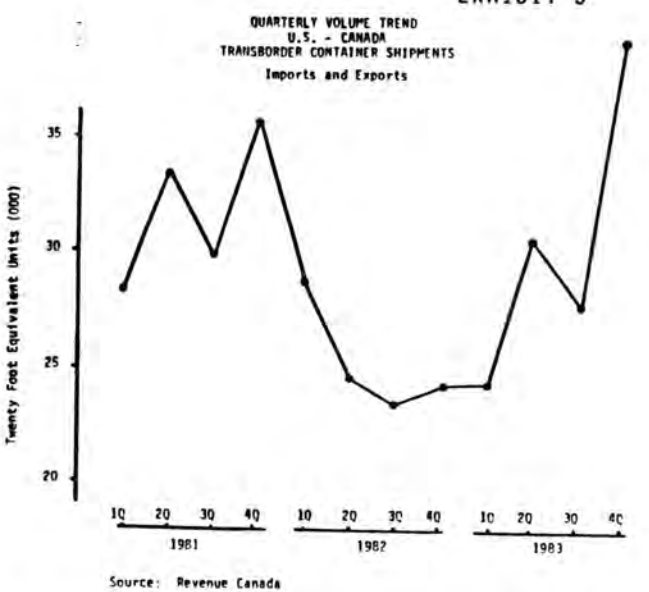
Expansion would be costly. The increased lengths of haul to bring the containers in or take them out from points further into the U.S. would erode savings or cause the ocean carrier to absorb more in its voyage revenue. It is four to five times more expensive to move containers on land than on sea. At some point it would place the Canadian routing cost and service into parity with competing U.S. ports. The further inland one moves from Montreal, the closer one comes to Baltimore, Savannah, or New Orleans.

Competitive reactions. Other carriers would adopt the same type of pricing and service. In fact, during 1983, many of the carriers serving the U.S. filed intermodal tariffs in direct competition with CAST.[12]

These carriers included Sea-Land, United States Lines, Hapag-Lloyd, Atlantic Container Line, Trans Freight Lines, and Dart Container Lines.

A review of quarterly data from Revenue Canada on transborder U.S. container shipments indicated depressed levels in 1982 and early 1983. Inspite of a very good fourth quarter, 1983 overall results were lower than 1981, see Exhibit 3.[6]

EXHIBIT 3



Source: Revenue Canada

METHOD OF ANALYSIS

The potential acquisition of the MILW by the GTC would enable the GTC, and the CNR, to provide essentially single line service to Minneapolis and Kansas

City. Since there were markets already being affected by routings through Canada, the objective was to determine the increments of new traffic that would be attracted by the enhanced capabilities. That which was already moving should not be counted as new traffic to the merged railroads.

Identification of potential traffic volumes was accomplished by first identifying the markets that could be accessed by COFC service out of Chicago on the MILW. As noted above there were only two real destinations: Minneapolis/St. Paul and Kansas City. Every other potential market was better served by other carriers, modes, or ports. For example, Louisville, KY, while accessible by the MILW out of Chicago, is more directly served by the C&O/B&O out of Detroit where a direct connection with the GTC is made. Also Louisville is much closer to the Port of Baltimore than it is to Montreal. In addition, the GTC already served Cincinnati out of Detroit. It was possible to dray containers from Cincinnati to Louisville faster and at less cost than with a direct rail move. Other examples abound. Exhibit 4, Access to Markets, illustrates the competitive problem facing both the GTC/MILW and the ship lines on the North Atlantic. The competition for U.S. cargoes is very tough indeed.

EXHIBIT 4

ACCESS TO MARKETS

Market Area	Montreal	Mileage to Closest U.S. Port	%	Closest U.S. Port
AR, Little Rock	1406	416	30	New Orleans
CO, Denver	1817	1268	70	New Orleans
IA Cedar Rapids	1047	889	85	Baltimore
Davenport	983	825	84	Baltimore
Des Moines	1150	974	85	New Orleans
Sioux City	1322	1088	82	New Orleans
KS, Wichita	1493	811	54	New Orleans
KY, Lexington	881	531	60	Baltimore
Louisville	908	576	63	Baltimore
MO, Kansas City	1304	803	62	New Orleans
Springfield	1292	634	49	New Orleans
ND, Fargo	1284	1302	101	Baltimore
Minot	1509	1564	104	Baltimore
NE, Grand Isle	1419	1085	76	New Orleans
Omaha	1283	987	77	New Orleans
OK, Oklahoma City	1576	663	42	New Orleans
SD, Aberdeen	1354	1354	100	Baltimore
Sioux Falls	1371	1167	85	New Orleans
TN, Chattanooga	1128	353	31	Savannah
Knoxville	1016	390	38	Savannah
Memphis	1274	387	30	New Orleans
Nashville	1077	472	44	Savannah

Source: Household Goods Carriers' Bureau Mileage Guide

Once the markets were identified an estimate of the traffic volumes could be determined. This was accomplished utilizing data from two sources:

1. A 1976 survey of the U.S. inland origins and destinations of imports and exports;[13]

2. Trade route specific statistics on containerized cargo.[14]

The data sources were complementary. The 1976 survey provided state identification of U.S. origin/destination of international flows. Included in this was the identification of foreign country, the port utilized and the shares of total shipments by commodity. The containerized cargo statistics listed 1976 and 1981 data on shipments between U.S. ports and foreign countries. It was used to update the volume representations of the 1976 survey.

Another dimension to the complementary nature of the data sources was the fact that data could be obtained that could be directly related to the situation under analysis. As was previously noted, the primary nature of the service offered from Montreal is to North Europe. Both of the data sources matched these requirements exactly.

By virtue of the fact that work was being done with carriers highly involved in the trade routes, validation checks on market determinations could be made. This provided heightened assurance that the market figures were reasonable. In the course of the analysis, the size of the Chicago market was discussed. Chicago is a very deceiving market because almost all rail trailers and container shipments currently routed through Chicago are rebilled. Thus a single container shipment from Kansas City to Montreal may, at present, be counted as two shipments, one to Chicago and another from Chicago to Montreal. This practice makes Chicago look far more important as a shipping center than it is in reality. Similar conditions exist at other gateway cities in the U.S. where railroads exchange interline traffic.

Identification of comparative economics and service levels was the next step in the analysis. These considerations were made on a door-to-pier basis, for example from the shipping dock of a projected shipper in Kansas City to the pier in Antwerp. Alternate routings via Montreal, New York, Baltimore, Savannah and New Orleans were made. What follows are areas of cost buildup that must be considered in an evaluation of this type:

- Drayage, from shipper's dock to railroad terminal;
- Lift Costs, from pavement to aboard railroad flat car in the railroad's terminal;
- Line haul, from terminal at origin to terminal at destination;
- Lift Costs, from railroad car to pavement in railroad's terminal at destination.
- Drayage, from railroad terminal to marine terminal;
- Marine Terminal Expenses, stevedoring, etc.;
- Vessel Calling Costs; pilots, dockage, wharfage, docking and customs fees; and
- Vessel Costs, Trans Atlantic

Only by evaluating all of these elements can one get a true appreciation for the attraction or viability of a routing option. One need only recall the difficulties that various carriers, of all modes, have had in recent times. One should recognize that current rates may give a poor indication of the underlying economics and the mid to long term viability of a carrier, routing, or even a mode of transportation.

CONCLUSION

The analysis concluded that a modest additional amount of U.S. Import/Export traffic routed through Canada could be expected to be routed over the merged railroads. It was anticipated that significant competition in the traffic would ensue. This competition would include other railroads serving the U.S. markets and connecting with the GTC. The competition would also include the other North Atlantic ship lines. Indeed, as previously noted, in early 1983 the other carriers filed broad and highly competitive intermodal tariffs.[12] In addition, Sea-Land Service announced that it would begin service to Halifax in mid-June, 1983.[15]

There is little doubt that benefits flow from the routing of some elements of U.S. Foreign Trade through Canada. However, the analysis suggested that the area within which these benefits would accrue was more compact than common wisdom would suggest. It was also found that the competitors could/would adjust their cost profiles so that the economic picture would change. For example, Conrail has adjusted its work force, line structure and other elements so that it has a lower cost profile. Similarly, Trans Atlantic carriers have been modernizing their vessels and

fleets so that they also have lower cost profiles. These carriers will compete very hard for the volumes necessary to fill up these new, larger and more efficient ships. In turn, they will pressure the inland carriers to provide low rates. The end result is that the U.S. Midwest market is going to have a multitude of good choices. And for most, it appears that the routings that will be chosen will be via U.S. Ports.

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